THE

JOURNAL OF THE SOCIETY OF ARTS

AND

INSTITUTIONS IN UNION,

AND

OFFICIAL RECORD OF ANNUAL INTERNATIONAL EXHIBITIONS.

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120TH SESSION.] FRIDAY, NOVEMBER 21, 1873. [No. 1096. VOL. XXII.

ANNOUNCEMENTS BY THE COUNCIL.

NATIONAL TRAINING SCHOOL FOR MUSIC.

H.R.H. the Duke of Edinburgh has appointed Thursday, December 18th, for laying the first stone of the building for the school. The site is to the west of the Royal Albert Hall. A *conversazione* and concert will be given by the Society in the evening, in the Albert Hall, the use of which is lent by the Council of the Hall. Cards of invitation will be issued to members in due course.

NATIONAL MUSEUMS.

On Friday last a deputation from the Council of the Society waited on the Commissioners for the Promotion of Scientific Instruction and the Advancement of Science, in order to bring before the Commissioners the action of the Society in reference to the present condition of our national museums and public galleries. The members of the Commission present were his Grace the Duke of Devonshire, K.G. (in the chair), Sir James Phillips Kay-Shuttleworth, Bart., William Sharpey, Esq., M.D., F.R.S., George Gabriel Stokes, Esq., M.A., LL.D., F.R.S., and Thomas Henry Huxley, Esq., LL.D., F.R.S., with Mr. Norman Lockyer, F.R.S., Secretary. The following members of Council formed the deputation:—Major-Gen. F. Eardley Wilmot, R.A., F.R.S. (Chairman of the Council), Mr. Edwin Chadwick, C.B., Lieut.-Col. A. Strange, F.R.S., Mr. Seymour Teulon, Col. A. Angus Croll, Mr. Hyde Clarke, the Rev. Septimus Hansard, M.A., Vice-Admiral Ommanney, C.B., F.R.S., Mr. James Heywood, F.R.S., with Mr. P. Le Neve Forster, M.A., secretary.

The Chairman proceeded to lay before the Commissioners copies of the resolutions at which the Council had arrived, and of the correspondence on the subject which had passed between the Prime Minister and the Secretary of the Society. These (which have already appeared in the *Journal*) involved the formation of a Committee to investigate the matter. In bringing forward these statements, he commented on the importance of the movement, as shown by the readiness with which persons from all parts of the country came forward to join in it and promote its objects. He added that the Council of the Society were anxious to bring the matter under the cognisance of the Commission, and for that reason had hastened to send the present deputation, in anticipation of the early conclusion of the labours of the commission. He then asked the members of the deputation to state their individual views.

Mr. Chadwick spoke strongly against the proposed transference of the South Kensington Museum to the Trustees of the British Museum, and suggested that the latter institution might be further utilised than at present by the establishment of lectures in connection therewith. He contended that a Science Minister should be appointed, who should also be the Education Minister, and should have under his control all public museums subsidised by Parliament.

Lieut.-Col. Strange referred to the correspondence between the Society and the Treasury as itself illustrating the necessity for the appointment of a minister within whose province should be included the regulation of museums. It was practically acknowledged in that correspondence that no government office existed to which such questions could be referred.

Mr. Heywood noticed that the name of Sir Stafford Northcote, himself a British Museum trustee, was on the list of the Committee, and argued from that fact that some members of the body in question were not adverse to reform. He strongly deprecated the proposed change at South Kensington.

Some further conversation then followed, from which it appeared that the Council of the Society were not yet prepared with any definite scheme, inasmuch as this matter was under the consideration of the Committee. They simply laid before the Commissioners the principles which, in their opinion, should govern the case.

The following letter has been received from Lyon Playfair, Esq., LL.D., C.B., F.R.S. Although the Society loses his services for this especial work, the Council yet hope that in his new position Dr. Playfair may be enabled and disposed to further many of the objects connected with his department in which the Society has interest:—

17th Nov. 1873.

MY DEAR SIR,—In consequence of my appointment to the office of Postmaster-General, I must resign my position as Vice-Chairman of your Committee on Museums. I hope that my resignation will not produce any practical inconvenience to your Council.—Yours sincerely, (Signed) LYON PLAYFAIR.

Peter Le Neve Foster, Esq.

PROCEEDINGS OF THE SOCIETY.

FIRST ORDINARY MEETING.

Wednesday, November 19th, 1873, Major-General F. EARDLEY-WILMOT, R.A., F.R.S., Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Abbott, Samuel, 72, Wilson-street, Derby.
Aird, John, jun., 14, Hyde-park-terrace, W., and Belvedere-road, Lambeth, S.E.
Allen, Thomas Bull, 7, Billiter-square, E.C.
Ansell, Charles, jun., 2, King William-street, E.C.
Arrol, Archibald, 16, Dixon-street, Glasgow.
Bain, Robert A. D., Albert Embankment, Lambeth, S.E.
Baldwin, Houghton, Elmstead, Chiselhurst.
Banister, Frederick D., Engineer's-office, London, Brighton, and South Coast Railway, London-bridge, S.E.
Bartlett, William, 39, Canning-street, Liverpool.
Behr, F. B., 27, Marloes-road, Cromwell-road, S.W.
Blackburne, J. W., Ivy-cottage, Burleydown, Whitchurch, Salop.
Blakiston, Matthew, 18, Wilton-crescent, S.W.
Blockley, Frederick M., 42, Pall-mall, S.W.
Bloomer, John, 69, Upper Gloucester-place, N.W.
Brundell, Benjamin Shaw, Hall-gate, Doncaster.
Buck, Joseph Haywood Watson, London and North-Western Railway, Engineer's-office, Watford.
Burgess, Edward James, 29, Palmerston-buildings, Old Broad-street, E.C., and Pittville-house, St. James's-road, Brixton, S.W.
Calderon, Don Abelardo Alvarez, Ivyhurst, Edge-hill, Wimbledon, S.W.
Calvert, John, F.G.S., Kulu Valley, Punjab, India.
Cawkwell, William, Euston-station, N.W.
Chance, James T., Four Oaks Park, Sutton Coldfield, Warwickshire.
Coulthard, H. C., C.E., 25, Duke-street, Westminster, S.W.
Craufurd, George Ponsonby, Buenos Ayres, Rio da Prata.
Craven, Mr. Councillor, Woodland-house, Whalley-range, Manchester.
De Tivoli, Professor Vitale, Oxford.
Donaldson, William, 41, London-street, Reading.
Dorman, Mark, J.P., Melbourne-crescent, Northampton.
Douglass, James N., Trinity House, E.C.
Edwards, William, 366 and 368, Euston-road, N.W.
Emden, Walter, 8, Adam-street, Strand, W.C.
Eunson, John, Gas Light Company, Northampton.
Fairbank, Josiah Forster, C.E., 18, Abingdon-street, Westminster, S.W.
Farwig, John F., 36, Queen-street, Cheapside, E.C.
Faviell, W. F., Down-place, near Guildford.
Forbes, J. S., London, Chatham, and Dover Railway, Victoria Station, S.W.
Franklin, J. W., 3, Pemberton-road, St. John's-park, Upper Holloway, N.
Gooch, John Viret, Reform Club, Pall Mall, S.W.
Goold, J., 8, Forbes-road, Penge, S.E.
Govett, Charles Albert, 10, King's Bench-walk, Temple, E.C.
Gray, John William, C.E., 16, Southampton-buildings, W.C.
Greck, P., 56, Hereford-road, Bayswater, W.
Green, Charles James, Rushall, near Walsall, Staffordshire.
Grierson, James, Great Western Railway Company, Paddington, W., and 4, Holland-villas-road, Kensington, W.
Hamand, Arthur S., Stephenson Chambers, New-street, Birmingham.
Harker, William, Norwood, Beverley.
Hart, Henry Neville, 107, Harley-street, Cavendish-square, W.
Hartley, Frederick W., 55, Millbank-street, Westminster, S.W.
Healey, B. D., Swansea.
Heron, John, Bandon, County Cork, Ireland.
Hogg, Col. J. M., M.P., 26, Grosvenor-gardens, S.W.
Innes, Lieut.-Col. P. R., 39, St. George's-square, S.W., and Junior United Service Club, S.W.
Johnson, Frank, 110, Cannon-street, E.C.
Johnson, Henry William, 331, Camden-road, Holloway, N.
Langley, Alfred A., Great Eastern Railway, Stratford, E.
Livesey, George T., South Metropolitan Gas Light and Coke Company, 589, Old Kent-road, S.E.
Lund, George, 42, Pall-mall, S.W.
Lydgate, Robert, 20, Clayton-place, Peckham, S.E.
Macey, George Robert, 2, Holland-road, Kensington, W.
Mackinnon, Alexander K., Belgrave-mansions, Grosvenor-gardens, S.W.
Marillier, Robert A., 1, Harrow-terrace, Stepney, Hull.
Martin, H. O., 7, Adam-street, Adelphi, W.C.
Martin, James A. N., Tizpore, Assam, India, care of Messrs. Denny, Bailey, and Co., 29, Great St. Helen's, E.C.
Milligan, Robert, C.E., 6, Brockley-buildings, South John-street, Liverpool.
Mitford, Robert Sidney, Downshire-hill, Hampstead, N.W.
Moorsom, L. H., Manchester Central Station Railway, Engineer's office, Windmill-street, Manchester.
Newman, Thomas, Bell-lane, Spitalfields, E.
Noakes, Thomas Joseph, 195, Brick-lane, Spitalfields, E.
Paddon, J. B., Hove, near Brighton.
Palmer, John B., C.E., 57, Gracechurch-street, E.C.
Peacock, Richard, Gorton Foundry, Manchester.
Plevins, C. H., Dunston-hall, near Chesterfield.
Pope, Frederick, 14, Upper Montagu-street, Montagu-square, W.
Poppleton, Henry, College Boarding School, Farnham.
Potter, W. A., Cramlington-house, Cramlington, Northumberland.
Ravenhill, John Richard, Glass-house-fields, Ratcliffe, E.
Read, W. T., 207, Maida-vale, W.
Reynolds, James, 174, Strand, W.C.
Robertson, D. F., Dundee, care of the African Barter Company, 30, Gracechurch-street, E.C.
Robertson, George, F.R.S.E., 47, Albany-street, Edinburgh.
Ross, Owen C. D., 41, Craven-street, Strand, W.C.
Sullivan, D., 6A, Sylvan-grove, Old Kent-road, S.E.
Thin, J., Ormiston-lodge, 169, Brixton-road, S.W.
Tombleson, Henry William, 184, Camberwell New-road, S.E.
Trevor, Henry, the Plantation, Norwich.
Tucker, G. A., Ph.D., Bay-view-house, Cook's River, Sydney, care of C. L. Tucker, 24, Sutherland-place, Wolverhampton.
Turner, John, Crown Brewery, Lewisham, S.E.
Wade, C. G., 46, Strand, W.C.
Walburn, Edmund, Grosvenor College, 366, Brixton-road, S.W.
Welsh, Edward, Witham-office, Boston, Lincolnshire.
West, James, 151, Poplar High-street, E.
Whitaker, Frederick, Horton-street, Halifax.
Whitwell, Thomas, Stockton-on-Tees.
Wigan, James, Cromwell-house, Mortlake, S.W.
Williams, R. P., 9, Great George-street, S.W.
Winder, Thomas R., Pentewan, St. Austell, Cornwall.
Woodward, T., Plough Brewery, Wandsworth-rd., S.W.
Worssam, Samuel William, Oakley Works, King's-road, Chelsea, S.W.

The CHAIRMAN delivered the following

ADDRESS.

We have met this evening to open the One Hundred and Twentieth Session of our Society, and the duty again devolves upon me of bringing to your notice an outline of our proceedings during the past year, and of making some few remarks as to what the Council has in view as suitable matters for consideration during the year on which we are now entering.

We have to lament the loss of many old and tried friends of the Society, of whom notices have appeared, from time to time, in the *Journal*. Of these, several have contributed papers which have been read before the Society, or have received the Society's medals, while all have, more or less, interested themselves in the work that is carried on. Among the names more generally known may be mentioned that of Lord Westbury, who rendered most especial service by his persevering and successful action in respect to the Fine Arts Copyright Act of 1862. Sir Francis Ronalds was one of the early engineers in the field of electric telegraphy, and in 1870 he received the honour of knighthood, which had previously been conferred upon fellow-workers in the same field. By the death of Mr. Varley the Society has lost its oldest member, and one who, having taken an active part in all the Society's labours for so many years, was well known and highly respected by all. He was the last survivor of the founders of the Water Colour Society. In early life his time was much occupied in various important scientific pursuits,—such as the means of perfecting lenses, and the perfecting of various chemical processes,—and in scientific investigations. It was in 1800 that he turned his attention particularly to drawing, and devoted himself especially to sketching from nature. Among the mountains of Wales his familiarity with electrical experiments caused him to feel a deep interest in thunderstorms, and in 1807 and 1809 he sent papers to the *Philosophical Magazine*, "On the Atmosphere." From 1804 to 1844 his name will be found on the greater number of engravings in the Society's "Transactions;" and for the "Graphic telescope," by means of which these were traced without the aid of compass measurement, he received medals at the Exhibition of 1851, and Paris, 1855. Space does not admit of justice being done to his varied and active pursuit of science and art. Mr. Varley was in the sixtieth year of his membership and the 92nd of his age when he died.

Though Sir Edwin Landseer was not a member, it may be mentioned that the Society was the first public body that acknowledged his merit. In 1814, "the silver Isis medal" was awarded to "Master Edwin Landseer for a drawing of a hunting horse."

Sir John Bowring became a member in 1859, and in the same year read a paper on "China, and its Relations to British Commerce." On this and kindred subjects he did not cease to manifest his deep interest, and to communicate with the Society from time to time, notwithstanding a vast amount of work in the field of letters, philosophy, and politics.

In Dr. Crace Calvert, F.R.S., not only has the Society of Arts lost one of its most eminent members, but the loss of a man of such varied and distinguished attainments has to be lamented by other societies, and by all that are cognisant of his great labours, especially in that branch of analytical chemistry to which he devoted himself. He read a series of papers before our Society on "Chemistry applied to industry," and brought forward the discoveries of M. Chevreul in relation to the laws of colour, pointing out their application in the effective arrangement of coloured fabrics. Subsequently he delivered lectures before the Society on "Chemistry applied to the arts," as well as on "Aniline and coal-tar colours" and other kindred subjects. His well-known diligence enabled him, among his other avocations, to contribute many valuable papers to the pages of the *Journal*. The great variety of subjects with which his untiring diligence and devotion to science enabled him to deal, with more or less commercial advantage, is more properly noticed in the pages of those special societies of which he was so great an ornament. The seeds of the disease through which his end was hastened, depriving the country of an indefatigable labourer in the cause of science, were laid during the fatigues that he underwent, acting as a juror, at the Vienna Exhibition.

There are other names so intimately connected with science and art, and so well-known to fame, that it is not desirable to add anything here in the abbreviated form that is only possible. Among these may be named Baron Liebig, Sir William Tite, Samuel R. Graves, M.P., Dr. Donald Dalrymple, M.P., J. R. Maclean, M.P., Sir D. Salomons, the Earl of Zetland, and Mr. Startin.

I will now mention in order a few of those subjects relative to which the Council has been engaged.

The growing importance of economy in the use of coal led, during the last session, to the placing in the hands of the Council by a gentleman, through Sir William Bodkin, of the sum of £500 in aid of solution of this question. A list of premiums in connection with it has been published in the *Journal*, and the Council are expecting a large number of stoves and grates for the competition which will take place after 1st December next. It has been necessary to have a building specially erected for the trials, and it is hoped that, as regards domestic purposes, the desired economy will be secured without any but slight alterations in existing fireplaces. It does not speak very highly for the skill of the builders or of the grate manufacturers that, with few exceptions, houses are found to require the unsightly rows of chimney pots, cowls, or other contrivances that disfigure our buildings.

The economical question is one that affects the whole community directly in relation to this necessary of life; but there is one point of even more importance in a national point of view, namely, what will be the effect of the continued and increasing high price of coal on the industry and intercourse of the people of this country? This question has been discussed by many able men, and though there may be differences of opinion on it, there is one practical conclusion which is forced on all who consider it, and that is not merely the more economical use of what we possess, but the importance of seeking elsewhere than in coal for some source of power which can be economically applied, and with an equal or greater result. Gas and air engines, though employed for stationary engines where great power is

not required, are not applicable to locomotives; but it may be inquired whether among the earth oils, now so abundant and cheap, or the highly explosive compounds—as gun cotton—so largely used for other purposes, generators of force adequate to the traction of railway trains could not be found. The Society has offered the Howard prize of £25 or its gold medal in connection with this subject as follows:—For the production of a traction engine of moderate power, capable of being employed as a substitute for horse-power on tramways and in the streets of cities and towns. The engine to form one structure in combination with the tramway carriage. The power may be generated by any means, provided that noise, noxious fumes, and the discharge of refuse into the air or on to the road-surfaces are avoided. A second gold medal is also offered by the society for the discovery or manufacture of a means for safely and economically generating power suitable for use in place of steam. It should be free from refuse, noxious fumes, and injurious effects either on the metals with which it may be brought into contact, or on the workmen employed.

The utilisation of peat, owing to the high price of coal, is naturally attracting a considerable amount of attention at the present time, and the Irish Commission appointed to investigate the peat question recently visited the principal peat manufactories, both at home and on the Continent. Peat and its profitable and economical utilisation form one of those subjects which have constantly occupied the attention of the Society; and it is much to be regretted that, up to the present time, no large commercial results have been obtained from so important and extensive a natural product. The question has formed on several occasions the subject of premiums offered by or through our Society; and on the last occasion, in 1865, Mr. J. Bailey Denton placed at the disposal of the Council the sum of £50 as a money prize, to which was added the Society's gold medal, for the production of fuel from peat which shall be equal in quality to good household coal for ordinary purposes, and capable of being sold in the market commercially at less cost than such coal; but I am sorry to have to add that the Society has been unable to award the prize. The attainment of the object was to be demonstrated practically, and on a commercial scale. Papers have been read in this room upon the same subject, and samples of coal and peat-charcoal in endless variety have been exhibited. Inventors have been many, and of the most sanguine temperament; large sums of money have been from time to time expended in attempts to work the almost inexhaustible bogs of Ireland, as well as others in this country; but hitherto no commercial result of importance has been attained. The Irish Commission last year, in their report, state that the only reasonable system of producing peat fuel upon a commercial base, is by macerating the raw peat, and in the air-drying process, aided by the use of sheds, a process long since published in the *Journal* of our Society; and it is to be hoped that the company now forming, and which is stated to have purchased of our Royal President the right to work upwards of 1,000 acres of peat land in Devonshire, may prove more successful than its predecessors have hitherto done.

The question of railways and their management is one of great practical importance as well as personally interesting to every member of the community. I do not now allude to it in relation to State purchase and management, an alteration which would be of no value unless many changes resulted from it, such as should be insisted on by the public under any circumstances. The Midland and the North-Western Companies have commenced the laying down of distinct lines for slow traffic, and the action of government should be called in to make this system imperative on all railways, naming, as in the case of all bad arrangements for which legislation is required, a certain fixed date, previous to which such changes are to be completed. If the law obliges the owner of a cab to have it inspected by the police in Great Scotland-yard, in regard to its dimensions, fittings, &c., before it is allowed to ply for hire in the streets, it is not too much, for instance, to expect that the law, however famous for the eccentricity of its action, should so far coerce the liberty of companies as to oblige all platforms and carriages to be mutually arranged with a view to rendering the entrance and exit more easy, and the terrible consequences of a slip between the two impossible. The block system, and the arrangements for communication between the passengers and guard are extending, but are as yet very far from being as universal as safety and economy demand.

The special Committee appointed to examine by what means fires and conflagrations in the metropolis might be prevented, have collected a mass of evidence, pointing out, among other valuable information, what are the mechanical, structural, and administrative measures to be adopted for this purpose. The importance of this information has been acknowledged by members of the legislature, by the press, and by all who have given serious attention to this subject, and it forms a basis on which action of unquestionable utility can be carried out. Practical witnesses have expressed the opinion that two-thirds of the average loss of life, two-thirds of the serious loss of property, and the probability of an extended conflagration, might be prevented by adopting the measures indicated. Further inquiry has since been made, making the evidence yet more complete.

Mr. Braidwood and other authorities have shown that fire-escapes and the ordinary engine appliances are of little avail for the saving of life or property within the premises where fires break out, unless they are brought to bear within a very short time from the outbreak. In cases where life is lost it has usually been from half to three-quarters of an hour before the water has been made available. By the measures indicated in the evidence laid before the Committee this supply can be made immediately available. It involves, however, a system of constant supply, under unity of management, and on a public footing. Manchester and other places testify in favour of this system. It is confidently stated that under such a system the saving effected would supply ample funds for compensation to existing shareholders. As regards Manchester, it is stated that only three cases of loss of life from buildings taking fire have occurred during the last twelve years. In the twelve months ending September 1872,

there were 306 fires, and it was only necessary to use engines to assist the hydrant and street supply in eight cases. In the three previous years there were 841 fires, and the engines were only required at 21 of them; and, further, there has not been one case of the total destruction of property in three years, while fires classed as "serious" only amount to three per cent, *i.e.*, fires where more than one-sixth of the property is destroyed. The whole evidence merits the most serious consideration. The unnecessary waste of human life and property, to say nothing of the enormous quantity of water daily pumped up for no purpose, and the lamentably insecure condition of this vast metropolis, call loudly for legislative and administrative action, based on the principles pointed out, but even improving on the existing practice by the experience that has already been gained.

Circumstances have interfered with the experiments, of which I spoke last year, relative to the draught of carriages over roads of various descriptions, but enough has been done to show that very interesting results may be expected. The machine proposed by Mr. Amos has been tried on more than one occasion by the committee, and the necessity of certain modifications has been made apparent. On the completion of these, the experiments will be continued. It is expected that we shall be able to show that a reduction of tractive force by horse-power, amounting to one-half, can be obtained by improved road surfaces. Connected with this inquiry is the important one of cleanliness of the streets, on the condition of which traction force greatly depends; and here also the question becomes joined to that of fires, because, were the great security obtainable by hydrants placed at regular and short intervals obtained, there would be a simple means of improving the sanitary condition of the metropolis, and putting an end to annoyance of mud and dust at a far cheaper rate than on the present inefficient system.

The supply of food is another of those important questions to which the Society has for many years directed attention, with considerable gain to the public. The Council feel that much remains to be done before a satisfactory solution of the problem can be arrived at. Until fresh meat can be brought in bulk into our markets, and in the form in which the public are accustomed to see it, but little effect will be produced on the market prices. The conclusions to be derived from various experiments go to show that chemicals of any kind are not suitable, while cooking and placing in tins adds to the prime cost and tends to limit the supply. Large quantities, however, of such tinned meat are being used in some districts, where convenience and portability are important. At present, Australia and South America are the chief sources of supply, though why places nearer home, as the Baltic, should not compete in this trade, is not quite clear. Large quantities could be obtained if the facilities for bringing the cattle from the interior were adequately provided. It is exactly thirty years since the Society directed attention to the waste of animal food in Australia. At that time a leg of mutton could be bought for sixpence, and a barrow-full of the inferior parts for the same sum. The meat was of all the products of the animal of the least value. The Society awarded its medal for attempts then made to render down the lean of meat, by means of the water-bath, and the introduction of the extract into this country in a solid portable form. In 1853, Mr. Harry Chester, Chairman of Council, in his opening address, again called attention to the subject, and added, "Is it impossible to preserve the flesh and to export it in a satisfactory condition to this country, where butchers' meat is not over abundant?" The question has steadily increased in interest and importance, and we, to some extent, benefit by the attention bestowed on it.

In order to draw our food supplies in a natural condition from Australia and other distant parts, the process which appears to offer the greatest promise of success is that in which the meat is kept in a cold atmosphere; and, though much has been done to increase the power of producing ice, or its equivalent, still much remains to be done in order that we may attain the power of producing it economically whenever and wherever required on board ship. When attempts were first made, one ton of coal was consumed in the production of about five tons of ice; now the equivalent of nearly four times that quantity is obtainable under certain conditions of temperature. The ice machine in its improved form has, however, now become a commercially available machine for many manufacturing purposes, and there is no doubt that it will ultimately be further improved, and the difficulties which still have to be surmounted will be overcome.

An experiment lately made goes to show that in a dry atmosphere it is not necessary actually to freeze the meat for its preservation, and that meat so treated is found to be excellent in flavour. Reduction of temperature is not the only question which has to be solved in relation to the shipment and preservation of fresh meat on shipboard. The proper construction of the ships themselves to be employed requires much consideration, so that the meat tanks may be placed in the best possible condition of freedom from variations of temperature. Meat, however, is not the only waste food-product our colonies and possessions might supply us with. The turtle abounds in many places, and only requires to be gathered up and dried to fit it for shipment and consumption in this country; and it is gratifying to find that, after a lapse of nearly twenty years after the Society first directed attention to the subject, supplies are beginning to arrive, and dried turtle of excellent quality is now obtainable, though at present 10s. per pound. Dried fruits and preserves have also recently been sent in from Australia, some of which are of excellent quality, while the Americans have been utilising their surplus pines, peaches, apricots, cherries, and other fruits, by preserving them in tins, after the fashion of tinned meat, and now send us large quantities for our use. It is gratifying to find that a commencement has thus been made in several new directions, and there can be little doubt that ultimately the public of this country will be greatly benefited by the large supplies which will be brought in. The question has now taken a commercial form, and several companies have been established for the importation of food products, and if they are all conducted with the same ability and energy as has been displayed by our members, Mr. Mort, Mr.

Tallerman, and Mr. McCall, the result must in the end be successful.

It is a matter of congratulation to the Society that one object for long desired is now about to be realised. The "National Training School for Music" has received a large amount of support, and, thanks to the munificence of one of the members of Council, Mr. C. J. Freake, a suitable building is about to be erected in the neighbourhood of, and communicating with, the Royal Albert Hall. H.R.H. the Duke of Edinburgh has consented to lay the foundation-stone on the 18th of December next, and a conversazione in honour of the occasion will be given by the Society, in the Royal Albert Hall, in the evening of that day, the Council of the Hall lending the building, free of cost, for that purpose. Addresses will be made explanatory of the objects and prospects of the Training School, to be followed by a musical entertainment.

Although the promises of support to this new institution justify the Council in anticipating a complete success, they would still earnestly beg the co-operation of all the members in so important a work.

The subject of museums and their educational uses has lately been brought before the Prime Minister by the Council, and the correspondence relative to it has already appeared in the *Journal*. The Council have invited a large number of their own members, members of both Houses of the Legislature, and others interested in this important movement, to form a joint committee for the purpose of examining into the question, and reporting to the Council the action that it is desirable to take. In the meantime, a deputation from the Council has waited on the Royal Commission on Scientific Education, and without specifically laying down any definite recommendation, which could not be done until the committee had reported, has stated generally but plainly the tenor of the Society's views. These may shortly be stated to embrace—1st. State aid to Museums. 2nd. Museums to be made conducive to education. 3rd. Administration to be conducted by a responsible minister. Leaving out of view, for the present, the question as to how this shall be effected, the Council cannot but feel that every exertion should be tried to make the advantages of such changes clearly understood by the public, so that means of general scientific instruction, now but little available, may be brought into active and efficient operation.

Science is ever advancing our knowledge and aiding our industries, but probably among the many discoveries of the present day none have opened up wider or more interesting fields for investigation than has the spectroscope. Spectrum analysis has already lent its aid in the discovery of new metals; and it will be remembered that Mr. Norman Lockyer, whose name is so intimately connected with modern researches by means of the spectroscope, has already placed before the Society much valuable information. I am now glad to have it in my power to announce that he has kindly undertaken to add to what he has already done for the Society by delivering two lectures in this room on Spectrum Analysis, as aided by and aiding the arts.

In addition to the General Examinations, the Council have this year inaugurated a system of Technological Examinations. Taking up a few trades only as a commencement, they propose to extend the number in the coming year. It is with much satisfaction that I can announce a considerable amount of pecuniary support in aid of this object from some of the City Companies and from private individuals, as already mentioned in the *Journal*. The Council trust such a hopeful beginning will result in a large and increasing number of candidates for examination, and that there is being now founded what will become an important and permanent national institution.

The Silk Supply Committee will continue its labours, and the *Journal* will, as hitherto, contain information connected with the growth, importation, and manufacture of silk.

It has already been announced in the *Journal* that the offer of prizes for improved cabs attracted numerous competitors, and that two four-wheeled and two hansom cabs were rewarded as coming nearest to what was required. The Council believe that the competition has successfully directed attention to the subject, and that an improved class of public vehicles will result.

His Royal Highness the President having been pleased to express his willingness to inspect the prize cabs, the Chairman and Secretary waited on him, on behalf of the Council, at Marlborough-house. After a careful and practical examination, by riding in each, His Royal Highness was pleased to testify his interest in the competition by ordering a two-wheeled cab, precisely like that which obtained a prize, to be made for him by Messrs. Forder.

It is gratifying to know that the attention which the Society has drawn to the hitherto very defective service of the Channel passage has already resulted in some improved vessels, the railway companies having most cordially taken up the subject. No great advance appears to have been made in respect of improved harbours, circumstances not being favourable to the settlement of this question. As regards vessels, the "Bessemer saloon ship," described last spring in this room, is rapidly approaching completion, and will probably be at work in the ensuing spring. The Sedley-Dicey ship, also described before the Society, is expected to be on her trial by March next. There are thousands that wish them success.

Bearing in mind the importance of a knowledge of the producing as well as the absorbing power of the British possessions, and of foreign countries, the Council, some few years since, instituted, under the conduct of a committee, a series of Indian meetings, which have brought forward much useful information in relation to the wants and capabilities of India, and they hope to continue a like action during the present season. The series of meetings upon India—its industry, commerce, and art, will be continued during the present session.

The Council have now appointed an African Committee. The able paper read by Governor Pope Hennessy at the close of the last season showed the great importance of our commercial relations with these regions. Africa, as you are aware, is at present attracting a large amount of attention commercially. The nature of the country and its requirements have recently become much more

generally known than was formerly the case, while its capability of supplying us with gums, spices, fibres, gold, diamonds, &c., appears almost boundless. I hope that, through the labours of this Committee, much interesting information will be brought forward in reference to Africa in the coming session.

The British colonies and foreign possessions afford a wide field for the Society to work in, and it behoves us as a nation to cultivate commercial relations with them to the largest possible extent; but in order to do so it is essential that we should make ourselves thoroughly acquainted, not only with what they produce, but also what they require, not raising up standards of our own, but rather seeking to ascertain the nature of their wants, and any peculiarities of style or fabric, and then to endeavour to supply their wants by means of our more economical processes of production.

Another year has passed without any advance in connection with telegraphs towards that improvement in the system that is so much needed. We are still obliged to quote Continental States, with their half-franc messages, as indicating the next step required for ourselves. Until we get a sixpenny message, and perhaps an additional half rate, when prepaid by the sender, for the return message, it is clear that a large section of the community will still remain excluded from the advantages of this means of communication. The delay in putting the ocean telegraphs on the same footing as the inland telegraphs has, since the Council first made representations on the subject, lead to further and increasing cost in their acquisition by the Government. Great as is the value of the ocean telegraph to this country, the centre of the world's commerce, and specially during seasons of panic or other alarms in the mercantile world, the high tariff makes its use almost prohibitory to smaller firms and to individuals. To the great mass of those of our countrymen whose relations have emigrated its use is impossible. The present system renders branch lines impracticable, as such would scarcely pay except in connection with main lines. England is now the great carrier of ocean messages, and, as one of our members, Mr. Alexander McEwen, has shown, it is possible for the government, by an expenditure of three hundred thousand pounds per annum, and by the purchase on fair terms of existing lines, to secure an income of upwards of five hundred thousand pounds per annum, thus greatly reducing the existing charges, and assisting Arts, Manufactures, and Commerce. The Council will not fail to use every opportunity of keeping this question in view, in the hope of reducing the loss to the public and to the revenue from delay.

It will be remembered that last year Mr. Buckle offered an important prize, £100, to the head master of that half-time school, of mixed physical and industrial training, which showed the best results at the least annual cost per head, and the least total cost for primary instruction. Important returns were received, and it was intended to test these at a public inspection of the half-time schools, but circumstances put an end to arrangements that were in train for this purpose. The prize stands over for adjudication during the coming session. Whatever may be the merits of any particular district school, they generally present satisfactory national examples of what may be accomplished by the half-time system.

On former occasions the subject of drill, as an important national adjunct to all schools, has been noticed, and the Council do not intend that it shall be lost sight of. They are in communication with the War-office, whose views in respect to this matter they are happy to state are favourable. It is also a matter of congratulation that the London School Board have resolved to introduce the system as soon as practicable.

The award of the Swiney prize for the fifth time will be made in January next. This prize, as doubtless many present are aware, is made in conformity with the terms of the will of the late Dr. George Swiney, for "the best published work on jurisprudence," and is presented alternately for medical and general jurisprudence. The value of the prize is £200, £100 being presented in a silver cup of like value. The next award will be for medical jurisprudence. The Council have felt long since that the conditions attached to the award of this prize render it difficult, if not impossible, to realise any real good from the award. The prize work must have been already published, and therefore whatever good is to result to the public must already be attainable, and no writer of eminence can be expected to incur the risk and responsibility of publication, in addition to the labour of editing any new work, upon the mere chance of the Society awarding him the prize. Under these circumstances the Council have been considering in what way the bequest of Dr. Swiney could be made more really beneficial to the public, and at the same time carry out the intentions of the donor. With this object application was made some time since for power to vary the trust, with the intention of establishing scholarships for the study of jurisprudence, in connection with the proposed educational movement brought forward by the legal profession; but, unfortunately, the proposition has fallen to the ground, owing to Sir Roundell Palmer (now Lord Selborne) and those associated with him having been unable as yet to mature their plans for the establishment of a college or university for the education of students for the legal profession. The Council will be again under the necessity of making the award upon the old base; but it is greatly to be desired that before the time for the next award comes round—viz., 1879—a more really useful application of the fund may be rendered possible.

In the report by the Council read to the Society in June last it was announced that Sir Joseph Whitworth had offered, through the Society, prizes of the value of £100 for the best essays on the "Advantages that would be likely to arise if railway companies and limited companies generally were each to establish a savings-bank for the working classes in their employ." It will be remembered that the importance of thrift on the part of the working classes, and proper facilities being afforded for the exercise of it, were ably dealt with in a paper on "Individual providence for old age," read before the Society by Mr. G. C. T. Bartley, in February, 1872. The essays are to be sent in by the 1st of December, and it is to be hoped that the offer of the prizes named may

induce such a consideration of the subject as will enable the Council to award them, and lead to the introduction of such a system as may be generally acceptable to and available by the classes it is desired to benefit.

The Hall marking of jewellery has been in an unsatisfactory state for some years past, great confusion resulting from the multiplicity of marks used in London and the various country towns, and the imperfect and confused arrangements for effecting the object. In the hope of developing some system upon which Hall marking may be conducted in the future on a more satisfactory basis, Mr. E. W. Streeter placed at the disposal of the Council the sum of £25, to be offered as a prize for essays upon that subject. Several essays have been received, but the report of the committee has not yet been made to the Council.

Not many years have passed since the important changes in the policy of this country, as regards the conduct of trade, took place, and later still the first great International Exhibition was opened. The results have been truly great. Imports and exports were relieved from heavy duties by the one step, and the knowledge of what other nations are doing was exhibited to our own countrymen by the other. What an advance on the value of the old trade fairs of former times, which, useful as they were in their day, were fast degenerating into mere resorts of so-called pleasure and idleness! The great impetus given to trade and manufacture could not, however, be expected to affect our country alone, and the consequence is that at this time we are engaged in a more equal race with others in supplying staple articles of manufacture. It was, perhaps, a necessary consequence that a system should follow which necessitated a subdivision of the labour of production, and so divided the various branches of knowledge and skill that it has become difficult to find men as teachers who are competent to meet the Council's demand for a course of lectures on "Industrial Machinery," such, for instance, as the structure and working of the loom, the nature and mode of applying lace machinery, and many of the machines employed in connection with the industries of the country. I mention this because it is the anxious desire of the Council to institute lectures relative to such, rather than on those connected with the principles of steam-engines, or similar well-known engineering subjects.

The Council have arranged that, during the Christmas holidays, two evening meetings shall be held, to which the children of members will be especially invited, when lectures of an instructive character, suitable for a youthful audience, will be delivered; at these Mr. Frank Buckland has undertaken to bring forward the subject of "Birds, Beasts, and Fishes."

Previous to the opening of the last session, as will probably be remembered by some present, I addressed a letter, as Chairman of the Council, to the members, asking them to assist the Council in its endeavours to increase the action of the Society, by enabling it to establish an extended sectional scheme of work. I pointed out in that letter that if additional funds were placed at the disposal of the Council, it would then be able to appoint paid officers to take charge of chemistry in its relation to industry; that the mechanics of industry demanded the undivided attention of more than one officer, if the improvements brought forward from time to time are to receive that amount of consideration which their importance demands; that the raw produce of commerce, upon which industry is based, was at present almost lost sight of; that our colonies and foreign possessions, and their relations to the trade of this country received but little attention; and that fine art, in its relation to, and the methods by which it is applied on industrial products, was only exceptionally brought forward for discussion in this room. I intimated the anxiety of the Council and officers to alter all this, if members would take a larger amount of personal interest in the work of the Society, and assist the Council by providing the necessary increased amount of funds. I regret to say that I did not receive so large a response to the appeal then put forth as I deemed the proposition was entitled to. Nevertheless, I am glad to be able to state that the Society is now in a stronger and more healthy position financially than probably it has even previously attained to, and I am glad to have it in my power to announce that the Council, never doubting the great utility of a sectional and extended action, propose during the coming session to hold a series of meetings on Friday evenings, alternately with the Indian meetings, when papers relating to improvements in chemical industry will be read and brought forward for discussion. Arrangements have been made with Mr. Wills, a gentleman already known to the members as an accomplished chemist, to take charge of those meetings, and I have no doubt that members will take this fact as an earnest of the intention of the Council to proceed in the adoption of the course proposed last session as rapidly as the necessary funds are placed at its disposal. Nor is the want of adequate funds for the carrying on of the work of the Society felt and known to the Council alone, for in the preface to a work recently published, I find the following paragraph. Speaking of the patent office, the writer says:—

"This surplus income (after paying the expenses of the Commissioners' Office and compensation pensions) amounts to about £80,000 per annum, and is now paid into the Consolidated Fund, whence it may be drawn out for prosecuting the Ashantee war.

"Surely it must be unjust that so large a sum, which is extracted from the bone and sinew of the country, viz., the manufactures, and from the brains of the nation, viz., inventors, should be handed over to the already swollen Consolidated Fund, which now amounts to seventy millions sterling per annum. Much has been done by the Commissioners of Patents to facilitate research and to promote the general interests of the inventing classes, and the formation of a convenient and well-stored reading-room reflects much credit on them and on their excellent chief officer; but they have been cramped in their efforts by the exigencies of the Treasury, which has inexorably forbidden any expenditure beyond what was absolutely necessary for conducting the business of the department, and has grasped and retained funds which never ought to have been applied to any other purpose than that of stimulating and rewarding inventors and of encouraging industrial progress. In all probability this injustice will soon be remedied. It would be a grateful act, meanwhile, if a part only of these funds, say £20,000 per annum, was placed at the disposal of the Society of Arts, to be employed for purposes in connection with the objects of the Society. The Society of Arts is the only association in the kingdom which avowedly attempts to foster industrial invention, and it certainly is not creditable that its income should only be £7,000 per annum, an amount which, after

providing for expenses, leaves very little for rewarding struggling genius or inventive talent. The Society of Arts has done much and done well, but its means have been far too limited and wholly incommensurate with its objects. Now, if the portion of the patent fund indicated were placed at its disposal, or even only £10,000 per annum, the Society would be enabled to take up that position to which it is entitled as the oldest and almost the only Society for promoting the arts and encouraging manufactures.

"It would be an act of gratitude, an acknowledgment of the vast prosperity bestowed on this nation through the agency of inventors, if Parliament were to make a grant of £20,000 per annum, to be applied, through this Society, in furtherance of interests which are truly national. Let us hope this may come to pass, and to insure it let every inventor, and every man who feels that the welfare of this country depends on her manufactures, urge on his representatives in Parliament the urgency and expediency of the proposition."

I would again urge members to give to the Council their hearty support and co-operation by bringing forward, during the present session, such a numerous addition to the list of members as will justify the Council in entering upon the greatly-increased expenditure which such a broadened course of action would necessarily involve.

I would now refer for a moment or two to another section of the letter I issued to the members, viz., that in which the Council asked for donations and subscriptions in aid of an Endowment Fund. The Society, as at present constituted, depends mainly for its support on the voluntary subscriptions of its members, and this it must ever continue to do; but the Council desire to see the Society in a position to maintain a vigorous action at all times, and this it believes may be attained to if a sufficient amount of funds can be invested to secure to it the means of guaranteeing adequate remuneration to those gentlemen whose time and talents it desires to apply in carrying on the work of the Society.

I hope that some of our wealthy members will be induced to come forward and assist the Council, by providing the necessary endowment fund for the permanent carrying on of its work.

What a useful and continuously beneficial work has the Society been enabled to establish under the gift by the late Dr. Cantor! For how many years past has this room been crowded night after night with attentive listeners and learners at the Cantor Lectures! I am glad to be able to add that the arrangements the Council have been able to make for the present session leave no doubt as to the continuance of interest and the utility of those meetings. If the necessary funds are provided, a great extension of such work may be effected, and I hope that, if I am allowed to appear here at the Annual General Meeting in June next, I shall be in a position to announce that members have come forward and responded liberally to the Council's appeal, so that when the Chairman of Council shall deliver his address from this chair next session, he may be able to announce that not one more, but many more, sections of development in the Society have been determined on and arranged.

I would add that the work of our Society does not die with the closing hour of our meetings; the papers and lectures delivered live in the pages of the Society's *Journal* for the information of those who reside beyond London or are otherwise prevented from attending our meetings. How vastly would the influence of the Society's *Journal* be extended if it embraced, as I hope it will ere long, reports on all the varied classes of subjects to which I have already referred.

The Chairman then presented the following medals and prizes:—

The Society's gold medal to Dr. Hiddingh, of Stellenbosch, Cape of Good Hope, for his successful exertions in promoting the cultivation and reeling of silk in that colony.

The Society's silver medal to Mr. Thomas Wills, F.C.S., for his paper read at one of the evening meetings last session, entitled, "On some Recent Processes for the manufacture of Gas for Illuminating Purposes."

The Prince Consort's prize of twenty-five guineas, accompanied by a special certificate, to Thomas Richard Clarke, aged 21, formerly of the Salford Working Men's College, and now of the Birkbeck Literary and Scientific Institution, accountant's clerk, who has obtained the following first-class certificates in the present and three preceding years at the Society's general examinations:—

1870—Arithmetic—First-class Certificate.
,, Geography—First-class Certificate, with First Prize, and Royal Geographical Society's Prize.
,, English History—First-class Certificate.
1871—Metric System—First-class Certificate, with First Prize.
1872—Book-keeping—First-class Certificate, with First Prize.
,, English Language—First-class Certificate.
1873—Logic—First-class Certificate, with Second Prize.
,, Political Economy—First-class Certificate, with Second Prize.

The following prizes awarded to candidates at the Technological Examinations held in May last:—

Carriage Building.

Mr. T. F. Mullins, the Society of Arts prize of £5.

Mr. M. Mullins, the prize of £3, offered by G. N. Hooper, Esq.

Mr. J. J. Heywood, the prize of £2, offered by G. N. Hooper, Esq.

Cotton Manufacture.

Mr. Thomas G. Mills, the Society of Arts prize of £5.

Steel Manufacture.

Mr. W. H. Warren, the Society of Arts prize of £10.

The Prizes awarded by the Council for Improved Cabs, exhibited in the Annual International Exhibition of the present year, as follows:—

Two-Wheelers.—Mr. C. Thorn, Norwich, a prize of £30. Messrs. Forder and Company, Wolverhampton, a prize of £30.

Four-Wheelers.—Mr. Lambert, 66, Great Queen-street, a prize of £30. Messrs. Quick and Normington, 8, Netherwood-street, Kilburn, a prize of £30.

Mr. Webster, Q.C., moved a vote of thanks to the chairman. After a few congratulatory remarks on the position of the Society, he turned to the question of the transference of the South Kensington Museum to the authorities of the British Museum. The one institution was progressive, the other stationary, and he thought it the duty of the Society to do all that lay in its power to prevent so unfortunate a consummation.

Mr. Saywell, in seconding the vote of thanks, deprecated any feeling of antagonism between the British Museum and other bodies. He thought there was work for all such institutions, and that the British Museum had done its part well.

The vote of thanks was then carried unanimously.

ANNUAL INTERNATIONAL EXHIBITIONS.

The first meeting of the Committee for the Class of Civil Engineering took place on the 18th inst. at Gore-lodge. The following gentlemen were present:—Sir John Coode, Colonol Henry Wray, R.E.; Mr. R. More land, Mr. John Bird, Dr. G. Ross, Mr. C. Gatliff, Mr. Geo. Godwin, Mr. Chas. Manby, Mr. W. H. Barlow, Mr. William Clode, Mr. John Grant, Mr. Edward Woods, Mr. Henry Grissell, Mr. T. Roger Smith, and Major E. F. Du Cane, R.E. Sub-committees were formed for Building, for Civil Engineering, for Sanitary Apparatus, and for Cement.

The fourth meeting of the Committee for Foreign Wines was held on the 19th inst. at Gore-lodge. The following gentlemen attended the meeting:—Sir Daniel Cooper, Bart., Mr. F. W. Cosens, Mr. Morgan Yeatman, Mr. John Corlett, Mr. Robert Gray, Mr. H. G. Smith, Mr. E. Apps Smith, Mr. Joseph Prestwich, F.R.S.; Mr. Gordon W. Clark, Mr. C. Lombard de Luc, Mr. H. Matthiessen, and Mr. Lewis H. Meryon. The Committee recommended her Majesty's Commissioners to receive applications up to the 1st of January.

EXHIBITIONS.

United States Centennial Exhibition.—The report of the Committee on Plans and Architecture has just been issued. It will be remembered that in April last an offer of prizes for suitable designs was made. In September ten were selected from the forty-three sent in, and each of these received a prize of 1,000 dols. Now a further examination has reduced the number to four, among which the promised amount of 10,000 dols. has been divided in sums of 4,000, 3,000, 2,000, and 1,000 dols. The Committee, however, report that no one of these designs sufficiently fulfils all the proposed conditions, and they consequently put forward a scheme of their own, made up principally from the selected designs. They recommend the erection of the following buildings, viz.:—

1. The art gallery, covering one and a half acres.
2. The grand pavilion, or main industrial hall, covering thirty-six acres.
3. The machinery hall, covering ten acres.
4. The agricultural hall, covering five acres.
5. The conservatory.
6. Also, from time to time, smaller buildings for specific purposes, as annexes to the above.

The question of a permanent memorial hall is not yet decided, and consequently, as the erection of the art gallery depends on its decision, plans for the latter have not yet been drawn up. As for the grand pavilion, it has been determined to dispense with massive external additions, such as domes, towers, and the like, in consideration of the costly nature of such structures. The plan of the building is rectangular; the principal part of the design is made up of vaulted or domed pavilions, each 140 feet in diameter, clustered together, and connected by arches of 100 feet opening, with interior courts of 36 feet diameter. The principal part of the building thus covered by these pavilions becomes one spacious hall 408 feet wide and 2,040 feet long, with a transept 408 feet wide and 952 feet long. The vistas extend to 952 and 2,040 feet in length. A covered piazza surrounds the entire pavilion, giving access to and communication between all the entrances. On the same exhibition *Iron* says:—"The Executive Commission for the above exhibition have received a large number of communications from prominent iron-masters, manufacturers, and chemists, to induce them to take action on the proposition of Mr. J. B. Britton, to secure a comprehensive exhibition of the iron ores of the United States; but after mature consideration the Commission objected to undertake the collection on their own responsibility, as it would entail claims for "comprehensive" displays of every product and manufacture of the United States to be made by the commission, whereas their province is merely to "house" what others send. They will, however, assign a good position in the building for the display, and in so doing refer the matter to the American Iron and Steel Association, as an organisation most competent to assume the direction of such a labour. They also suggest that a fund be raised and placed in the hands of the treasurer of the association, and that that body appoint some skilful metallurgist to receive and arrange the specimens. The executive committee likewise suggest to the governors of the different States and Territories the duties of assisting, and that each specimen sent should not weigh less than 50lbs., and be accompanied by an analysis of a portion. Also that a geological map of the district should accompany the specimens, and anything in connection therewith which may be deemed of interest. We understand that the American Iron and Steel Association have shown themselves willing to undertake the responsibility of the direction, and will shortly announce that intention by circular."

THE RECLAMATION OF LAND IN ITALY.

One of the largest undertakings for the reclamation of land at the present time is that which is being carried out by the Ferrarese Land Reclamation Company, for the drainage of a large tract of country near Ferrara. This district is bordered on the one side by the Adriatic, and lies nearly midway between Ravenna and Venice; its length is about twenty kilometres, and its breadth twelve. The surface of this tract of country varies from the condition of a wet marsh to a submerged morass under a metre in depth of water, and has an area of over 75,000 acres.

There are already some large drains and canals existing—that of the Po di Gozo connecting it with the sea—but others are to be cut in each direction, about a kilometre apart, from which the flow of the waters will be directed towards the southern or Ravenna border of the tract of Codogow, where the great pumping station will be erected, and the drainage waters will be discharged into the Volano, and from thence into the Adriatic.

The pumping-engines, which have just been completed by Messrs. Gwynne, of Hammersmith, will be placed in one great building, and are considered to be equal to the discharge of ten days' continual rainfall. The Po flows, as is well known, on an embankment of its own silt, and advantage will be taken of this to supply, by means of syphons, water for irrigation in dry seasons, if it should be necessary.

The pumps, which are centrifugal, are eight in number, each pair being driven by a separate engine of 500 horse-power; and an idea of their magnitude will be obtained from the fact that their collective throw of water is over 2,000 tons per minute.

The boilers are ten in number, two being spare. The total cost of this undertaking it is estimated will be about half a million sterling, one half of the capital being subscribed in the Italian district itself.

According to M. Poggiale, most of the enamels on cooking utensils of enamelled cast iron, especially of the cheaper kinds, are made with lead, and dilute acids at a boiling temperature were found to extract the lead from them in some cases. It is proposed in France to interdict the sale of such enamelled utensils as yield lead to dilute acids when boiled in them.

NOTES ON BOOKS.

Waste Products and Undeveloped Substances. By P. L. Simmonds. *Robert Hardwicke*, 1873.

There are, perhaps, not many subjects to which the Society has given more careful or more frequent attention than those connected with the utilisation of waste. With the perpetual growth of civilisation and industry comes an equal increase in the amount of waste products caused by each new manufacture. Every industrial process has naturally among its resultant numerous products besides that one to obtain which it is carried on. To utilise such by-products has been a frequent object of modern invention. Such efforts, when successful, may be considered as accumulating so much pure gain, by turning a useless and, therefore, cumbersome, or even a noxious product, into a valuable and useful material. Manufacturers have learnt that there are very few things that are really waste, while, thanks to the investigations of science, the list of really waste substances is daily diminishing. Perhaps it would not be difficult to frame a list of industries of which the by-products have become of nearly equal importance with the main process, and it is certainly true of very many of our principal manufacturing processes that they could hardly be carried on but for the commercial value of products once stigmatised as waste. It might, therefore, be said that when any substance has found its commercial value it ceases to be waste, but Mr. Simmonds has more accurately defined the scope of his work in calling it "A synopsis of progress made in their (waste substances) utilisation during the last quarter of a century." As a matter of fact, he has adopted rather wide limits for his work, and included substances—esparto grass, for example—which a more strict application of his system might have shut out. The field, then, is a wide one, and its importance is obvious when it is remembered that each of the materials here spoken of is practically as real an addition to the wealth of the country as a new import; more so, indeed, because, *cœteris paribus*, the waste matter has generally the advantage of being at or near the spot where it can be utilised, while often the mere fact of its easy disposal is an absolute gain.

To give anything like a sketch of the contents of the work under discussion would—in the narrow limits of a notice like the present—be indeed hopeless. It is obvious, at the first glance, that its author has gone most deeply into the matter, and that, difficult as it is for a single writer to grapple with a subject so complex and varied in its nature, Mr. Simmonds has succeeded in bringing together an immense mass of information upon the most widely divergent subjects.

Although the book appears in the form of a second edition, it is so totally different to the previous work that its author has hardly done himself justice by confounding the two together, and it should be distinctly understood that the two books are quite distinct, and that the new one supplements, and does not merely replace, the first.

Sikhim. With Hints on Mountain and Jungle Warfare. By Colonel J. C. Gawler, F.R.G.S., &c. (*E. Stanford*, 1873.)

It need hardly be doubted that one motive which led Colonel Gawler to publish this narrative at the present time was the wish to serve the Ashantee expedition. It is not, however, for its suggestions on such warfare that it will recommend itself to members of the Society, but because it contains much information about Central Asia, and the facilities for opening commercial relations, through the State of Sikhim, with the Central Asian districts, Thibet and Western China. It will be remembered that a memorandum by Colonel Gawler formed a portion of the documents laid before the Duke of Argyle by a deputation from the Society last session, and there can be no doubt that there are few travellers better qualified to add to our knowledge of the district in question than the adventurous commander of the Sikhim field force. The present work deals mainly with the doings of that expedition, but it will lead many of its readers to wish that its author may at some future time expand his notes into a larger work on the same subject.

GENERAL NOTES.

Whitworth Scholarships.—The following minute has recently been passed by the Lords of the Committee of her Majesty's Most Honourable Privy Council on Education:—"At Whitehall, the 14th November, 1873.—Read and approved the following memorandum on the Whitworth scholarships, prepared by Sir Joseph Whitworth:—I wish that candidates for my scholarships in 1874, who, owing to the shortness of the notice, may not have been able to be in a mechanical shop for six months before the competition takes place, should be allowed to compete; but that if successful their scholarship should not begin until they have worked six months in a mechanical shop. I think the same privilege should be accorded to candidates in 1875 who have not served eighteen months in a mechanical shop, the scholarship not beginning until this period is completed."

Technical Education and the City Companies.—The most recent action in this matter took place on the 28th ult., at a meeting of the Committee of the Livery Companies, which has been formed for the purpose of ascertaining what can be done by the companies for the promotion of technical education. The Lord Mayor presided, and the meeting was attended by representatives from the following companies:—Skinners, Coachmakers, Tallow Chandlers, Mercers, Stainers, Ironmongers, Saddlers, Loriners, Farriers, Spectacle Makers, Turners, Pewterers, Fishmongers, Carpenters, Coopers. The chairman suggested that as a commencement the companies should jointly subscribe the sum of £10,000, with which they might raise a suitable building in some convenient and central place in the City—as, for instance, on the Holborn-viaduct, and that the elements of science and art, and other matters connected with the trades of the City, should be explained and taught in classes and by lectures to such workmen and apprentices as may choose to avail themselves of them. There should also be a public lecture-room, in which, from time to time, and by rotation, articles of skilled workmanship sent in for competition by each handicraft could be exhibited; and lectures or classes given on the subject of the various forms of industry with which the companies were nominally connected. Those lectures, if the funds admitted, might be delivered to the men gratuitously, or, at any rate, on the payment of a very moderate fee. Another portion of the money might be spent in purchasing tickets for museums and exhibitions, to be distributed among workmen and apprentices and the elder scholars of the public elementary schools. He urged that to some such scheme, with the necessary modifications, the companies should be invited to assent and to subscribe, it being understood that the management of the proposed college or school should be in the hands of a representative committee of the companies. He moved that the committee be requested to complete a draught plan embodying some such scheme as he had suggested, and submit it to the Livery Companies. The motion, after some little discussion, was carried.

The Elba Iron Works.—There now seems to be some probability of the rich iron mines of the island of Elba being worked on a far larger scale than they have hitherto been conducted, as a convention has just been signed between the Minister of Finance and a society of Italian capitalists, for leasing these mines from the Government for a term of thirty years. According to this contract, the remainder of the present lease to Messrs. Bastogi, which terminates in 1881, will be taken up by the new company, who have engaged to establish iron works on a large scale on the island for the production of 35,000 tons of pig-iron annually, and to carry out all necessary works for the carriage of ore from the mines.

Enamelling Paint.—One of the most recent inventions for painting or coating surfaces is a new paint brought out by Mr. Thos. Griffiths, of Liverpool, which has the property of forming a firm, impenetrable enamel on the surface of the article to which it is applied. By this means the surface is rendered absolutely waterproof, however porous it may be. The material is consequently intended, not only for decorative purposes, but to be applied as a waterproof coating to the walls or foundations of dwelling houses, railway arches, bridges, tunnels, viaducts, and other structures of brick, plaster, wood, or iron. It is also stated that the paint is well adapted for covering the bottoms of vessels or submerged structures of any description. Various trials have at different times been made of it. At Portobello it was tried on some iron plates, and these were immersed for three months in sea-water. At the expiration of that time the plates were taken up and examined, when it was found that they looked fresh and clean as ever, and quite free from seaweed; and, on some of the enamel being scraped off, the metal showed no signs of rust, although similar plates, treated with other kinds of paint, and immersed in the same way, were both foul and greatly oxidised. As a second test some of this paint was applied to tho steamers trading to Africa from Liverpool; and these also showed no corrosion on their return. It is also said that its smooth surface gives it a considerable sanitary value, and for this reason, as well as that it defies the attacks of white ants, the huts used for the soldiers in the Ashantee expedition are to be coated with it. The walls of the huts, which the paint will make smooth and polished like glass, can be washed with soap and water or disinfecting fluid. This enamel is also available for painting the walls of hospitals, fever wards, &c., as the porosity of the plaster is entirely stopped, thus preventing infection from lodging. It can be made of any colour. White and chocolate are generally used. Various processes for the preservation of ships' bottoms from fouling have from time to time been noted and described in the *Journal*, and the patents on the subject are very numerous. The earliest of these was taken out in 1695 (No. 341) by Charles Ardesoif, for "A new invented composicion which will preserve ships from the worms, insoemuch that any ship may by virtue of the same continue at sea for the space of four or five yeares without receiving any damage from the worms." Since that time very various methods have been employed with greater or less success. The chief merit claimed by Mr. Griffiths for his invention is that of simplicity of application, as it is simply spread on with a brush, like common paint, and sets quite firm in about an hour, even on a wet surface. It is stated that the Liverpool Silicate Paint Company have purchased the sole right of sale and manufacture of the article.

The Leather Trade in Russia.—Tho excellent material obtained from horned cattle on the steppes, on the immense pasture lands of Podolia, and on the broad plains of Central Russia, acquires a high degree of solidity, flexibility, and excellence, from the perfect system of tanning employed. Russia exported in the year 1868, 6,390 tons of leather and hides, amounting to £472,670, and imported in the same year 468 tons of manufactured leather, of the value of £121,000. A few years ago there were in all Russia 2,731 tanneries and 114 leather manufactories, producing annually to a value of £2,925,000, and it is calculated that the annual value of sheepskins and other prepared leather in Russia amounts to £7,875,000.

NOTICES.

THE LIBRARY.

The following works have been presented to the Library:—

Transactions of the Institution of Engineers and Shipbuilders in Scotland. Vol. XVI. Presented by the Institution.

British Association of Gas Managers. Report of Proceedings of the Tenth Annual Meeting held at Edinburgh, June, 1873. Presented by the Association.

Principles of Decorativo Design, by Christopher Dresser, Ph.D. Cassell, Petter, and Galpin. Presented by the Publishers.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

ORDINARY MEETINGS.

The following are the dates of the Wednesday evening Meetings, the chair being taken at eight o'clock:—

1873.	November	—	—	—	26	
,,	December	3	10	17	—	—
1874.	January	—	14	21	28	
,,	February	4	11	18	25	
,,	March	4	11	18	25	
,,	April	—	8	15	22	29
,,	May	6	13	20	27	

For the Meetings previous to Christmas, the following arrangements have been made:—

November 26.—"On the Manufacture of Iron and Steel," by Sir Francis C. Knowles, Bart.

December 3.—"On Australian Vines and Wines," by J. T. Fallon, Esq. On this evening Sir Daniel Cooper, Bart., will preside.

December 10.—"On Mechanical Processes for producing Decorative Designs on Wood Surfaces," by Thomas Whitburn, Esq.

December 17.—"Whitby Jet and its Manufacture," by John A. Bower, F.C.S., Science Master, Whitby School.

CANTOR LECTURES.

The first course of Cantor Lectures for the ensuing Session will be "On Spectrum Analysis as aided by and aiding the Arts," by J. Norman Lockyer, Esq., F.R.S., and will consist of two lectures, to be delivered on Monday evenings, the 24th November and 1st December.

Lecture I.—November 24th, 1873.

On the application of Photography to Spectroscopic Researches.

Lecture II.—December 1st, 1873.

On Spectroscopy in its quantitative relations.

MEETINGS FOR THE ENSUING WEEK.

Mon.....Society of Arts, 8. Cantor Lectures. Mr. J. Norman Lockyer, F.R.S., "On Spectrum Analysis as Aided by and Aiding the Arts."
Royal Geographical, 8½. 1. Capt. J. Moresby, R.N., "Recent Discoveries at the Eastern end of New Guinea." 2. Rev. W. Wyatt Gill, "Three Visits to New Guinea"
Institution of Surveyors, 8. Mr. E. P. Squarey, "Agricultural Geology."
Medical, 8.
London Institution, 4.

Tues....Medical and Chirurgical, 8½.
Civil Engineers, 8. Mr. Leveson Francis Vernon-Harcourt, "Account of the Construction and Maintenance of the Harbour of Braye Bay, Alderney."
Anthropological Institute, 8.

Wed....Soci ty of Arts, 8. Sir Francis Knowles, Bart., "On the Manufacture of Iron and Steel."
Royal Society of Literature, 8. "On the Demeter of Cnidus." Contributed by Dr. Henry Brunn, keeper of the Glyptothek at Munich, and translated by Mr. A. C Murray, of the British Museum.
Archæological Association, 8.

Thur....Royal, 8½.
Antiquaries, 8½.
Philosophical Club, 6.

Fri......Quekett Club, 8.
Clinical, 8½.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,097. Vol. XXII.

FRIDAY, NOVEMBER 28, 1873.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

NATIONAL TRAINING SCHOOL FOR MUSIC

H.R.H. the Duke of Edinburgh has appointed Thursday, December 18th, for laying the first stone of the building for the school. The site is to the west of the Royal Albert Hall. A *conversazione* and concert will be given by the Society in the evening, in the Albert Hall, the use of which is lent by the Council of the Hall. Cards of invitation will be issued to members in due course.

JUVENILE LECTURES.

It having been determined by the Council to provide a short course of lectures suitable for a juvenile auditory during the Christmas holidays, arrangements have been made with Mr. Frank Buckland, M.A., her Majesty's Inspector of Salmon Fisheries, to deliver two lectures "On the Structure and Habits of Beasts, Birds, and Fishes, as showing Beauty and Design," on Friday, January 2nd, and Friday, January 9th, at 8 p.m. The lectures will be illustrated by specimens. Tickets each to admit a member and two children (under 16) will be prepared; and it is requested that those members who wish to avail themselves of the lectures for their children will make early application to the Secretary. The issue of tickets will be strictly limited to members, and none will be sent except to those applying for them. As the lectures are intended specially for the children of members, it is hoped that the number of adult visitors may be as far as possible restricted; and that only ladies accompanying the children will make use of the tickets. Only one ticket, as above, will be issued to any one member, and no person will be admitted without a ticket.

TECHNOLOGICAL EXAMINATIONS.

The Programme of Examinations in the technology of the Arts and Manufactures of the country for 1874, is now ready for issue. These examinations will be held annually, in conjunction with the examinations of the Science and Art Department, and due notice will be given of the particular subjects selected each year.

The subjects for the year 1874 will be Cotton, Paper, Silk, Steel, Carriage-building, Pottery and Porcelain, Gas Manufacture, Glass-making, and Cloth Manufacture. Candidates, in order to obtain certificates in any of these subjects, must pass the examinations of the Science and Art Department in certain sciences, which are specified in the programme as bearing upon the particular art or manufacture. In addition to these, special papers will be set in the technology of each manufacture, by examiners appointed by the Society of Arts.

The following Prizes are offered by the Society of Arts in each of the nine subjects.

To the best candidate in Honours, £10.

To the best candidate in the Advanced Grade, £7.

To the best candidate in the Elementary Grade, £5.

The following special additional Prizes are offered :—

By the Worshipful Company of Clothworkers, a Scholarship of one hundred guineas, to be awarded to the best Candidate in Cloth Manufacture, presuming that in the opinion of the Council he reaches a sufficiently high standard. The Candidate who obtains this Scholarship must spend at least one year in some place of scientific instruction, to be approved by the Council of the Society of Arts and by the Court of the Clothworkers Company.

By the Worshipful Company of Spectacle Makers, to the Second-best Candidate in Honours in the Advanced Grade and in the Elementary Grade respectively, in the Manufacture of Glass :—

A Prize of......................	£5	5
A Prize of......................	3	3
A Prize of......................	2	2

By Wyndham S. Portal, Esq., to the Second and Third best Candidates in the Elementary Grade, paper Manufacture :—

A Prize of	£3
A Prize of	2

By G. N. Hooper, Esq., to the Second and Third best Candidates in the Elementary Grade, Carriage Building :—

A Prize of	£3
A Prize of	2

The Worshipful Company of Plumbers have also contributed £10 10s. to the Prize Fund.

The examinations of the Science and Art Department will be held during the first three weeks of May, the technological paper being worked on the evening of the 16th May. The dates of the

Science subjects are given in the Science Directory, published by the Science and Art Department.

In order that these Examinations may really be successful in promoting technical education in this country, it is desirable that encouragement should be given to candidates by the offer of prizes and scholarships. With this object the Council appeal to the trade guilds of the city of London, to merchants and manufacturers, and to members of the Society generally, to aid them by contributing to the prize fund.

While expressing their thanks for the assistance they have already received, both from the companies of the City of London and from private individuals, the Council would repeat the appeal, made last year, when the scheme of Technological Examinations was first put forward, for further funds to enable them to prosecute and carry out in its entirety the plan which has been drawn up.

Large bills have been prepared, suitable for suspension in workshops, &c., in which full information is given respecting these examinations. Employers of labour, secretaries of institutions, and others interested in the movement, can be supplied with any number of them required, on application to the Secretary of the Society.

PROCEEDINGS OF THE SOCIETY.

SECOND ORDINARY MEETING.

Wednesday, November 26th, 1873, Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Alliott, James B., Bloomsgrove, near Nottingham.
Beasley, Charles, 30, Upper Hamilton-terrace, St. John's-wood, N.W.
Brown, William Ray, Forest-hill, S.E.
Cramp, Charles Courtney, 87, Litchfield-road, Grove-road, E.
Denman, James L., 20, Piccadilly, W.
Fairfax, Henry, 435, West Strand, W.C.
Garrett, Edmund, Bow Brewery, Bow, E.
Hodson, George, C.E., 6, Park-lane, Loughborough.
Kenward, Henry, 1, Market-street, Bloomsbury, W.C.
Kitt, Benjamin, Vernon-house, Tiverton, Bath.
Liddelle, Henry, 9, York-terrace, Beverley-road, Hull.
Mackay, John, Mountfields, Shrewsbury.
Malcolmson, Captain John Grant, V.C., 17, Kensington-gardens-square, W.
Mansergh, James, 3, Westminster-chambers, Victoria-street, S.W.
Myers, S., 1, Vale-terrace, Sutherland-gardens, Maida-vale, W.
Simpson, George, Lovell's-court, Paternoster-row, E.C., and Shortlands, Kent.
Stevenson, David, F.R.S.E., 84, George-street, Edinburgh.
Strina, M., 4, Bute-crescent, Cardiff.

The paper read was:—

ON A METHOD OF REFINING AND CONVERTING CAST IRON INTO IRON OR INTO STEEL.

By Sir Francis Charles Knowles, Bart, M.A., F.R.S., &c.

The object of this method, generally stated, is the refining or purification of cast-iron from sulphur and phosphorus, and its conversion into iron, or into steel, of various qualities, according to the nature of the metal treated, with an increased yield of malleable iron or steel per ton of metal.

The ordinary puddling furnace is at one and the same time a generator of gases and a converting vessel, of simple construction, requiring no motive power, and readily admitting of the application of manual labour to conduct the process which it is intended to perform. But, on examining more closely its operations, we shall perceive that the above advantages are more apparent than real. The gases generated depend for their production on their own combustion, and the greater part of the heat which they evolve goes to heat the chimney-stack, and to create the necessary draught, after which it is wasted. That part of it which is applied to the metal is applied under a great disadvantage, and by the aid of the most severe form of manual labour; and the chemical action of the heated air, in its oxidising of the impurities and of the carbon of the metal, is discontinuous and uncertain, and involves, besides, the needless oxidation of much of the metal itself. Both the heating flame and the re-agents, where used, are applied on the surface of the bath, which is protected by a layer of liquid scoriæ of great specific heat, except when the rabble exposes the metal, while the re-agents are diluted or decomposed by the scoriæ. These disadvantages become more sensible in proportion to the degree in which other re-agents than heated air are to be applied to the purification of the metal. The present is an attempt to devise a method which should be free from the waste of heat and material which takes place, not only in puddling, but also in methods of more recent origin.

The means adopted are:—

1. The separation, as far as possible, of the heating process from the chemical process.

2. The securing of a highly basic scoria—or cinder—of not exceeding 30 per cent. of silica, by means of finery and converting furnaces in which that acid is not present.

3. The employment of caustic soda in conjunction with pure and rich oxide of iron in the elimination of the sulphur and of the phosphorus.

4. Where pure cast-iron is treated, and superior iron or steel is to be produced, the use of nitrate of soda, or of permanganate of soda.

The source of heat employed is the complete combustion of gases rich in carbonic oxide gas combined with heated air to 500 deg. C. in due proportion. The metal being first melted in a cupola with pure dense coke or anthracite coal, the resulting gases are collected and utilised by freeing them from carbonic acid (if any), and enriching them with pure carbonic oxide gas, cheaply produced, until a compound is obtained of from 70 to 80 per cent. of carbonic oxide gas and 30 to 20 per cent, of nitrogen; or, if a higher heat be required, a larger charge be treated, and a more speedy

operation be the object, the cupola gases are used to heat the retorts, and pure oxide of carbon, as described below, is generated for the purpose.

In the former case a temperature of combustion of 2,500 deg. C. and upwards, is obtained, in the latter one of 2,979 deg. C., without taking into account the heat (500 deg. C.) of the air and gas, and the pressure, as it is easy to calculate from the data of the case.

The gas (in either case) being mixed in the condenser with hot air in the proportion to insure the production of only carbonic acid gas and nitrogen by the combustion, with no excess of air, is blown into the body of the metal bath by appropriate apertures at the level of the hearth or sole, giving therefore a neutral flame, while the carbonic acid gas and the nitrogen rising from below with force in all directions, and, aided by the natural lightness of the hotter metal, stir, agitate, and mix the particles of the metal, and so bring them all successively into contact with the re-agents employed, and with each other, doing in fact the work of the puddler. The iron can be "balled" by simple machinery. The blast is urged, in the Bessemer plant, by an engine of from 250 to 300 horse-power, adapted to appropriate sucking and forcing pumps, and the gaseous mixture enters the bath at a pressure of about 1·2 atmospheres. From this it appears that in practice there is an injection of about 1 cubic metre, or of something less than 35·5 feet per second.

The gases are collected in gasometers, the hot air in the usual apparatus. The stopcocks in the leading pipes are so regulated by a graduated scale as to allow the proper volumes to pass under the given pressure into the condenser.

The carbonic oxide being thus burned with a neutral flame, the carbonic acid gas that is formed and the nitrogen quit the surface of the bath at an intense heat (2,150 deg. C., subject to radiation and conduction), which heat may be easily utilised. If the gaseous product of the combustion be passed through a kiln or retort of anthracite coal or of coke, the carbonic acid will take up a second equivalent of carbon, and one volume of it will yield two volumes of carbonic oxide, which absorb 2,400 units of heat per kilo. of weight, the nitrogen remaining constant. A computation given below will show that the resulting gas contains about 47 per cent. of carbonic oxide. If after a second combustion this conversion of $C\,O_2$ into $C\,O$ be repeated, the proportion of $C\,O$ to N will fall to 39·71 per cent., and so on in a decreasing ratio, until we arrive at 34 per cent., the ratio of the cupola gas. The carbonic acid may thus be used as an economical beast of burden to carry fuel to its destination. These converted gases may be used first to heat the generating retorts, and may finally pass into the flues of the boilers, which, with good management, ought to be heated without any other fuel. (If desirable, the nitrogen may be freed from the remaining carbonic acid gas and obtained pure, in which state it may possibly be turned to good account in the preparation of cyanides.)

Enough has been said to show, as the degree of heat generated is indisputable, that the sufficiency of the finery or converter to resist the intense heat evolved and the corrosion by the reagents, is the main condition of the success of this process in the physical and chemical point of view. The question of its commercial success will be considered subsequently.

In order to insure this condition, the finery or converter is made of pieces of cast metal, so constructed that the tuyeres may form one piece with the casting itself. In fact, they are bored out of the solid casting itself, and the apertures are countersunk to meet them at the level of the hearth. The whole is bound together by an exterior jacket of well-rivetted boiler-plate, so that in case of an accidental fracture of the castings there may be no danger of the access of water to the molten iron. The whole finery (or converter) is enclosed and well supported in an iron tank or cistern, through which run currents of cold water adequate to prevent fusion of the sole or walls of the finery. In order to protect from corrosion the interior of the finery, which the re-actions might cause, a basic paste is formed of protoxide of iron, or as nearly such as may be, or of manganese, of Naxos emery or bauxite (an aluminous mineral used in France for making aluminium), and caustic soda in small quantity. This is laid on in thin layers, which, when gently dried, are successively reduced to a state of pasty fusion by the flames of the gases, so that the particles of the mixture may cohere, and furnish a lining of adequate thickness in the form of a semi-enamel or glazing. The best Naxos emery is now quoted at £12 per ton in the stone. This lining is so slowly fusible if the soda be not in excess (which economy alone will prevent) that it will last a long time, and cause but a trifling cost per ton of metal. So far as it is fused, being highly basic, it will be an advantage to the scoria, and it is a bad conductor of heat. Its basic nature is of great importance. It will be seen on reference to Baron Gruner's last pamphlet, "Etudes sur l'Acier et le Procédé Heaton" (Dunol, Paris), that he considered it as a *sine quâ non* for the elimination of the phosphorus that the maximum dose of silica in the scoria should be 30 per cent.; and he cites, in confirmation of his opinion, Berthier's analysis of the only cinders which were found to contain phosphoric acid. The fulfilment of this condition would enable us to make at once good bar iron or steel from the oolitic iron ores of Cleveland, Northamptonshire, Lincolnshire, Belgium, and the North of France.

There remains only one more point to be considered, namely, the efficiency of the re-agents, caustic soda, and the rich oxides of iron or manganese. As the former substance is costly, it must be used with due precaution against waste. Accordingly, where the metal treated contains much silicium, or where sand adheres to it from the casting-bed, it must undergo a preparatory refining with peroxide of iron alone, if possible, with the variety of red hematites (to be found in abundance in Devon and Cornwall), containing only carbonate of lime as its gangue. The silica, and much of the sulphur and phosphorus being thus expelled, and the scoria being removed, the metal is to be treated with caustic soda and peroxides of iron free from silica. Manganesiferous spathose ore calcined, or calcined spathose ore, with the addition of from 5 to 10 per cent. of oxide of manganese, pure and rich magnetic ores, particularly iserine, which contains about 10 per cent. of titanic oxide, are the most valuable adjuncts.

It is hardly necessary to argue in a chemical

point of view the superiority of these re-agents; if, indeed, there is room for comparison between the use of a pure detersive re-agent, and that of scoriæ already charged with the very substance which is to be expelled. But we need not resort to chemical affinities to establish this efficiency. Both nitrate of soda and caustic soda with oxides of iron have been tried in the common puddling furnace, and in the Heaton converter, and the scoriæ produced in the latter case, when tested by the analysis of the late Professor Miller, F.R.S., and subsequently by those of Baron Gruner, were found to contain phosphate of soda, while the metal had lost above 80 per cent. of its phosphorus, under the oxidation of the nitrate, and in presence of the alkaline base, which it is evident, as in other analogous cases in chemistry, had induced the combination of the phosphorus with the oxygen present in a nascent state. More than this, sodium was found in the metal, which both Professor Miller and Baron Gruner affirm forms volatile compounds with the residue of the phosphorus, and thus leads to a further cleansing of the metal in the ulterior stages of manufacture. The quality, moreover, of the iron produced by the author in his works at Flint with nitrate of soda, after treatment of the iron with peroxide of iron, aluminous kaolin, and lime, was extraordinary; for the metal treated was no better than a charge of three-fourths of the cheapest and most ordinary scrap metal with one-fourth of grey metal, made from a brown hydrated peroxide of iron (a decomposed spathose ore). Rivet rods made with it were tried in the factory of Portsmouth Dockyard, and were pronounced to be at least equal to best Lowmoor or Bowling rivet iron. The author has samples, both of this and of iron made with oolitic ores without admixture, which speak for themselves.

The converter destined for casting steel, or homogeneous iron, is cast in one or two pieces, and has a similar jacket of boiler plate with a similar lining, or enamel. It is moveable, so as to admit of being hoisted by a chain and pulley, and removed by a crane for casting or charging. The tuyeres are bored in flanges at the side, and communicate with an aperture at the bottom of the hemispherical, or hemiovoidal vessel. The whole, as in the case of the finery, is placed and firmly supported in a cistern or tank of running water. The casting may be conveniently made through the tuyeres themselves, and the steel is to be poured into moulds, just as in the method of Mr. Bessemer. The saving of wear, as compared with the wear of any finery or converter at present in use, must be very large, the wear in fact being confined to the enamel lining, which will in each heat become at once slightly viscous on the surface.

Such is the outline of this very simple process, and the author leaves it for consideration whether more heat is required to produce the mechanical power employed in it than now goes up the chimney of the puddling furnace, or would be required for any conceivable system of mechanical puddling.

It remains to exhibit the calculations which measure the quantities of the gases employed, their temperatures of combustion, and their effective heating powers; and their cost of production with the cost per ton of iron of this method of treatment.

1. To calculate the composition of the cupola gases, we may take $2\frac{1}{2}$ cwt. per ton of cast metal as about the weight of coke or anthracite coal required to melt that ton. Let W^1 be the weight of carbon contained in this (which will vary from 91 to 98 per cent. in the anthracite coal). Then the oxygen required to form with this carbon carbonic oxide gas will be

$$\frac{8\,W^1}{6} = \frac{4\,W^1}{3};$$

and

$$\frac{77}{23} \times \frac{4\,W^1}{3}$$

will be the weight of the nitrogen in the air which the blast supplies for it. Therefore, the compound gas of the cupola per ton of molten metal will be represented by

$$\left(W^1 + \frac{4\,W^1}{3}\right) + \frac{4}{3} \times \frac{77}{23} \times W^1 \quad .$$

and the richness of this gas in carbonic oxide will be measured by the fraction

$$\frac{\frac{7\,W^1}{3}}{\frac{7\,W^1}{3} + \frac{4}{3} \times \frac{77}{32} \times W^1} = \frac{7\,W^1}{7\,W^1 + 4 \times \frac{77\,W^1}{23}} = \frac{1}{1 \times \frac{44}{23}}$$

$$= \frac{23}{67} \text{ or } 34{\cdot}32 \text{ per cent.*}$$

2. This cupola gas being given, and also a supply of pure carbonic oxide, in what proportion by weight must they be mixed in order to produce a gas consisting of 75 per cent. of carbonic oxide and 25 per cent. of nitrogen?

Let the weight per ton of molten iron of the cupola gas be called

$$C = \frac{7\,W}{3} + \frac{4}{3} \times \frac{77\,W^1}{23},$$

and let x be the weight of carbonic oxide gas required.

Then, by the conditions of the question, we must have:—

$$\frac{34{\cdot}32}{100} C + \frac{100}{100} x = \frac{75}{100} (C + x),$$

from which equation we deduce,

$$x = 1{\cdot}627 \text{ C, and } x + C = 2{\cdot}627 \text{ C.}$$

we readily find—

$$\frac{7\,W^1}{3} = \overset{\text{cwt.}}{7{\cdot}6766}, \quad \text{and } \frac{4}{3} \times \frac{77 W^1}{23} = \overset{\text{cwt.}}{14{\cdot}6851},$$

whence we have value of—

$$C = 22{\cdot}3620 \text{ cwt., and } x + C = 58{\cdot}745 \text{ cwt.}$$

Thus the carbonic oxide at our disposal will be $\cdot 75 \times 58{\cdot}745$, or nearly 2 tons 4 cwt., the only part which is not waste gas being $x = 36{\cdot}383$ cwt.

3. To determine the temperature of combustion of this gas, its initial heat and that of the air being 500°, our data are as follows:—One kilo. of carbonic oxide in burning evolves 2,400 units of heat, or calories, and the products of combustion are carbonic acid and nitrogen. The specific heat of carbonic acid is ·216, that of nitrogen is ·244. Of the proposed gas, $\frac{3}{4}$ kilo. are carbonic oxide, and $\frac{1}{4}$ kilo. nitrogen. It will come to nearly

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* This agrees within a few hundredths with the result of direct analysis of generator gases.

the same thing whether we consider the carbonic oxide and the oxygen and nitrogen to be heated to 500°, or the carbonic acid and the nitrogen be so heated. We have upon this data :—

$$\tfrac{3}{4} \text{ kilo} \times 2{,}400, \text{ giving out } 1{,}800 \text{ calories}$$

To burn $\frac{3}{4}$ kilo. of carbonic oxide, we require $\frac{8}{14} \times \frac{3}{4}$ kilo. of oxygen, making $\frac{33}{28}$ kilo. of carbonic acid, and importing $\frac{77}{23} \times \frac{3}{7} = \frac{33}{23}$ kilos. of nitrogen from the air;

Thus the total nitrogen will be $(\frac{1}{4} \times \frac{33}{23})$ kilos or $\frac{155}{92}$ kilos.

The specific heats for 1° are :—

	kilos.			
Of the carbonic acid gas	$\frac{33}{23}$	×	·216	= ·2546.
„ „ nitrogen	$\frac{155}{92}$	×	·244	= ·4110.
Sum				= ·6656.

Therefore for $(t° - 500°)$ the number of degrees to which the products are raised, this sum will be—

$$·6656 \times (t° - 500°)$$

which is to be equal to the sum of the calories developed, that is —

$$·6656\,(t° - 500°) = 1800,$$

and for the temperature of combustion $t°$,

$$t° = \frac{1800 + 500 \times ·6656}{·6656} = \frac{1803·328}{·6656} = 2709° \text{ C.}$$

(This does not take into account the effect of the compression). Chevalier Bunsen made the temperature of combustion of pure carbonic oxide 3,042° C.; the above data give 2,979° C. The gas resulting from the 1st conversion of CO_2 in the above products into CO, viz., 47·09 per cent. of carbonic oxide gives a temperature of 2,221° C., independently of its initial temperature.

The cupola gas gives 1,900° C nearly, which, it is evident, is more than is required to heat the retorts or the air.

4. The carbonic oxide being 75 per cent., and the nitrogen 25 per cent., if we put the former $= W^1$, we have the latter $= \frac{W_1}{3}$, and the composition of the gas will be denoted by $W_1 + \frac{W_1}{3}$.

The oxygen required to burn this gas completely is $\frac{8\,W_1}{14}$ or $\frac{4\,W_1}{7}$

1*st Combustion*.—The CO_2 yielded is :—

$$W_1 + \frac{4\,W_1}{7} = \frac{11\,W_1}{7}$$

The nitrogen due to—

$$\frac{4\,W_1}{7}, \text{ is } \frac{77}{23} \times \frac{4\,W_1}{7} = \frac{44\,W_1}{23} \times 7$$

and the total nitrogen is—

$$\frac{W_1}{3} + \frac{44\,W_1}{23}$$

1*st Conversion*.—By passage through the kiln of anthracite or coke.*

* The blocks of anthracite, or coke, being continually heated by the gas of combustion, have all the advantages of Mr. C. Siemens' regenerating furnace.

To form CO from $CO_2 = \frac{11\,W_1}{7}$ we must add to it of carbon $\frac{6}{22} = \frac{11}{7} \times W_1$; thus giving of CO the weight $\frac{11\,W_1}{7} \left\{1 + \frac{6}{22}\right\} = \frac{11}{7}\left\{\frac{28}{22}\right\} = 2\,W_1$

The composition of the gas will now be,

$$2\,W_1 + \frac{W_1}{3} + \frac{44\,W_1}{23}$$

and its richness in CO will be measured by the fraction—

$$\frac{2\,W_1}{2\,W_1 + \frac{W_1}{3} + \frac{44\,W_1}{23}} = \frac{1}{1 + \frac{1}{6} + \frac{22}{23}} = \frac{47·09}{100}$$

2*nd Combustion*.—To burn this gas completely, the O required is—

$$\frac{8}{14} \times 2\,W_1 \text{ and the } CO_2 \text{ produced is } 2\,W_1 \left\{1 + \frac{8}{14}\right\}$$

$$= 2\,W_1 \times \frac{11}{7}$$

The nitrogen corresponding to O in the air is—

$$\frac{77}{23} \times \frac{4}{7} \times 2\,W_1 = \frac{44}{23} \times 2\,W_1$$

and the total nitrogen becomes—

$$\frac{W_1}{3} + \frac{44}{23}\,W_1 + \frac{44}{23} \times 2\,W_1 = \frac{W_1}{3} + \frac{44}{23} \times 3\,W_1$$

2*nd Conversion*.—To convert this CO_2 into CO, we require of O,

$$\frac{6}{22} \times \frac{11}{7} \times 2\,W_1$$

and the CO formed will be now,

$$\frac{11}{7} \times 2\,W_1 \left\{1 + \frac{6}{22}\right\} = \frac{7}{11} \times 2\,W_1 \times \frac{28}{22} = 4\,W_1$$

The composition of the gas will be as follows :—

$$4\,W_1 + \frac{W_1}{3} + \frac{3 \times 44\,W_1}{23}$$

Its richness in CO is measured by the fraction

$$\frac{4\,W_1}{4W_1 + \frac{W_1}{3} + 3 \times \frac{44W_1}{23}} = \frac{4\,W_1}{4 + \frac{1}{3} + 3 \times \frac{44}{23}} = \frac{39·71}{100}$$

The law of the progression is evident, as well as the economy of the process. These gases may be used in heating up the metal bath, but they may be better employed for the retorts and the boilers of the steam-engines. We may readily compute their temperatures of combustion, but it must be remembered, in employing the data above given, that, unless we take into account the temperature 2150 deg. C. at which it will be seen they rise from the bath, as well as the specific heat of the fuel employed to give the additional equivalent of carbon, we shall have our results much below the actual temperature of combustion.

It might seem that there is a loss of heat in the conversion of the CO_2 into CO_1, one volume yielding two; but this heat, 2,400 units for each kilo. of the gas, is in reality stored up, and is given out again upon its combustion. This is to be borne in mind when we come to the conversion of the carbonic acid-gas of limestone into carbonic oxide.

5. The blast-engine of from 250 to 300 horse-power, delivering at a pressure of 1·2 atmospheres, 1 cubic metre, or 35·3,198 cubic feet per second, required the weight of carbonic oxide gas injected into the metal bath, the gas containing it (viz., 75 per cent. CO and 25 per cent. N) being combined with the weight of air due to complete combustion.

Let W_1 be the weight of the gas required, then is $\frac{W_3}{3}$ the weight of the nitrogen combined with it. Let—

$$\left.\begin{array}{l} s_1 = \text{the specific gravity of } W_1 = \cdot 9{,}706 \\ s_2 \quad ,, \qquad ,, \qquad \frac{W_1}{3} = \cdot 9{,}760 \end{array}\right\} \begin{array}{l}\text{the sp.}\\ \text{gravity of}\\ \text{air being}\\ 1{,}000.\end{array}$$

As 1 cubic foot of air weighs 1·2 oz. avoir., if we make 1·2 the unit, we must put $s_1 = \cdot 9{,}706 \times 1{\cdot}2$, and $s_2 = \cdot 9{,}760 \times 1{\cdot}2$. Let W be the weight of air due to complete combustion, W_2 that of the nitrogen of the mixed gas, then the total weight will be—

$$(W_1 + W_2 + W) \times 1{\cdot}2 \text{ atmosphere.}$$

The total volume injected in one second will be the sum of the volumes of the air and of the component gases, that is of each component in the blast, and will be equal to the sum of their weight divided by their specific gravities respectively, that is, we must have in 1 second of blast—

$$\frac{W_1}{s_1} + \frac{W_2}{s_2} + \frac{W}{2} = 35{\cdot}3{,}198 \text{ ft.}^3$$

Now, $W_2 = \frac{W_1}{3}$ (by hypothesis). The oxygen required to burn W_1 is $= \frac{8}{14} \times W_1 = \frac{4}{7} W_1$, and the nitrogen of the air which furnishes this oxygen will be $\frac{77}{23}$ of its weight, so that we have

$$W = \frac{4}{7}\left(1 + \frac{77}{23}\right) W_1 = \frac{4}{7} \times \frac{100}{23} \times W_1$$

Thus finally we obtain—

$$\frac{W_1}{s_1} + \frac{W_1}{3 s_2} + \frac{4}{7} \times \frac{100}{23} \times \frac{W_1}{1} = 35{\cdot}3{,}198 \text{ ft.}^3$$

If we put 1·2 for the unit of air we get $s_1 = \cdot 9{,}706 \times 1{\cdot}2$, and $s_2 = \cdot 9{,}760 \times 1{\cdot}2$, so that the equation becomes—

$$\frac{W_1}{\cdot 9{,}706} + \frac{W_1}{3 \times 9{,}760} + \frac{400 W_1}{7 \times 23} = 35{\cdot}3{,}198 \times \overset{\text{oz. av.}}{1{\cdot}2} \times \overset{\text{atmo.}}{1.2}$$

Whence we obtain for the value of the weight W_1 sought—

$$W_1 = \frac{31{\cdot}3{,}198 \times \overset{\text{oz. av.}}{1{\cdot}2} \times \overset{\text{atmo.}}{1{\cdot}2}}{\frac{1}{\cdot 9{,}706} + \frac{1}{3 \times \cdot 9{,}760} + \frac{400}{7 \times 23}}$$

Effecting the numerical calculations indicated, we find

$$W_1 = \cdot 260 \times 1{\cdot}2 \times 1{\cdot}2 \times 35{\cdot}3{,}198 \text{ oz. av.}$$
$$= \cdot 82{,}648{,}332 \text{ lbs. av. per second of time.}$$

Thus the weight of carbonic oxide gas injected per hour is 2,975·333 lbs. In two hours (which for the present will be assumed as the utmost limit of the operation, in order to compare the results with those of ordinary puddling) the weight injected is 5,950 lbs., or nearly 2 tons 13 cwt. 0 qrs. 14 lbs.

If pure carbonic oxide be employed, the quantity blown in and burned in the same time is not quite four tons. This may be calculated by neglecting the second term in the denominator of the fraction, which term represents the nitrogen in the compound gas.

It has been shown that we can command, by admixture of the pure carbonic oxide with the cupola gases, 2 tons 3 cwt. (if need be) per ton of iron of the above gas, so that there is an ample supply for all purposes. We are thus able to insure any temperature of combustion from 1,900° C to 2,979° C, which, besides refining and converting the cast-iron, may enable us to form valuable alloys with other metals, which alloys have hitherto been thought to be hopeless on the scale of manufacture.

If we employ pure carbonic oxide, which it is probable, as we shall see presently, would be the most economical in time, labour, and fuel, and then convert successively in the products of combustion the CO_2 into CO, as above described, we shall find as follows:

	C O per cent. in the gas.	Temperature of Combustion. Deg.
1st Conversion ..	51.11 ..	2,355 C:
2nd ,, ..	41.07 ..	2,075
3rd ,, ..	37.40 ..	1,976

Pouillet found the point of fusion of "spiegel-eisen" to be from 1,050 deg. to 1,100 deg. C., and we see that our lowest temperature much exceeds it. Grey metal, according to his assays, melted at from 1,100 deg. C. to 1,250 deg. C.

The following is a table drawn up by M. Pouillet:—

Points of Fusion.

	Deg.
Of slighly fusible white cast iron	1,100 C.
Of slightly fusible grey cast iron	1,300
Of slightly fusible steel	1,400
Of malleable iron..................	1,600

Plattner makes the point of fusion of malleable iron 2,100 deg. C, and the author has taken this as the greatest heat to which the metal bath need be raised, though he regards M. Pouillet's as the better determination. It is, however, quite clear that the high temperature will insure the reduction of the protoxide of iron by the carbon of the metal, not to mention the other foreign elements.

6. I have calculated the temperature of combustion of the above several kinds of gases without reference to the purpose to which their heat is to be applied; we will now take the practical case of a metal bath containing ten tons of iron, and we will enquire "to what temperature the carbonic oxide blown in during two hours will raise such a mass of metal?"

We will take, first in order, the gas containing 75 per cent. of carbonic oxide, and 25 per cent. of nitrogen, of which we found that 5,950 lbs. are injected in two hours. We suppose that the gas and the air have an initial temperature of 500 deg., and the molten iron an initial temperature of 1,400 deg.

M. Scheinz, C.E., of Strasburg has fortunately given a series of determinations of the specific heat of two typical kinds of cast metal for every 100 deg., from 1,150 deg. to 2,000 deg. The mean of these at 2,000 deg. (the least favourable values for the author's method) is 1,914.

The kilogramme is little more than $2\frac{1}{5}$ lbs. English, so that if we take $\frac{5}{11}$ths of the above weight of 59·50 lbs., we shall have 2,704·54 kilo. $= W_1$ (above) and $W\frac{1}{3} =$ the combined nitrogen is 901·50 kilos. The oxygen for combustion will be $\frac{4}{7}\ W_1$ or the CO_2 will be $\frac{11}{7}\ W_1 = 4{,}249$ kilos. The nitrogen due to this oxygen in the air will be 5,130·42 kilos, the total oxygen will therefore be 6,031·92 kilos. With the above data we find as follows :—

Specific heat of CO^2 due to 1 deg.....		$2{,}704 \times \frac{11}{7} \times {\cdot}216$	.. 917·784
ditto	N	$6{,}031{\cdot}92 \times {\cdot}244$	.. 1,471·788
10,000 kilos. of	Fe.	$10{,}181 \times 1{,}914$	.. 1,948·643
Total specific heat for 1 deg.......			4,338·215

Calories due to	CO	$2{,}704{\cdot}54 \times 2{,}400^\circ$	.. 6,490,896·000
ditto	CO_2	$917{\cdot}784 \times 500^\circ$	.. 458,892·000
ditto	N	$1{,}471{\cdot}788 \times 500^\circ$	.. 753,894·000
ditto	Fe.	$1{,}948{\cdot}643 \times 1{,}400^\circ$	.. 2,728,100·000
Total calories......			10,371,782·000

If we divide the latter by the former, we obtain as the common temperature of the metal bath, and the products of combustion after two hours operation, 2,398 C.

Now, we do not require so great a heat as this. A temperature a little above the melting point of malleable iron, say 2,150 deg. C (taking the numbers of Plattner), would be amply sufficient to insure the fluidity of malleable iron or homogeneous iron, and, during the increase of heat up to that point, the reduction of the protoxide of iron in the ores employed. This reduction begins to be sensible at 650 deg. in the blast furnace.

7. We are led by this result to inquire what quantity of carbonic oxide, and what duration of the operation would suffice to give us this temperature of 2,150 deg. C.

In order to arrive at the solution of this question we must take the inverse of the preceding problem, and, assuming as an unknown quantity the quantity of gas required, proceed to determine its value by means of the preceding data and its relation to the temperature supposed.

Let then t be the number of kilos. of the gas required to raise 10,000 kilos. from 1,400 deg. to 2,150 deg., with a gas of this composition where t represents the carbonic oxide contained in the weight $t + \frac{t}{3}$ of the gas.

These t of CO give 2,400 t calories or units of heat. They require of oxygen to burn them $\frac{8t}{14} = \frac{4t}{7}$ forming $\frac{11t}{7}$ of CO_2. The nitrogen of the gas is $\frac{t}{3}$; that due to the oxygen of the air is $\frac{77}{23} \times \frac{4t}{7} = \frac{44t}{23}$ so that the total nitrogen will be $\frac{t}{3} + \frac{44t}{23}$. For a rise of 1 deg. of temperature the specific heat will be :—

$$\text{Of } \frac{11t}{7} \text{ kilos of } CO_2 \ldots\ldots \frac{11t}{7} \times {\cdot}216 = {\cdot}339\,t$$

$$\text{Of } \frac{44t}{23} \text{ ditto N} \ldots\ldots \frac{44t}{23} \times {\cdot}244 = {\cdot}475\,t$$

$$\text{Of } \frac{t}{3} \text{ ditto N} \ldots\ldots \frac{t}{3} \times {\cdot}244 = {\cdot}081\,t$$

$$\text{Sum} \ldots\ldots\ldots\ldots {\cdot}895\,t$$

10,000 kilos. of metal—$10{,}000 \times {\cdot}1{,}914 = 1{,}914$, making the total specific heat due to a rise of 1 deg. in the aggregate of products and metal $1{,}914 + {\cdot}895\,t$. (1)

For the calories we have :—

$$\text{From CO} \ldots\ldots\ldots\ldots 2{,}400\,t$$

$$\left.\begin{array}{ll} \frac{11t}{7}\ CO_2 & \text{at } 500^\circ \\ \frac{44t}{23}\ \text{N} & \text{ditto} \\ \frac{t}{3}\ \text{N} & \text{ditto} \end{array}\right\} \ldots\ldots\ldots\ldots 447{\cdot}500\,t$$

From 10,000 kilos. of metal at 1,400 deg.—$10{,}000 \times 1{,}400$ deg. $\times {\cdot}1{,}914 = 2{,}679{,}600$.

Total calories—$2{,}847{\cdot}500\,t + 2{,}679{,}600$. (2)

If we divide (2) by (1) we have the temperature t° of the bath and products of combustion :—

$$t^\circ = \frac{2{,}679{,}600 + 2{,}847{\cdot}500\,t}{1{,}914 + {\cdot}895\,t} = 2{,}150^\circ$$

From this equation we find $t = 1{,}554$ kilos., and the total gas is $t \times \frac{t}{3} = 2{,}072$ kilos. The time required for the injection of this 1,554 kilos. is 2 hours $\times \frac{1554}{2704} = 1$ hour 17 min. 28 secs.

It follows that, instead of two hours, as we assumed above for the sake of comparison and certainty of effect, less than one hour twenty minutes suffice for the operation, and that the cost in gas and labour, &c., will be proportionally diminished, while we shall obtain more heats in the 12 or 24 hours.

8. Let us lastly take the case of pure carbonic oxide. The weight injected in two hours will be found to be 6,797 lbs. avoirdupois, or somewhat above three tons. This is equal to about 3,090 kilos. in two hours. Let us, as before, suppose that we require t kilos. to raise 10,000 kilos. of metal from 1,400° to 2,150°, then the time required for this will be $\frac{2t}{3090}$ hours. The statement of the analysis will be as follows :—t kilos. CO give out 2,400 t calories or units of heat, requiring $\frac{8t}{14} = \frac{4t}{7}$ kilos. of oxygen to burn it, and forming $\frac{11t}{7}$ kilos. of CO_2. As the CO is at 500 deg., and the air also, the specific heat of $\frac{11t}{7}$ kilos of CO_2 will be $\frac{11t}{7} \times 500 \times {\cdot}216$ or $\frac{11t}{7} \times 1{,}000 \times 108 = 169{\cdot}714\,t$. The $\frac{4t}{7}$ kilos. of O import $\frac{77}{23} \times \frac{4t}{7}$ of nitrogen $= \frac{44t}{23}$ which at 500 deg. gives a specific heat of $\frac{44}{23} \times 500 \times {\cdot}244t. = 44 \times 1{,}000 \times {\cdot}122t. = 233{\cdot}400t.$ At 1,400 deg., 10,000 kilos. of cast-iron have 1,400 deg. $\times 10{,}000 \times {\cdot}1{\cdot}914$ of specific heat $= 2{,}679{,}600$. We have, therefore, of calories—

Due to C O	2,400 t.
„ CO_2 at 500 deg.	169·714 t.
„ N at 500 deg.	333·400 t.
10,000 kilos. of Fe at 1,400 deg...	2,679,600 t.

Total calories = 2,863·114 t. + 2,679,600.

In rising by 1 deg. we have of specific heat in—

$\frac{11}{7}$ kilos. of CO_2	$\frac{11}{7} \times$ ·216	·339
$\frac{44}{23}$ „ N	$\frac{44}{23} \times$ ·244	·475
		·814

∴ t kilos. will have ·814 t.; 10,000 kilos. of iron in rising 1 deg. take 10,000 × 1914 = 1,914 of specific heat.

If, then, we divide the total calories above by ·814 t × 1,914, we shall, as in the last case, have the common temperature of the products of combustion and of the iron, which we assume to be 2,150 deg. This gives us the equation in t:—

$$\frac{2679{\cdot}600 + 2863{\cdot}114\,t.}{{\cdot}814t. + 1{,}914} = 2{,}150 \text{ deg.}$$

whence it is found to be 1,290 kilos. nearly. The time required to inject this quantity will be $\frac{2}{3090}$ hours × 1,290, or a little more than 50 minutes.

At this point it is necessary to remark that the extreme heat of 2,150 deg. will be required only towards the end of the operation, when the carbon of the metal is nearly all taken up, and the metal is the least fusible. A temperature of less than 1,400 deg. will suffice to oxidise the silicium, the phosphorus, and the sulphur, and to reduce the protoxide of iron by the action of the carbon.

We shall revert to the results obtained in the last two cases when we come to calculate the cost in gas per ton of produce. Assuming that the above analysis and description of the process and of its attendant phenomena have established the soundness of the physical and chemical part of the process, it remains to consider it in the economical and commercial point of view. A finery hearth of 10 ft. by 5 area, with a depth of metal equal to the average depth of a charge in a Bessemer converter, would allow of the treatment of 10 tons of metal at a heat. Two hours were assumed as the possible duration of this treatment, but it has just been seen that, as regards the heat, from less than one hour to one hour 20 minutes is quite sufficient. In practice, we should commence with a degree of heat little, if any, above the heat at which the charge was run out from the cupola into the finery, and raise it by degrees, as should become necessary, to the full development of the reactions employed.

Two methods would have been selected for producing the carbonic oxide gas required, and a third is under consideration. The first is the calcination of broken limestone in close retorts by means of waste gases, and the conversion of the carbonic acid gas evolved into carbonic oxide in connected retorts containing anthracite coal or pure clean coke. When there are blast-furnaces, calcined lime is obviously beneficial as well as economical, were it only that it would prevent the cooling of the furnace by its change of volume in becoming changed into carbonic oxide, and by its own change from the solid in the stone to the aeriform state which must take place somewhere with the absorption of latent heat. For the rest, it can be more cheaply calcined in retorts with the waste gases than in the ordinary limekiln.

A second mode is the employment of the gas produced by passing highly heated steam over incandescent coke or anthracite coal. The hydrogen contained in such gas, however, limits the proportion in which it may be safely mixed with cupola or other gases, while the vapour of water formed by its combination with oxygen, or combustion, with its great specific heat, would reduce the temperature.

Estimate of the probable cost of carbonic oxide produced by converting the carbonic acid gas of limestone calcined in retorts heated with waste gases, and passed through adjoining retorts, containing anthracite coal or coke.

The limestone contains—lime, 54.10; carbonic acid, 42.20; and it requires about two hours for its complete calcination. The cost of the limestone, labour, &c., are paid by the lime produced. One ton of limestone yields $\frac{42.2}{100} \times$ 20 cwt., or 8.44 cwt. of CO_2. To convert this 8.44 cwt. of CO_2 into C O, we require $\frac{6}{22} \times$ 8.44 = 2.30 cwt. of carbon, forming 10.70 cwt. of C O. To yield this 2.30 cwt. of carbon, we require of anthracite coal (91.44 per cent. of carbon) 2.62 cwt., say 275 cwt. Thus our amount stands—

	s.	d.
8.44 cwt. of CO_2	0	0
2.75 cwt. of anthracite at 12s. per ton....	1	8
Two hours' labour, one man to 4 retorts .	0	10
Wear and general expenses	0	2
Cost of 10.74 cwt.	2	8

Or about 5s. per ton.

In forming this gas of 75 per cent. C O and 25 per cent. N., we employ 58.745 cwt. of pure C O and 22.362 cwt. of cupola gas. The latter gas contains only 34.42 per cent. of C O, or 7.67 cwt. of pure C O. The total C O due to both sources will be 66.41 cwts., of which the pure C O is 58.74. We must, therefore, take $\frac{58.74}{66.41}$ of the 1,554 kilos. of C O, or 3,419 lbs. av., as that part which costs 5s. per ton. This amounts to 3,024 lbs., which, at 5s. per 2,240 lbs, amounts to 6s. 9¼d., being 81.25d.

If, now, we divide by 10 the number of tons treated at a heat, we find the cost per ton of iron balls to be as nearly as possible 8d. per ton. The cost of melting is 3½ cwt. at 12s. per 20 cwt., or not quite 2s. 2d., so that the total cost of fuel is 2s. 10d. per ton of balls or blooms. It is premature to offer an estimate of the cost of labour, but, allowing liberally for one engineer, one sub-engineer, one labourer, and two head finers with two aids, we find the total cost per heat of 10 tons to be 2s. 6d., or 3d. per ton of metal ready for balling. To this have to be added the cost of the iron ores and that of caustic soda, which latter, for the worst metal, is now 7s.* per ton; the ores costing about 9s. 6d.† This is a total of 19s. 7d. per ton of metal balls. Against this we have to set the gain in produce of 20 per cent., or from 4 to 5 cwt. of iron (the produce of the iron ore employed to oxidise the impurities and the carbon of the metal), which, at only 6s. per cwt., is from 24s. to 30s. In puddling we have coal 15s.; labour, per ton, 12s.; fettling, at least 3s., with other expenses, amount-

* Exceptionally high; it was only 3s. 6d. in 1870.

† At present high prices.

ing in all to above 30s.; so that, even with the present high prices, there is a saving of not less than 10s. a ton, independent of any gain in produce, or any question of quality and price. Moreover, this is the cost of common impure metal, which cannot be made to yield good iron at all in the puddling furnace. Good metal requires very little soda, and only iron ore enough to discharge the carbon (about 3s. 6d. cwt.) at some 5s. per ton, the gain in produce being $5\frac{1}{2}$ cwt. per 20 of metal. It must be distinctly understood, therefore, that all that part of the above cost per ton which exceeds 2s. 10d. for labour and gas, and 5s. for iron ore to take up the carbon (a total of 7s. 10d.) is laid out solely for the purpose of making good bar iron out of bad and intractable metal without loss in yield.

The cost per ton of carbonic oxide prepared by the third method under the author's consideration is 6s. 2d. The cost of its consumption (2,838 lbs.) per ton of produce is about $9\frac{1}{2}$d., and adding to this 2s. 2d. for the melting, makes the total cost of fuel per ton of iron about 3s. To this the preceding remarks equally apply. It might seem, at first, that this cost of preparing carbonic oxide in retorts is too low. It is necessary, therefore, to state that all the materials for making the gas will be charged into the retorts by machinery of very simple construction, which dispenses with manual labour.

The materials, being prepared for the retorts, descend through a hopper into a long gutter, furnished with apertures above the retorts, which apertures may be closed at will. In this gutter an archimedean screw, shaped like a flat-wormed cork-screw, revolves and carries forward to the apertures the materials, which drop through into the retorts. The retorts are so constructed as to admit of being closed by a mechanical movement, and of being discharged similarly. With such an apparatus two men may attend to a hundred retorts.

We may illustrate as follows the gain in the yield of 20 cwt. of metal:—

1. The usual loss of 8 to 10 per 100 in puddling (say 8) is 1·6 cwt., which is saved. The metal contain- 3 per cent. of carbon, this requires (it being on 20 cwt. 6 cwt.) $\frac{3}{5} \times \frac{8}{6}$ cwt. of oxygen to form carbonic oxide, or $\frac{4}{5}$ cwt. The protoxide contains in nine parts two of oxygen and seven of iron. If then x be the weight of it required, we must have $\frac{2x}{9} = \frac{4}{5}$, or $x = 3{\cdot}6$ cwt., which, at 30s. a ton, is 5s. $4\frac{3}{4}$d. The iron reduced from this protoxide will be $\frac{7}{9} \times 3{\cdot}6$, or 2·8 cwt. This added to 1·6 makes a total gain of 4·4 cwt.

Only the richest and purest ores are to be used, but still a small allowance is to be made for earthy matter; this, at 10 per cent. would be 36 cwt. In fact, it would rarely exceed five per cent., so that if we allow 4 cwt. it would be ample, and this leaves a clear gain of 4 cwt.

If we suppose in the ores which contain much silicium, phosphorus, &c., that these elements, upon their oxidation, reduce the iron ore, the increase of yield would be larger. The increase above estimated cannot be unreasonably large, for Mr. Danks claims to have increased the yield by 15 per cent., which is 3 cwt. at least. There cannot, it is submitted, be much doubt that at so great a heat a sensible quantity of sodium would be reduced and thrown into the metal. This would, as Baron Gruner and Professor Miller have suggested, have a powerful effect in purifying the iron in the re-heating operation.

Much, however, has yet to be learned as to the behaviour of the iron, of its impurities, and of the reactions to which it would be submitted at these high temperatures; but there is good ground for hope. Mr. Bessemer is said to have tried the nitrate of soda with his air blast; but Baron Gruner states that in the presence of fire-brick this is quite illusory as regards the expulsion of phosphorus, in fact a pure waste of the re-agent.

It has been stated above that the iron may be "balled" by machinery when it is "coming to nature." This observation, however, had reference much more to the possible preference of the iron-master than to any supposed necessity for the operation. The fact is that the iron at so high a temperature, though malleable, remains in fusion, so that it may be cast into blooms ready for the hammer and the rolls, when sufficiently set by diminution of the temperature. This process, being nearly mechanical, would be far less costly than that of balling, while the iron would be free from scoriæ and "cleaner" (in the phrase of the trade). In truth, the whole process is chemical and mechanical from beginning to end.

It is hardly necessary to add that the crystalline structure of the metal will be broken up by the hammer and the rolls and replaced by the fibrous.

NOTE I.—Since the above was written the author has found two ores of iron admirably suited to this process—the "Marbella" magnetic ore, and the "Iscrine," or Titaniferous magnetic ore, in the state of a fine sand, both of which may be obtained to almost any amount at about 30s. per ton. The "Marbella" would be greatly improved if ground up with one-fourth of its weight in "Ilmenite," in which the oxide of Titanium attains to 40 per cent.

NOTE II.—If it be the object to obtain very superior iron or steel for special purposes from cast iron free from impurities, nitrate of soda may be employed. This being injected with the blast (which in such case need not be heated) in small quantities at a time would have all the effect of the Heaton converter, without its waste of the nitre, The cost per ton of iron would be trifling, such metal being practically free from sulphur and phosphorus.

DISCUSSION.

Mr. Lowthian Bell, F.R.S., said it would require a careful consideration of the paper, before one could attempt to deal properly with the speculations it contained, and he had even followed it with some little difficulty, and was not quite certain he understood the drift of some of the observations. Sir Francis began by eulogising, as he understood, the Heaton process, which consisted in the application of nitrate of soda, a substance well-known to chemists as possessing a high de-oxidising power in the manufacture of iron and steel, and using it instead of atmospheric air. Much stress was laid upon the necessity of calculating as accurately as possible the amount of base which would be required in removing the phosphorus and sulphur, but in practice it was quite impossible to apply exact science in such a way, for this simple reason that this substance was readily decomposed in the absence of all

substances having an affinity for oxygen, a high temperature alone being quite sufficient. In fact, it was one of the ordinary methods used for generating oxygen gas, nitrate of soda being decomposed at a temperature far below that required for melting iron. With respect to any importance which M. Gruner attached to that operation, he fancied Sir Francis must be under a mistake, because he knew that gentleman personally, and had met him at the works in question, when they both agreed in an opinion, in which they were confirmed by the observation of Mr. Williams, that the process could have but one termination, that of failure. Whether or not M. Gruner detected the presence of sodium in the steel was not of much practical moment, but it very much surprised him to hear such a statement made, because he had submitted for some honrs the gases escaping from the non-oxidising zone of an iron furnace to experiment, in order to ascertain whether or not any vapours were carried away in the blast containing a trace of either potassium or sodium. It was quite consistent with theory that there should be a large quantity of these metals, because every large blast furnace contained a quantity of these metals in combination with cyanogen. It therefore became a matter of great interest to determine whether or not any trace of those two metals could be found in the gases, and to put the matter beyond all doubt he had some holes drilled in the sides of a furnace, in a locality where, if the metal could exist at all, it would be found, being in the presence of no oxidising gas, the only gas being carbonic oxide mixed with a quantity of nitrogen. He conducted that gas for many hours through mercury, which was a ready solvent of potassium and sodium, but after several hours he was unable, on carefully testing the mercury, to find the least trace of either of these metals. He then introduced into the mercury itself a slight trace of potassium—as far as he remembered, a mere fraction of a gramme to a kilo—and it immediately made its presence known in the usual way. He therefore doubted exceedingly whether Gruner did detect sodium under the conditions described by Sir Francis. Passing now to the proposal to deal with ten tons of metal by blowing in carbonic oxide, there could be no doubt that, under the circumstances, a high temperature would be produced, but whether high temperature and its accompanying chemical products would have the effect upon phosphorus or sulphur or silicon anticipated, was one of those things which he thought any one would be very rash in expressing an opinion upon until it had been submitted to experiment. As he understood, this had not yet been reduced to practice, and until that was done he must decline to give an opinion as to the effect. He might perhaps, however, be permitted to say that he did not quite entertain the views expressed by Sir Francis, if he thought that Leverrier and Adams had no better grounds for supposing their calculations correct than he (Sir Francis) had in the present instance. Then, with regard to obtaining carbonic oxide cheaply by heating carbonate of lime in retorts, that was a proposal made public a year ago by Mr. Schintz, who went through a most laborious set of experiments on the production of fuel with the elimination of nitrogen in order to avoid the immense quantity of heat which is carried off in blast and puddling furnaces by the large volume of nitrogen ordinarily present. He sought to eliminate the nitrogen by the method proposed by Sir Francis. He could not say at the present moment what were the results of the calculation he had made—how many thousand retorts, and how many acres of ground would be required, in order to produce carbonic acid, and subsequently convert it into carbonic oxide; but he perfectly well recollected the conclusion he came to that the scheme itself was totally impracticable. Another problem brought forward was that of producing steel directly from the ore. That was a process now in embryo. Theoretically it might be correct, and Mr. Siemens was now engaged in extensive experiments, the results of which he hoped would soon be published. Lastly, with regard to the possible influence of cobalt upon iron, he was not personally acquainted with the great cohesive power possessed by cobalt, but assuming this to be true, it by no means followed that, when used in an alloy, it would in the least degree beneficially affect the metal with which it was united. For instance, carbon possessed no power of resistance whatever, but yet if only one-half per cent., or a little more, was introduced into iron, it immensely added to its power of resistance. The converse might well hold true, and alloying iron with cobalt, instead of adding to its tenacity, might have an opposite effect. But assuming this good effect, Sir J. Herschel, when he made that recommendation, had not, as he understood, informed Sir Francis where he would obtain an amount of cobalt sufficient to alloy the seven millions and a-half tons of pig iron annually made in this kingdom.

Mr. Williams said he was not competent to discuss the chemical part of the subject, but he was under the impression, from such knowledge as he had, that it would be extremely difficult and costly—if not impossible—to produce a gas containing 70 or 80 per cent. of carbonic oxide by the method suggested of collecting carbonic acid from the calcination of limestone in retorts, and then passing it through a coke fire. Sir Francis Knowles seemed under the impression that iron could not be well or properly puddled by mechanical means, but, that being a part of the question with which he was better acquainted, he could assure him that it was an entire mistake. After experiments with a couple of revolving vessels, extending over a year, he had come to the conclusion that no hand puddling could be anything like efficient. Unfortunately they had as yet no machinery for doing the work cheaply enough; but as regards quality, there was no doubt whatever that the wrought iron produced from the machines was practically free from phosphorus, sulphur, and silicon. Not only so, but the yield was much greater than in the old hand furnace. In the old system the process was to stir up the iron with a rabble, exposing it to the air, which oxidised the impurities and likewise the iron, the effect being that there was a loss probably of 15 per cent. of iron by the very best hand puddling. By the revolving vessel, however, there was an actual gain, the quantity of wrought iron brought out being greater in weight than the pig-iron put in, notwithstanding that something like 7½ per cent. in the shape of sulphur, phosphorus, silicon, &c., had been eliminated. The revolving vessel was lined with oxide of iron, over which the liquid iron was rolled, the effect being that the lining was deoxidised, and the impurities he had mentioned eliminated. He thought it unlikely that nitrate of soda, or any other chemical introduced into the iron, could effect this result with anything like the same economy. To see the Heaton process, he went by invitation twice, at the interval of a year, being accompanied by one of the best practical iron makers in England, and after watching it for a day each time, they came to the conclusion that, as a system of practical iron or steel making, it was an entire failure; the samples they brought away were analysed, the result in each case showing only slight elimination of sulphur and phosphorus; in fact, there was much more phosphorus remaining than in Cleveland iron puddled in the old way. It seemed to him that the puddling of iron in a revolving vessel, lined with oxide of iron, was the most promising of all improvements at present before the public. Owing to the difficulty of puddling, it had become an article of belief that to produce a certain quality of bar you must have scarce and expensive brands of pig iron, but this he believed to be a mistake, and that not quite absolutely perhaps, but very broadly, the quality of the result depended upon whether the iron was

puddled or not. If it were thoroughly puddled you had good wrought iron, almost chemically free from impurities. If you had iron charged with a considerable quantity of sulphur or phosphorus, no hand puddling would bring it out, and therefore the result was bad. The difficulty of puddling iron was enormous, even at the best of times, when labour was more easily controlled than at present, and now it was more difficult still. When, therefore, it was desired to produce iron of very good quality, it was necessary to find pig iron that did not contain the injurious elements which ought to be puddled out of it, and thus, not having them in the pig, a good quality of bar iron was produced. On the other hand, with a revolving vessel lined with oxide of iron, the quality of the pig was a less important matter. He failed to see what margin there was for introducing expensive chemicals, and preferred the revolving furnace, which got rid of the impurities effectually. The enormous heat spoken of, something like 4,500° F, was something they had had no experience of, and he was inclined to think that if it could be produced in any furnace for the manufacture of iron or steel, it would be impossible to find materials to stand for long.

Professor Tennant remarked that the titaniferous oxide of iron, which had been referred to as coming from New Zealand, was really a menaccanite, which had been used for many years in small quantities, but could not be introduced practically into the manufacture because, although you could get a few pounds, or perhaps a few tons, comparatively pure, when you came to get a cargo it was always mixed with a large quantity of extraneous matter which was injurious to the steel and iron. It might be got from Vesuvius, or the northern part of Germany; in fact, it was very widely distributed over the world, but under all circumstances it was liable to these impurities. It always contained phosphorus and other matters which were found in volcanic rocks.

Sir Francis Knowles said he might have misunderstood Mr. Bell with regard to the blast furnace when he mentioned cyanide, but it did exist in large quantities, as he might possibly have seen in the embouchure of the furnace. It might exist without traces being found in the vapours which he had examined, because the function of the cyanide of potassium was very peculiar. There could be no doubt that it rose up from before the blast, and exercised a very powerful reducing action on the iron. When it ascended to a certain height and had acted as a reducing agent, it no longer existed in the form of cyanide, but became again oxidised at a certain level, and was really potash. It then re-descended towards the blast, was again caught by it, and the cyanide of potassium in that form, with the nitrogen of air and the alkali, re-ascended. It was occasionally thrown out, and was found outside in large quantities; he had even found that the women in South Wales used it as an alkali for washing, though it was not very suitable for that purpose. It might well be quite consistent with Mr. Bell's observations that he might not have detected potassium or sodium in the vapour from the furnace; but he heard some time ago of a family in Durham being asphyxiated by a crack in the blast furnace from which the vapour had issued. He had hardly touched the question of the function of sodium when it entered as an alloy, but Professor Muller and Baron Gruner had published their observations to the effect that they considered sodium thrown into the iron, particularly referring to the Heaton process, had the effect of forming a volatile compound with the remaining sulphur and phosphorus, and in that way eliminating those elements from the iron in the ulterior stages. He was unable to speak on this point from his own experience, but he was inclined to think there was a great deal in it. At any rate, Baron Gruner distinctly stated that he saw the grey vapour of sodium ascending during the operation. As had been observed, oxygen might be derived from the air, or from oxide of iron, but the peculiarity in this case, which had always struck him in the use of nitrate of soda, was that the oxygen when it took effect was in the nascent state. Now, the effect of an element in the nascent state was not the same as its effect in another state. For instance, the effect of oxygen in the air was not the same as that of oxygen at the moment of escaping from its combination with another substance; it was generally believed to possess a totally different property under such circumstances to the crude oxygen in the air. Probably that was why it operated so powerfully in withdrawing the phosphorus from iron. He did not know what proportion was desirable, but thought Professor Miller's results showed that 80 per cent. of the phosphorus in the iron was expelled. That was a matter of fact, stated in Professor Miller's report, and he believed the same thing was stated in Baron Gruner's elaborate pamphlet on the Heaton process. Unfortunately that came to an end from a cause which was not generally known, but which had nothing whatever to do with the process itself. He believed that it was generally considered to be a process for the final treatment of iron, whereas he had always considered it merely as a fining process. So also was that which he had now brought forward, although he believed it might be carried to such a length as to allow of running out the malleable iron into moulds. It might be a question whether any materials would stand the intense heat he had mentioned, but Mr. Siemens had come very near to it, and found his new materials stood it very well. Of course it could only be decided by experiment, but if a furnace could be made to stand, it seemed to him there would be immense advantages arising from driving the heat through the body of the metal in connection with the re-agents employed. It was simply a question between one re-agent and another, because the oxide of iron with which the revolving furnaces were lined was a re-agent. He had already given a caution, that although there was such a temperature at command, it by no means followed that it should be employed; it would depend upon the amount of iron operated upon; 20 tons would require a greater heat than 10. The metal would be quite as much puddled as in a revolving furnace, because the gases rising up through it would effectually stir and mix up all the ingredients. With regard to the manufacture of steel, he had merely introduced that incidentally, because he believed the process would readily lead itself to that result. As to the apparatus for making carbonic oxide, he had two other processes by which he could produce it in very large quantities, by one of which, now under trial, he believed it could be made at a profit. Still, the plan described was so exceedingly simple, and caused so little wear and tear, that he should probably prefer it. He had the gas completely under control, and it was well known that carbonic oxide possessed higher heating power than the weight of carbon contained in the gas if perfectly consumed, so as to produce carbonic acid gas, by about 20 per cent. The only part of the process he had actually tried was the chemical re-agents, and as to them he could only say that if Mr. Bell would put a furnace at his disposal and a puddler, he would undertake to produce from the worst specimen of iron which could be got samples of metal which would probably surprise him. His main object was to produce as perfect iron as possible out of materials at command; in fact, the problem he had set before himself was to produce a quality of iron equal to Staffordshire bars out of the newly found deposits in the north of England.

The Chairman, in proposing a vote of thanks to Sir F. Knowles, said there could be no doubt of the deep importance to the country at large of the question which had been so ably treated that evening; and, seeing how generally it was the case that men discussed these subjects from the standpoint of their own knowledge, and with an application simply to the materials with which

they were in the habit of dealing, he hoped that when the paper and the remarks which followed upon it were published in the *Journal*, others would be found to take it up and treat the subject on a broader basis. What was wanted was to collect and bring to a focus all the information that could be obtained on the whole question of iron, not simply on iron of one particular character; and if gentlemen interested in the manufacture would do their best to enlarge the scope of the inquiry in this way, he was convinced they would be rendering the country a great service.

The vote of thanks having been passed unanimously and briefly acknowledged,

Mr. Evans said he should be happy to place a furnace at the Bowling Iron Works at the disposal of Sir Francis Knowles for the purpose of experiment.

FOOD COMMITTEE.

The Committee met on Friday, November 21st. Present:—Benjamin Shaw, Esq., in the chair, Lord Alfred S. Churchill, Sir Daniel Cooper, Bart., Dr. Blakiston, Messrs. F. A. Abel, F.R.S., W. H. Michael, Seymour Teulon, and E. Wilson. This meeting was specially summoned to receive a report from Mr. James Harrison, of Melbourne, with reference to his experiment in the conveyance of frozen meat on board the ship *Norfolk*, from Australia to England. Members generally were invited to it, as well as other gentlemen specially interested in the subject.

Mr. Harrison read the following paper:—

It would have been more pleasant to me, and gratifying to you, if I had come forward to announce a success instead of having to account for a failure; but it is some satisfaction to know that the work in which I have been engaged was a success before it was a failure—a fact which renders the present temporary disappointment the more easily borne. My task is indeed twofold—to describe a success and to record a mischance. The success was that of a principle and a process; the failure was that of the workmen who were entrusted with the construction of the requisite mechanical appliances. But in saying so, I do not seek to shield myself from a fair share of blame. It was my duty to see that the appliances were sufficient, and my only excuse is that I could not recall the time wasted by others. I had allowed myself a week for supervision, but even on the last day the work was not finished, and it was then too late even to abandon the experiment. But I am anticipating. I merely throw out these remarks at the outset to bespeak a favourable hearing; not that I have any reason to fear the contrary, for it is my greatest consolation to find that, despite this failure, I have been cheered by assurances, both from acquaintances and strangers, that there is a very general confidence in my ultimate success—a confidence which I will endeavour to justify.

Descending from generalities to particulars, I may be allowed to say that, from my previous habits of thought and experience, I felt myself well qualified to grapple with the problem I have attempted to solve. On the occasion of my last visit to England, 17 years ago, I introduced my process of ice-making by the evaporation and condensation of ether—a process which, as is known to many of you, became at once a pronounced success.* The very first machine I had constructed was as good as any that has been made since; and this success was achieved by careful forethought and minute attention to details. For many years, however, I had ceased to take any interest in that invention, and it was not until the great food question—the problem how best to convey the superabundance of one-half of the world to satisfy the wants of the other half—became urgent, that I felt called upon to resume my old studies. I took my time, and went over the matter carefully. The conclusions I arrived at, and my reasons for them, I will now briefly recount. The various plans for producing cold on board ship by means of machinery and apparatus requiring fuel are open to many and serious objections. The use of ether is undesirable, on account of the inflammability of the material. Ammonia is a powerful refrigerant, but the pressure under which it would have to be used when within the tropics is so enormous that it is questionable whether vessels which could be relied upon for containing it can be made. This pressure may be diminished, but with corresponding loss of efficiency. The use of air condensed and expanded by machinery is the most plausible, and I may say, fascinating, of these devices, but it is also the most expensive. All these schemes are open to the objections that considerable space is required for the apparatus as well as for fuel, and that their success depends upon the efficiency of complicated machinery, which would have to be erected in duplicate. It appeared to me that the expense of these processes would be too great to permit of their adoption. No doubt, with meat at a penny per pound in Australia and a shilling in England, there is a margin broad enough apparently to warrant any outlay. But the very essence of the problem is here overlooked. The object should be to assimilate as nearly as possible the prices at the port of supply and at the port of debarcation. It is not how to buy meat at a penny and sell it at twelve pennies, but how to raise it to fourpence at one end and lower it to sixpence at the other. The process of meat-preserving, to be satisfactory, must be inexpensive as well as effectual. The use of ice alone is, within certain limits, sufficient, but is not generally reliable. If not entirely surrounded by ice, the temperature of the meat will be some degrees above freezing, while its juices remain fluid some degrees below that point, and while fluid they are liable to chemical as well as organic change. The presence of moisture where there is ice is not easily preventible. Something more than ice is wanted. Even if it be not requisite to freeze the meat (and on this point there is room for much discussion), it is certainly desirable to have the control of a very low temperature. This is requisite, even though the desired average should be above 32°, just as it is requisite to have a good fire to boil a kettle of water; it would be slow work if the fire were no warmer than the steam. In my search for a cheap refrigerant, I, of course, could not but take cognisance of the oldest of all freezing mixtures, ice and salt. Everybody knows how this mixture is made to do daily service in the production of ice-creams, but the received idea of it is that it is rapid and transient in its action, and there is at first something startling, if not ridiculous, in the proposition to take a shipment of ice and salt through the tropics. It did not appear very promising at first sight, but, after careful consideration and a few experiments, I arrived at the law which governed the conduct of this and other freezing mixtures when partially isolated from surrounding influences. I found, in fact, that a mixture of ice and salt melts no faster than would the ice itself under an equivalent difference of temperature. If we take an ice-chamber at 32°, with the outside atmosphere at 82°, the difference of

* In support of his claim to be considered well-fitted to investigate the subject, Mr. Harrison read the following note from Professor Tyndall, which he had just received:—"Mr. Harrison. Dear Sir,—I clearly remember accompanying Professor Faraday on a visit of inspection to your ice machine; and I have an equal recollection of the pleasure we both experienced in witnessing the performance of the machine. I afterwards experimented with the machine myself; and from first to last was impressed with the honesty and the thoroughness with which you had worked out your problem. That the machine has many useful applications as regards the preservation of meat I do not for a moment doubt. In expressing this opinion I believe myself to be aiding a worthy man and a worthy invention.—Yours truly, John Tyndall."

temperature is 50°. If, again, we take a mixture of ice and salt at zero, with the external air at 50°, the difference is the same; and we will find that the freezing mixture and the ice alone melt at the same rate. But if the atmosphere be at 82° in both cases, we shall then have the melting of the ice and salt and of the ice alone in the ratio of 82° to 50°; or if we adopt a time measure, the ratio is inverse, the mixture melting in 50 hours or days, and the ice melting in 82 hours or days. But we do not want so low a temperature as zero, and I then had to consider how it could be regulated. Ice and salt are usually mixed together with a great expenditure of animal heat and sweat, but it occurred to me that a more certain result could be attained with little labour, by directing a stream of brine among the ice, the strength of the brine being regulated so as to produce the required degree of cold. This, on experiment, was found to answer well, and the law by which the temperature was effected was found to be very simple. It requires just one per cent. of salt in the water for each degree below 32°. Five per cent., or half-a-pound of salt in the gallon, reduces the temperature to 27°, a very convenient point for meat freezing. The melting of ice subjected to this process as compared with ice alone, is in the ratio within the tropics of 55 to 56. In other words, in order to attain the control of 5 degrees below the freezing point, it is only requisite to ship one ton of ice for every ten tons that would be requisite to maintain a temperature of 32°. Of course, I assume that the actual freezing of the meat has been accomplished before starting. The importance of establishing these two points, the law of the melting of freezing mixtures and the proportion of brine required to produce definite results, will be at once seen. They do not deserve the name of discoveries, but they are, so far as comes within my knowledge, inferences drawn and demonstrated for the first time, and as such I submit them. They will be of value to all who turn their attention to this subject.

I next investigated the best means of employing the brine thus artificially cooled to the preservation of the meat. There was no difficulty about that. To allow it to circulate in tubes round the enclosed chamber was the most obvious plan, but tubes are expensive, and must have many joints. I preferred to make the meat tank double, and to allow the brine to circulate in the interspace. To remove pressure, and to diminish the risk of leakage, I filled the space with sheets of coarse blanketing, hanging loosely, so that the brine should keep them continually wet, and yet not run away too fast. The surplus I pumped up occasionally to be used over again. This pumping, for which the labour of one man for two or three hours a day suffices, is all the work attached to the process.

There was one other matter which I had to make the subject of research and experiment before my plans were complete. I had to ascertain the relative properties of the heat-resisting materials available for forming the protecting envelope of the meat and ice chambers, and to ascertain the rate of melting under different conditions. The relative merits of sawdust, charcoal, wool, tallow, and analogous substances are but indifferently known, and they are usually applied as regards their thickness and distribution according to no recognised rule. It is correctly laid down in the text-books that heat is conducted through any substance in the inverse ratio of its thickness, or, in other words, that heat is obstructed in its passage through a given substance in direct proportion to the thickness of that substance, each kind of material having its special coefficient of conductivity. But, in the practical application of this law to enclosed spaces, a difficulty arises. At first, it would seem that if one foot of thickness gave a certain amount of protection, two feet would afford twice as much; but it is not so. The inner or cold surface is necessarily less than the outer or warm surface, and with every additional layer the disproportion increases. The results will be equally erroneous, whether the inner or the outer surfaces be taken as the basis of calculation, and what is true of a small enclosure will not be true when applied to a larger. It occurred to me that, to ensure accuracy, it would be requisite to ascertain the position and extent of an intermediate neutral surface, or line of mean temperature. There are difficulties in the way of ascertaining this by experiment, but I have ascertained with, I think, sufficient exactness for practical purposes, the approximate law by which this line is to be found. The warm moiety of the envelope is to the cold moiety as the outer is to the inner surface. If, for instance, the outer surface is of double the extent of the inner, the neutral line will be found at a distance of one-third of the thickness from the inner surface and two-thirds from the outer. Even this is only true when the enclosure is spherical. If it be a cube the masses of envelope at the angles will exercise a disturbing influence and carry the neutral line nearer to the inner surface than at the sides. If the masses at the angles were absolute non-conductors, then the neutral line would be found equidistant between the inner and outer surfaces at the sides; but if of the same material as the sides, then the neutral line will be a curve of variable radii, the cold moiety of the envelope being thickest at the centre of each side, and thinnest at each angle. It is not requisite to go into the mathematics of the problem to see the great importance of fortifying the angles by the employment of the best heat-resisting material in the construction of the envelope at these points, while it would be thrown away if used in the centre of the sides. It is with a heat-resisting envelope as with a fortress—its strength is that of its most vulnerable point.

With respect to the relative value of heat-resisting substances, my experiments were limited to those which I found practically available in the colony. The properties of sawdust are well known, and I adopted that as the standard of comparison for tallow and bark, the articles of produce best available for shipment. Tallow I found to be inferior to sawdust in the proportion of three to two, that is, the ice surrounded by tallow lasted only two-thirds of the time it lasted when packed with sawdust. Bark, roughly ground or finely chopped, was as good as sawdust, and when finely ground was even better. It is also superior to sawdust, inasmuch as it is not so liable to heat when damp. This was exceedingly satisfactory, wattle bark being a staple export for which there is always a market in England. I therefore used it, packing it in bags, and filling up the interstices with sawdust. Charcoal was not obtainable in quantity on short notice, but I tried pounded gas coke, and found it, contrary to expectation, far inferior to sawdust, and no better than tallow. Wool I did not try, as it is a material too valuable and delicate to employ as mere dunnage.

My experiments on the waste of ice, and of ice immersed in brine, were made on three several occasions at different times of the year. The temperature of the air and the waste of ice were noted daily, and the results posted up on the outside of the enclosure in the Exhibition building, so that they might be tested at any time. From the data thus obtained I shipped on board the *Norfolk* a quantity which should have lasted 120 days. That there was no error on this score I am confident. But it was not until the fourteenth day that I discovered that there was a strong current of air passing downwards among the ice, and escaping, of course, at a lower point into the hold. The fittings were, indeed, defective at the very points where I was most solicitous about their efficiency. When my back was turned, the carpenters, who were not quite sober, covered up their scamped work, and the stevedores had it banked up with cargo before it could be inspected. It was not until the greater part of the meat was thrown overboard that I could secure the remnant of ice from rapid waste. During the first thirty-seven days, in the coldest part of the run, I

lost 20 tons of ice, and I carried the remaining 5 tons for thirty-nine days, including the run through the tropics. This of itself is collateral evidence of the correctness of my estimate, and of the abnormal waste of ice caused by defective fittings.

Throughout my experiments I attended to the desiccation of the air of the meat-chamber, so as, in fact, to keep up a slow but constant evaporation from the surfaces of the meat. In experiments on a small scale, I found it sufficient to place in one corner a wide-mouthed bottle containing fragments of chloride of calcium; but on board ship I placed the chloride in a separate compartment, with tubes leading to and from it in such a position as would ensure a continuous circulation of the air of the meat-chamber. This arrangement was, however, rendered nugatory by leakage into the meat tanks, from one of which three, and from the other seven, bucketsful of brine were taken after the meat was removed. But I do not care to go much into these details. To me they are simply sickening. The greatest loss was that of the brine, which leaked away, instead of doing the work allotted to it. This loss I reported to the captain of the vessel within seven days after sailing, and on the eighth day the chief officer called my attention to the discolouration of the bilge-water brought up by the ship's pumps, attributable, as he thought, to the admixture of my brine after percolating through the bottom tier of wattle bark. There could be no doubt of it. The bark and the brine, impregnated with iron from the tanks, formed a kind of ink which recorded its own history.

I have said that the process was a success before it was involved in failure. Happily, on this point I am not called upon to give my own testimony. The process was subjected to the severest of tests in a crowded exhibition, surrounded with flaring gas, in the hottest month of the year; and I more than once left it to itself, not going near the meat-chamber for a week at a stretch, and when I did go it was merely to see that the brine was of the requisite strength. In the *Times* there has already appeared the account of a public luncheon which was given to me prior to my leaving the colony, the principal dishes on the table being beef and mutton which had been frozen for eighty-five days. Many of you have, no doubt, seen the letter I refer to. Strange to say I have not seen it myself, so I cannot quote from it. But I have in my hand an official report supplied to the Department of Lands and Agriculture in Victoria, the author of the report being the Rev. Dr. Bleasdale, well known in scientific circles as a reliable authority. With your permission I will read an extract or two, and will then leave the report on the table for those who wish to examine it more particularly.

The first extract relates to the meat which was preserved in the Exhibition building, and for which I was awarded the medal:—

I had a piece of beef 14 or 15 lbs. weight cut off the next lump that was taken out. The whole might have weighed 60 or 70 lbs. It was all that an experimenter could desire, being from between the loin and rump, and from the size of the piece presented a more than average surface to the air, and not too much fat. I caused this piece, and a corresponding lump, fresh from the butcher, to be hung up in a corridor close to my office in the Exhibition buildings, with a thermometer midway between them. During the whole period of the first experiment it ranged from 63 degrees to 68 degrees Fahrenheit. Other portions of this beef were thawed in the orthodox way, in cold water, and cooked in the oven, and found quite equal to newly-killed beef, of good quality, full of gravy, and rather tough, as new meat usually is.

At the expiration of twenty-four hours (11 a.m. Christmas morning) I called the officer in charge of that division of Exhibition work, a very intelligent man, and he took down the meat and reported the thermometer at 67 degrees. Not without some misgivings, I cut off a steak of about 24 ozs., and ordered it to be cooked in the ordinary way for breakfast.

While the cooking was in progress, it occurred to me to try the then temperature of the lump, and, having some good thermometers at hand, I inserted one in the lump and left another in contact with its outer surface. Even then they both indicated what I should have expected if the meat had been ice, certainly not what I then anticipated. The inserted one indicated the temperature of ordinary ice, and the one on the outer surface that of ice passing into thaw, rather lower than the other.

Now for the first time I began to hit upon the difference between Mr. Harrison's work and the American practice.

The meat was cooked, and the officer and I made an excellent Christmas breakfast off it. The lump was suspended again in the same place, and the fresh meat examined; but, beyond the slight bleaching of the fat and blackening of the lean, there was nothing worthy of remark.

About 10 p.m. of Christmas day, when this lump had been thirty-five hours out of the ice, it was re-examined in presence of several ladies and gentlemen, and found to be not only perfectly sweet, but assuming the ordinary characteristics of kept meat. But the fresh butcher-meat, hanging not six feet from it, had turned sour, and was beginning to show signs of greenness, and, in order that it might not be lost, was given to the housekeeper to cook.

I then began to think there was no further use in following up the investigation, for if meat would keep in a temperature of 68 degrees, it would, on arriving at a British port, have a fairer chance than that newly killed. So thenceforth the remainder of the piece was let hang, and every six or seven hours re-examined, to see if it had become tainted. But what was my utter astonishment when the remnant, say about 5 lbs., was directed to be cooked, and found when served up to be excellent. Dr. McCrea, the Chief Medical Officer, Dr. Gilbee, and myself partook of it. The Chief Medical Officer dined off it, Dr. Gilbee lunched off it, and I carved it, and tasted both the meat and the gravy. Now this was at least seventy-five hours after I first hung it up.

. . . .

On the fortieth day after the meat had been first placed in the preserving-room, Mr. Harrison directed the remainder, a number of very large pieces, some of 40 lbs. or 50 lbs. weight, to be cooked, and, on successive days, given in the refreshment-room to any one who might think well to lunch off it. The further prosecution of this most interesting and valuable demonstration is in the hands of squatters, stockowners, and merchants.

The next extract relates to an experiment tried about three months afterwards:—

On this occasion Mr. J. Cosmo Newberry, scientific superintendant of the Technological Museum, was associated with me, and we both were made privy to all the details of the process. I entered on this second study of the frozen meat with the more pleasure because it would enable me, in company with Mr. Newbery, to control my former experiments, even if he added nothing new to the facts already ascertained.

On the 28th May, when the meat had lain four and a half weeks in the keeping chamber, it was opened at 11 a.m. in the presence of Lieut.-Colonel Stephens, Messrs. Hughes, Wilson, myself, several other gentlemen and representatives of the press. The principal reasons for opening the chamber at the end of thirty-two days were, firstly, to check the results obtained by watching the daily amount of water thawed by the weight of the remaining unthawed ice; secondly, suppose that from any cause it should be necessary on the long voyage to open the chamber, what would be the effect—the loss in ice—under such a possible occurrence; thirdly, what became of the aqueous vapour admitted into the chamber in the process of its ventilation. As I had conducted the first course of inspection and examination, as recorded above, I was naturally enough asked to carry out the second.

In regard to the first, 480 lbs. remained unthawed, and nearly corresponded with the calculations of the quantity that ought to be found.

At this moment (27th June) there is no reply to the second, because the chamber has not been re-opened; but this may be said, that during the first thirty-two days 720 lbs. were thawed, and that with substantially the same quantity of meat to keep. The next thirty days have not consumed 480 lbs., the weather being all the time of about the same average temperature. The reply to the third reason is most satisfactory. The towels laid over and around the meat were perfectly dry—not frozen—but actually dry; and we found the aqueous vapour of ventilation deposited like fine snow, and adhering to the under side of the lid cover of the chamber—a strong plate of iron. The chamber was left open more than four hours, and then closed, and the remainder of the ice replaced as before.

One of the reasons was that mentioned already—that I might repeat my former examination and check the results then obtained, as recorded in the first portion of this essay.

As soon as it was opened Mr. Harrison selected a large saddle of mutton (24 lbs.) that lay on the top of the stack, and a 19 lbs. piece of the thick rib of beef (a roasting joint) from the very bottom of the chamber. Two exactly corresponding pieces (a saddle and ribs) were obtained from the butchers who supplied the pieces frozen. This meat had been killed about thirty hours, and of course was quite fresh. I caused them to be hung in my office, not as before in a corridor, because I thought the air inside would more nearly resemble that of a butcher's cellar or a gentleman's larder. I rigged saucers under the frozen pieces to catch any drip falling either during or after the thawing. Thermometers in the room registered 59·21 degrees.

. . . .

At 11 a.m. on the 29th May, twenty-four hours after the meat had been exposed to the air, we found the temperature in the room 56·5 degrees. On examining the saucers we found hardly one-eighth of a fluid ounce of drip from the beef, and about half-ounce from the mutton, and this consisted mostly of blood. This seemed to have dripped down from the region of the kidneys, which, however, had been removed previous to the meat having been frozen.

Both pieces smelled quite sweet. On taking the actual temperature of all the meat, we found that of the unfrozen beef to be 54 degrees; ditto mutton 53 degrees. Frozen beef 50 degrees, at a depth of four inches in the thickest part; frozen mutton 52 degrees—the thaw was nearly complete.

. . . .

30th May.—At 12 noon to-day, twenty-five hours more, on entering I found several large blow-flies in the room, and noticed one on the frozen saddle of mutton; and fearing lest it should have blown the meat, I removed a few small bits from the place, and then had all the pieces enclosed in muslin bags, to keep off flies for the future. Temperature of the room nearly 60 degrees. Yesterday, and still more to-day, the weather was close, warm, and damp. Wind N.E. to E. All the pieces were perfectly good; but the frozen beef was firmer to the touch than the unfrozen, and no sign of mildew or sourness. Much grey mildew on the unfrozen piece, both on the thick and thin parts exposed.

There was nothing to remark about the mutton to-day, except that there was a single drop of reddish fluid hanging on the end of the spine bone of the frozen piece; and after removing the bits where the fly had been seen, both the frozen and unfrozen pieces were dusted with flour. Both pieces were perfectly sweet, and in the opinion of an experienced housekeeper, every way likely for keeping yet two or three days more, even in this very unfavourable weather. There was no mildew on either joint of mutton. As the weather became worse, I deemed it right to watch the meat very carefully. So at 4 p.m. I found the temperature of the room 60 degrees. Rain was falling, and I closed the windows completely. Again at 7.20 I examined the thermometers, and found the temperature rising—60 5 degrees. This was fifty-six and a half hours after the meat was taken out of the freezing-chamber. Nothing fresh to remark.

31st May.—At 11 a.m., thermometer in the office 59 degrees. We found all the meat quite sweet; it was now seventy-three hours out of the chamber. I caused the frozen saddle to be cut down the spine, and sent one-half to be roasted for luncheon at 1·15 p.m. At the same time I had a large steak cut from each of the pieces of beef to be served up at the same hour.

I invited several gentlemen, not directly concerned in pastoral pursuits, of known repute, and competent judges, to partake of these meats, who met at the appointed hour. I append the note made on the occasion, merely remarking that it was only by guessing that any one could say which pieces had been frozen and which had not.

The portions not used were ordered to be examined again next day, to see if the cold meat would prove as good in proportion as when fresh roasted.

June 1st.—1·20 p.m., thermometer in office registered 62 degrees, with wind north-westerly, very light, weather cloudy and muggy. Mr. Newbery and I examined the meat, in company with Lieut.-Colonel Stevens and Mr. and Mrs. Shaw.

After being ninety-nine hours out of the ice-chamber, the frozen beef was found to be quite sound and sweet; but in one or two places, where thermometers had been thrust into the thin parts near the bone, it showed signs of approaching change. I dissected the meat from the bone, but found no evidence of change but that just noted. Yet, for safety sake, it was put into a hot oven for ten minutes, and ordered to be cooked for luncheon next day. This meat was sour where the steak had been cut off, and much covered with grey mildew. The half of the saddle was looking wonderfully good, and devoid of any smell but mutton, even under the kidney fat and the flaps. It was ordered to remain until to-morrow.

It is but fair to remark that the beef was much handled and breathed upon by visitors anxious to satisfy their curiosity to the utmost. We observed another matter of interest to ourselves:—viz., when the frozen beef was first hung up the whole of the fat visible was quite white; it remained so until after the thawing was complete, and only after forty-eight hours did it resume fully its original yellow-brown colour. It was then wholly undistinguishable from the unfrozen as far as the colour of the fat was concerned.

To-day we tasted the cold mutton from yesterday and found it excellent. Some of it was made into a hash, and much relished by the gentlemen who had been invited. Mr. Harrison himself was present on this as on most of the previous occasions at luncheon.

2nd June.—We inspected the half saddle of mutton at 11·30 a.m., and found it perfectly sweet, even where the thermometers had been inserted. This was one hundred and twenty-three hours after being removed from the freezing chamber. The unfrozen mutton was also quite sweet. This morning our thermometers registered 58-34 degrees. It seemed hardly worth while to watch the keeping longer, since one hundred hours would be ample to allow it for sale and distribution in England, and place it, under equal conditions of temperature, &c., on a level, at least, with any fresh butcher-meat.

JOHN I. BLEASDALE, D.D.

MEMORANDUM.

Public Library, Museums, &c., Melbourne,
2nd June, 1873.

We, the undersigned, having partaken of a saddle of mutton and ribs of beef, preserved by Mr. Harrison's freezing process, desire to state that we have found the meat in admirable condition, not only palatable, but absolutely indistinguishable from fresh meat.

We are of opinion that if meat can be landed in England in the same condition as that eaten by us, the English purchaser can partake of a joint of mutton or beef absolutely as good in every way as the best of freshly-killed meat procurable from his own butcher.

(Signed)

HENRY AMSINCK, Capt. R.N.,
WILLIAM GILBEE, Surgeon-Major, V.V.,
GEORGE HARRISON, Capt., R.N., Melbourne Club,
J. COSMO NEWBERRY, Superintendent Technological Museum,
MARCUS CLARKE, Secretary to the Trustees of the Public Libraries, Museums, &c., Melbourne,
W. F. STEPHENS, Lieut.-Colonel,
JOHN I. BLEASDALE, D.D., F.G.S., Honorary Member of the Medical Society of Victoria, &c., &c,

The report from which I have just read was not published until after I left the colony; but I have some information still more recent to afford, and it is news even to myself. When I came away I left some pieces of meat in the chamber which was still standing in the Exhibition building. I had left the meat to take its chance, as I had more important business in hand. I merely left instructions that it should be removed before the ice had melted. Dr. Bleasdale, in his anxiety to make his investigation as complete as possible, intercepted some of the meat when in course of removal, and subjected it to experiment, in order to ascertain if the frozen meat was available for being salted. In a letter to the newspapers he records the result:—

While there had been obtained abundance of evidence upon the safeness of the process as a preservative one, and also that on arrival in Great Britain or India there would be more than sufficient time for its distribution or transmission by railway to outlying towns or stations, there yet remained one point unsettled, and by no means the least important, viz., would the flesh when thawed take salt? It is obvious that if it could be salted the wholesale purchaser would be secured against ultimate waste, as there is always a market for salt meat. In the study of other circumstances this one was overlooked to the very last, and it was only after Mr. Harrison had sailed for England with his large experiment that it occurred to me to think of salting. I succeeded in obtaining all I required for this purpose from the person to whom Mr. Harrison had entrusted the removal and disposal of the meat remaining at the Exhibition buildings. It should in all fairness be stated that during the fortnight preceding the sailing of the ship *Norfolk*, Mr. Harrison had wholly neglected the preserving chamber, so that the meat was hardly protected at all, yet it was found to be sound after having been opened twice during the ninety-two days that had elapsed since it was first frozen. I took for the purpose of this investigation a large rib of beef and a leg of mutton that had been cut into in several places some days before, and caused them to be put in salt without saltpetre. It was left in salt seven clear days, and took it most perfectly, the beef even more severely than the mutton. On the 31st July, the undermentioned gentlemen partook of it, and have left the subjoined expression of their opinions as to the success of this last stage of the study and investigation.

JOHN I. BLEASDALE, D.D.

The Public Library, 31st July, 1873.

We, the undersigned, having this day partaken of a portion of a leg of mutton and ribs of beef, salted, preserved by Mr. Harrison's freezing process, wish to state that we found the meat palatable, wholesome, and in no way inferior to that of an animal killed and salted by a butcher in the ordinary course of his trade. The meat of which we partook has been preserved, frozen, and then thawed eighty-five days, and had then been subsequently seven full days in salt without saltpetre—in all ninety-two days. If therefore Mr. Harrison can, with profit to himself, supply meat to the tables of English buyers in the same condition as that which we have now tasted, there can be, in our opinion, no doubt whatever of the commercial success of his invention.

(Signed)

ROBERT SIMSON. J. COSMO NEWBERY.
CHARLES RYAN. JNO. B. HUGHES.
A. R. WALLIS. W. F. STEPHENS, LT.-COL.
MARCUS CLARKE. JOHN I. BLEASDALE, D.D.
JOHN J. SHILLINGLAW.

In conclusion, it has been suggested to me that I should make some experiments, either in the preservation of meat in England, or in bringing meat from Texas, Brazil, or the Black Sea before my departure for Australia. I can only say that I shall be happy to cooperate in any experiments that may be suggested. I do not require to make any experiment for my own satisfaction; but, of course, I have not encountered adversity, in the shape of an apparent failure, without learning some precious lessons, and I shall be very glad to put them to the proof. I do not, however, propose to give any exposition of further improvements; my object in reading this paper being merely to point out what has

been done; and with respect to what may yet be done I will pay regard to Mr. Anthony Trollope's advice to Australians generally, and Victorians particularly—"Don't blow."

DISCUSSION.

Mr. Grafton, C.E., asked what was the size of the tanks which contained the meat, and whether the meat was suspended or packed.

Mr. Harrison said there were two tanks 11 ft. by 8 ft., and of an average height of 5 ft. The meat was not suspended, because he considered the more closely it was packed together the better. In answer to a further question, he stated that there were about 15 tons of meat in the cargo, and 25 tons of ice were employed. In a larger experiment, the proportion of meat would increase in proportion to the quantity of ice required, because the smaller the tank, the larger was the surface in proportion to its contents. Thus, a tank six feet square would only require one-sixth the quantity of ice in proportion to the meat which one foot square would require. He could not say exactly the weight of the largest piece of meat, but they were rather heavy bullocks cut in quarters.

Mr. Grafton said that in 1842 he took out a patent for the same thing, but he then found the amount of ice required was considerably more than that now stated. He succeeded in keeping meat and fish for six months perfectly good, though it was nearer the frozen state than described by Mr. Harrison. To the best of his recollection, however, the amount of ice required was almost three times that now mentioned.

Mr. Harrison said he might give a further short quotation from Dr. Bleasdale's report with reference to the quantity of ice in proportion to the size of the chamber:—

> It was my intention to have prepared certain tables of observations on the second experiment taken from day to day by way of a finish to my paper; and though I have the data by me, Mr. Harrison suggests, and Mr. Newbery and I agree, that it would be no easy matter to make them intelligible to the general reader. I will therefore content myself with saying that 15 cwt. of ice have sufficed to maintain and protect, at a temperature below 32° Fahrenheit, 27 cubic feet of a freezing-chamber for 74 days, and that the whole of the ice is not yet thawed.

Mr. Grafton said he could quite understand keeping the chamber at a low temperature afterwards, but it was the first freezing which he found took such a large quantity of ice. He should like to know also if the evaporation from the meat was found detrimental. In his patent process he used no chemicals, but a blower, which caused a constant current of dry air. He found the best thing to absorb the moisture was common oatmeal thoroughly dry.

Mr. Harrison said that chloride of calcium, which was similar in its composition to common salt, but with lime instead of soda for its base, was the best desiccating material. In answer to a further question, he said the meat was not frozen before it was put on board, but was merely put into the tanks, and frozen there. The 25 tons of ice were what he considered sufficient both for freezing the meat and preserving it during the voyage.

Mr. Botly said that, although meat in Australia could now be purchased at 1d. or 2d. a pound, it was obvious it would be raised in price if it could be readily brought to England. He should like to know, therefore, what would be the average cost of the meat under such circumstances; also the cost of the apparatus, the cost of the ice, and the expense of freight.

Professor Gamgee said it had given him much pleasure to listen to Mr. Harrison's paper, particularly as that gentleman had been so successful in years gone by as an inventor, especially in the case of freezing machines. He was the last man in the world to attempt to detract from the merits of Mr. Harrison, but, on the question of the freezing and transportation of meat there were certain points of great importance which had not been referred to. In Canada and other parts of the world frozen meat was eaten during a great part of the year, not as matter of choice, but of necessity, and the universal verdict with regard to it was that it would be much better not frozen. With regard to salting frozen meat, every meat preserver was aware that freezing meat with a view to salting it was beginning at the wrong end. In Canada and the United States a large number of hogs were every winter cut up and salted, and they very rapidly froze when put into the salt; unfortunately, the freezing stopped the process, and when they were brought down to New York and other places for shipment a great deal of the meat was often found tainted. This led every meat preserver to look upon the freezing of meat as the very thing he ought to avoid. At the same time he was much interested by the important truth brought out by Mr. Harrison's valuable investigations, that frozen meat might be kept side by side with fresh meat in Australia, and kept quite as long. This, at first sight, appeared to contradict what had been found to be the case with regard to frozen meat in Europe, but it was, no doubt, accounted for by the process of progressive desiccation which Mr. Harrison employed. It was one of the best methods of counteracting putrefaction in flesh, and it was this process of desiccation which was followed exclusively in America, either on Mr. Hye's system, or something similar. Chloride of calcium had been used in freezing chambers for a long time, especially in America, as he had himself seen in large ice-houses near Boston, which were so constructed that the ice was kept over the top, and the space beneath was partitioned off, and let out in chambers to provision dealers. He himself had been into one of these compartments, where he had seen a large salmon frozen quite hard; but there, in addition to the surface of the ice above, they were obliged to use certain methods of freezing with ice and salt in the separate chambers; and they also used chloride of calcium to keep the air dry. The disadvantage of this was, that in the case of vegetables and fruit they were liable to become dried up, and here and there a little mould would occasionally make its appearance. It was quite evident, therefore, that the process was successful, so far as preserving meat was concerned; but, at the same time, he did not think commercial results would ever be produced in this way. There was a prospect of a very much larger trade from Eastern Europe to England than from Australia; but, in accordance with both European and American experience, wherever attempts had been made to introduce the freezing system they had always been found impracticable. This commercial impracticability was thoroughly demonstrated in the case of the United States, where, during the winter, there was no difficulty in transporting and storing up large masses of ice; but when the summer season had arrived, although every care had been taken, and cars were specially constructed for the purpose of carrying the provisions, there was always found to be great difficulty in the way of a systematic trade in frozen meat. A friend of his thought that if pigs were frozen solid in Portland in winter, there would be no difficulty in transporting them to Liverpool, and selling them in their frozen state. He therefore brought over 200 at a time, and they entered the Mersey all right, but they were stinking before they had got them into the warehouse. He must admit, however, that in that case there was not the element of progressive desiccation. There seemed something feasible in a trade in frozen meat with Russia or Australia, certainly, but yet, notwithstanding the great shrewdness and intelligence of the Americans, they had never yet been able to carry it out. He had found no difficulty in Texas, if he could get the meat cool, in using antiseptics in such a way as to preserve it, the only question which had troubled him being that of transportation in large masses, and

very probably Mr. Harrison's experiments with regard to progressive desiccation would assist him in that matter. He had not the least doubt that Mr. Harrison could carry frozen meat where he liked, even thirty times round the earth, for the failure which had occurred was simply through defective construction. His only doubt was as to its commercial advantage.

Mr. Harrison, in reply, said he could not give the exact figures which Mr. Botly had asked for without going into the question of different quantities; but taking a small quantity, say 50 tons of meat, which could be brought over with less than 50 tons of ice; ice could be made even in Australia at 10s. a ton, but taking it at £1 a ton, that would be £50, the freight of 50 tons of meat and 50 tons of ice, at £2 a ton, would be £200, or a total expense of £250 for 50 tons of meat, equal to £5 a ton, or something over one halfpenny per lb.

Sir Daniel Cooper said he questioned if the freight would not amount to much more than £2 a ton from Australia to England.

Mr. Harrison said that, even taking it at £3 a ton, it would only come to £350, or about ¾d. a lb. With regard to the expense of the apparatus, of course it would not be fair to charge one cargo with the whole of the expense, but simply with a fair rate of interest upon it. The cost would be from £300 to £400, so that, allowing interest upon that, the whole expense of transporting the meat would not exceed 1d. a lb. for a cargo of 50 tons, and on larger shipments it would probably be less than ½d. With respect to Mr. Gamgee's observations, he would only say this, that when meat was frozen in the act of salting, as in America, the salt was prevented from penetrating by the ice, and it was no wonder if the process failed. He did not pretend to salt meat which was actually frozen; it was not salted until after it had been thawed. He did not insist on the necessity of freezing meat, but he simply asserted that if you wanted to bring meat a long voyage through the tropics, you must have a means of controlling the temperature, so as to keep it very low. If you could keep the meat at 35 or 36 degrees it was all very well; but supposing the voyage was a long one, the weather extremely hot, and the ship becalmed on the line, what would become of the meat? There must be some means of controlling the temperature, and in order to do so you must be able to produce a temperature below freezing point, although you might not freeze the meat.

The Chairman then proposed a vote of thanks to Mr. Harrison, for his able and interesting paper, which was passed unanimously, and the proceedings terminated.

PARLIAMENTARY RESPONSIBILITY.

It is more than eleven years since Lord Henry G. Lennox, M.P., one of the Vice-Presidents of the Society, made a remarkable speech in the House of Commons on Irresponsible Boards. He completely exhausted the subject, and proved that one canon of a real statesman's faith was that individual responsibility for the expenditure of public money should be recognised to be a necessity. It bears so usefully on the subject which has been confided to a standing Committee of the Society, that the following extracts are reprinted:—

From a valuable return which was moved for by the member for North Warwickshire, it appears that the total sum expended in the last fourteen years on Science and Art well merits the term "appalling," for it amounts to no less than £2,266,667; and that of this, in the estimates for 1861-2, no less a sum than £221,851 was taken, nearly half of which, viz. £106,000, was swallowed up by the three items to which I propose especially to call the attention of the House, and for the proper expenditure of which the House has not the proper guarantee of personal or individual responsibility.

The three principal items to which I am about to refer appear in Vote 4 of Civil Service Estimates, and they consist of the British Historical Portrait Gallery, the National and the British Museum.

Now, in one respect, the position of all these institutions is the same; the executive being placed in the hands of irresponsible Boards. For the estimates of the British Museum no Minister of the Crown even professes to be responsible to this House; and, in the case of the other two, the small modicum of responsibility that does exist is highly unsatisfactory, because it is both anomalous and shifting. And to this fact do I confidently attribute the mismanagement which exists.

With regard to the two Picture Galleries, the Treasury is the only recognised authority in this House—well, I suppose I shall be asked, and what more do you want? Is not the Treasury a Department of the Government, and have you not in that way got for these institutions a responsible Minister of the Crown? Well, Sir, I am afraid I am unable to accept the Treasury in such a capacity as that; for I do believe that if there be any one doctrine more sound than another, if there be any one dogma that has on its side a greater weight of testimony than another, it is this, that the Treasury should be a controlling and not an administering body, and that any attempt to combine the two duties of checking and spending, must necessarily weaken its powers of efficiency in both functions. This view of the proper duties of the Treasury is strongly laid down by Earl Russell, who, in 1854, in speaking of the position of the Commissariat of that time, administered by the Treasury, spoke in the following words; "Now, although the Treasury should have the general superintendence of the financial concerns of the public, there does not seem any convenience, but the contrary, in an officer of the Treasury having the regulation of the arrangement and distribution of the rations to troops; that is business which does not properly belong to a department which has the general supervision and control of the finances of the country; it is an executive function, and should rather belong to an Executive Minister, such as the Secretary of State, than to the department of the Treasury."

And, again, in the same debate, another noble Lord (Lord Herbert) whose untimely death has been lately deplored by the nation, and who at that time filled the post of Secretary of War, expressed himself as follows:—"I think the department of the Treasury, which is a department of check, but which is not an administrative department, should not be intrusted with a duty of the kind." And again, when speaking of the Secretary of War being intrusted with the duties of War Office and Treasury, he says, "If, therefore, you have him doing the duties of both departments, he ceases to have any check or control." And further on, he adds, "If therefore, you combine the two things, you do away with the whole system of economical control."

But, besides these great statesmen of the present day, I have other authorities equally unexceptionable to quote. Sir Henry Parnell, in his able work on Financial Reform, published in 1830, constantly refers to, and bases his arguments on the fact, that all departments are subordinate to the Treasury, and that to it rightly belongs the control over the expenditure.

Then there is another work of our time, to which I wish to call attention. It is a work on Representative Government, and is from the pen of one whose authority will not be disputed by many of the most eminent members of this House. This work, by Mr. John Stuart Mill, after alluding to the control which the Treasury would exercise over the other department, goes on to say. "There is a radical distinction between controlling the business of Government and actually doing it. The same person or body may be able to control everything, but cannot possibly do everything; and in many cases its control over everything will be more perfect the less it personally attempts to do."

Thus much, then, for individual authorities; but there remains one, the result of the collective wisdom of a Royal Commission. That Commission was appointed in 1837, and led to most valuable results. The report is one for which I naturally have the most profound respect, and it thus speaks of the Treasury as an executive:—"But above all, by this change [that is, removal of the Commissariat from the Treasury], the Treasury would be relieved from business which we consider it wrong in principle that it should undertake, and this large branch of public service would be placed under the superintendence of the department which ought to be responsible to Parliament on all subjects connected with the army. The Treasury, being charged with the general superintendence of the finances of the country, and with the duty of controlling the expenditure of each separate department, it seems to us that when that Board also takes upon itself the management of a service involving large expenditure, it leaves its proper sphere. Whatever be the department which immediately applies the public money, in carrying on any branch of the service, the proceedings of that department ought to be subjected to the superintendence of some distinct and superior authority. But this can no longer be the case when the Treasury, to which this authority properly belongs, and over which there is in the Executive Government no higher power, assumes also those administrative functions which ought to be subordinate. This is an objection of principle to the existing arrangement which, in our opinion, should be decisive."

But, Sir, I doubt not I shall be reminded that a sum is annually voted for the "civil contingencies" of the country, and that that sum is administered by the Treasury, independently of all other departments. This is quite true, but does not the name "contingency" show that this is an exceptional case, and that it is a fund to meet "unforeseen" expenses and sudden emergencies, and certainly cannot be placed in the same categories as the large sums voted for Science and Art, and which have now become part of the regular and annual service of the country?

The case of the civil contingencies, I venture to think, strengthens rather than weakens my position. It is "the exception which proves the rule," and a golden rule it is, that the Treasury should control and check, but not administer, the expenditure of the country.

And now I will proceed to state the second cause to which I mainly attribute the mismanagement of these institutions, and that is, that they are administered by large bodies of irresponsible men. Now, Sir, as in the very nature of the subject with which I am dealing there must be much of a personal matter, I am anxious before I go any further to disclaim any intention of saying one word which can be considered disrespectful to any one of the distinguished men who compose these bodies. And, Sir, perhaps I cannot give to the House a better assurance of this, than by calling attention to the fact, Mr. Speaker, that your honoured name stands foremost among the trustees of the British Museum. No one indeed can deny that these boards contain all that is most remarkable for intellectual attainments and high social position; but that very fact would lead to the belief that they must have their time fully occupied with their own affairs, and have proportionably less time to give to the duties in question. I am about to speak of them as being members of an irresponsible corporation, and to denounce the system of which they are, I doubt not, the able exponents. Well then, Sir, my position is this, that boards as executive bodies are wrong in principle; and have been condemned as such in all times, and by great authorities. Sir Henry Parnell, in his work* on Excise Enquiry, declared, that they deprive the public of the security of personal responsibility, and that the responsibility of a Board *quasi* Board is worthless; and again says Jeremy Bentham, "why a Board, my lord, is a screen, a screen to hide abuse in every shape;† what is everybody's business is nobody's business." And Stuart Mill likewise in glowing‡ terms corroborates the opinions of Parnell and Bentham.

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Well, sir, in addition to all the eminent writers and statesment whose opinions I have given, I find further confirmation of the views which I urge, in the acts of the legislature itself; and I think I shall be able conclusively to show that the tendency of legislation for the last forty years has been to increase personal and individual responsibility, and to repudiate the authority of Boards as an executive. The first case to which I will refer is the navy: in 1832, Sir James Graham, whose lamented death, for his wise councils and administrative ability, has left a gap in this House not easy to fill, came down and proposed to simplify the cumbrous machinery by which the navy was then governed. Up to that time it consisted of three numerous Boards, and Sir James, in his able speech, which proposed to sweep away two of these, and to re-model the third, produced considerable effect in the House, by proving that the principle which he advocated was not a new one. "Turn," said the right hon. baronet, "to Mr Pepy's memoirs, in which book it is stated that James II., then Duke of York, on his appointment to the office of Lord High Admiral, found himself compelled to dismiss these Boards, and, with the assistance of four commissioners, united the whole control of the civil administration of the navy in his own hands. The effects of this alteration were almost immediately visible; it was the first dawn of that brighter era which was followed by the splendour which has since encompassed the navy of Great Britain, and had at length raised it to that pinnacle of glory where it had since remained the envy and wonder of surrounding nations.

Then, Sir, came the case of the Record Commission, and to this I wish more particularly to call the attention of my Right Hon. friend, the member of Cambridge University (Mr. Walpole), and the other trustees of the British Museum who may have seats in this House. Well, that commission was constituted very much like the British Museum; the trustees consisted of the great officers of State, and of the most eminent men in the country. For some time public attention had been drawn to the administration of this body, and the feeling that it had been mismanaged was general; but at the same time there was but little hope of being able to effect a reform, on account of the power and influence of the governing body. Thus matters stood in 1836, when Mr. Charles Buller moved for and obtained a committee to inquire into the whole matter; clear evidence of this mismanagement was adduced, and so strong was the report of the committee, that justice triumphed over wealth and influence; the trustees were abolished, and the whole thing was placed, as Mr. Buller recommended, under an effective and responsible management.*

I will next allude to the case of the Schools of Design. These were originally called into existence by the recommendation of a Select Committee, which sat in 1837, under the presidence of Mr. Ewart. At the outset,† government officers were allowed to attend the meetings of the Boards, but had no distinct authority. This system, as might naturally have been expected, failed, and in 1850 another select committee was appointed, over which the Right Honourable gentleman the member for Ashton-under-Lyne (Mr. Milner Gibson) presided. The report of this committee led to further modifications, but they did not meet the wants of the case. Subsequently, Mr. Labouchere (now Lord Taunton), began a reform, and in 1852 my right hon. friend, Mr. Henley, member for Oxfordshire, at that time President of the Board of Trade, swept away the previous management, and placed it under a responsible Minister of the Crown, the President of the Board of Trade, from whose department it has since been removed to the Committee of Council on Education, and has formed the nucleus of that collection which is now familiarly known under the euphonious title of the "Brompton Boilers."

Then again, Sir, there is the case of the Poor Law Commission. Up to the year 1846, the Poor-laws had been administed by a body of irresponsible commissioners, not having seats in Parliament. During the distress which was at that time rife in the country, the great inconvenience of this system was felt, and the government of Lord John Russell successfully grappled with the difficulty. A Bill was passed, which, by placing two officers of the Poor Law Board in Parliament, virtually brought the whole distribution and management of the Poor Law funds under the direct control of the House of Commons. Since that time we have heard nothing of those unseemly charges which were formerly made against the manner of administering the Poor-law Funds. This change was advocated in the House of Commons by the late Mr. Hume, by Lord H. Vane, by the late Sir James Graham, expressly on the ground of the necessity of securing personal responsibility; and Sir G. Grey further adduced, as a reason for the alteration proposed, the great inconvenience that arose from the impossibility of obtaining any information, excepting at second hand, and from the very person whose judgment and discretion might be called in question. Well, sir, that same inconvenience

* "There is another great defect to be noticed belonging to management of business by Boards, and that is, the depriving the public of the security of personal responsibility for proper performance of its business. Responsibility of a Board as a Board is of no value whatever; and as to commissioners individually, no one of them is responsible for acts of the Board, as others participate with him in all he does, and much may be done in which some members of the Board have not acted."—*Parnell on Excise Inquiry.*

† "A Board, my lord, is a screen. The lustre of good desert is obscured by it; ill desert, slinking behind, eludes the eye of censure; wrong is covered by it with a presumption of right, stronger and stronger in proportion to the number of folds: and each member having a circle of partial friends, wrong in proportion again to the number, multiplies its protectors.'—*Bentham's Letters on Scotch Reform*, p. 17.

"Under the system of corruption the uses of a Board are manifold:—

"1. To afford a screen to abuse in every shape. What is everybody's business is nobody's business; what is everybody's fault is nobody's fault; by each one the fault is shifted off upon the rest. So many members, so many confederates; all of whom—they and their connexions—join in affording support and protection to whatever misdeeds in any shape are committed by any one of them.

"2. To afford a pretext for the multiplication of officers; to each of which is attached its mass of emoluments—so many needless offices, so many sources of waste, so many instruments of corruption.

"3. If upon occasion any desire should have place, as that of seeing the business miscarry, to secure the so desired effect.—*Bentham on the Radical Reform Bill*, p. 571.

‡ "Things are much worse when the act itself is only that of a majority—a Board, deliberating with closed doors, nobody knowing, or, except in some extreme case, being ever likely to know, whether an individual member voted for the act or against it. Responsibility, in this case, is a mere name. . . . . What 'the Board' does is the act of nobody; and nobody can be made to answer for it. The Board suffers, even in reputation, only in its collective character; and no individual member feels this, further than his disposition leads him to identify his own estimation with that of the body—a feeling often very strong when the body is a permanent one, and he is wedded to it for better for worse; but the fluctuations of a modern official career give no time for the formation of such an *esprit de corps;* which, if it exist at all, exists only in the obscure ranks of the permanent subordinates. Boards, therefore, are not a fit instrument for executive business; and are only admissible in it, when, for other reasons, to give full discretionary power to a single minister would be worse. . . . As a general rule, every executive function, whether superior or subordinate, should be the appointed duty of some given individual. It should be apparent to all the world who did everything, and through whose default anything was left undone. Responsibility is null when nobody knows who is responsible. Nor even when real can it be divided without being weakened. To maintain it at its highest, there must be one person who receives the whole praise of what is well done, the whole blame of what is ill."—*John Stuart Mill's Considerations of Representative Government, pp.* 250, 251.

* "Your committee, however, is not inclined to impute the inefficiency of the successive commissions for the most important purposes of their institution to any fault of the individuals composing them. Indeed, the distinguished characters* of the majority of those whose names are placed in them, go far, independently of the evidence, to negative such a supposition. But your committee can hence only draw a stronger inference, that in the constitution of a Board which contains so large a portion of political ability and literary talent, yet has exercised so slight a control over the objects for which it was instituted, there must be a radical and irremediable defect. These commissions have experienced the invariable fate of numerous boards entrusted with unpaid work.

"Your committee, in remarking on the defective management of past commissions, has attributed their errors, not to any peculiar incapacity or negligence of the individuals who composed those commissions, but to the defective principle which has pervaded the constitution of all those different bodies. Our experience of them furnishes but one additional and almost superfluous proof of the folly of expecting efficient labour and systematic care at the hands of a numerous body, unpaid for the discharge of its duties, and occupied by other avocations of a more imperative, and a wholly foreign nature. The defect being in the system, it is the system which must altered; and your committee can expect no substantial or permanent improvement of the present state of things, until it sees the present commission replaced by one constituted on an entirely different principle." (And it was. The grandees were abolished, and individual responsibility established)—*Extracts from the Select Committee's Report of the Record Commission*, 1836.

† Board of Trade.

* Speaker, Archbishop of Canterbury, Lord Chancellor, &c.

exists, in an exaggerated degree, in the case of the art institutions of this country at the present day. Take for example the National Gallery, and let us suppose that an hon. member objects to some administrative act of Sir Charles Eastlake, either in regard to the sum given or to the merits of any particular picture. What happens? Why, sir, up jumps the Secretary of the Treasury, or the Chancellor of the Exchequer, and professes, naturally enough, profound ignorance of the matter, but promises to write for further information. When next the subject comes on, the hon. member receives the comforting assurance that a reply has been received from the director of the National Gallery, and that all that had been done by him, had been done, and was for the best.

But, Sir, one of the most important of the changes that has been made in this direction was that which was made in the army departments in 1854. Up to that period, although a committee had strongly reported twenty years before, the army administration remained in the hands of four or five different members of the government. There was the Secretary at War, the Secretary of the Colonies, the Master-General of the Ordnance, the Paymaster of the Forces, the Commander-in-Chief, and our old friend the Treasury, and they had each and all a finger in the military pie. The unhappy war with Russia, which at that period broke out, drew closer attention to the matter, and at length, after twenty years, the recommendations of the commission were carried out, the administration of the Commissariat was removed from the Treasury, and a Secretary of State for War was created, who, with the assistance of an under-secretary, now administers the affairs of the army, proposes the estimates, and lays before Parliament any information that may be required.

Well, Sir, then, I come next to the Indian empire. Up to the year 1858 there existed for that magnificent dependency a double government, which shifted the blame from one to another. The president of the Board of Control, who should have been responsible to Parliament, was constantly thwarted, and his authority for a time set at nought by a body of irresponsible merchants sitting in Leadenhall-street. The absurdity of this was patent. The new India Bill was introduced, and, as the House is well aware, the whole responsibility and power was vested in the Secretary of State. It is true he is assisted in deliberation by a Board of eighteen councillors, but they are merely for deliberative purposes, and the voices of the whole eighteen can be overruled by the *ipse dixit* of the Secretary of State; indeed, I am told that at the present time they are not even asked for their advice, but are merely puppets in the despotic clutch of the Right Hon. Baronet the Secretary of State for India (Sir C. Wood), who, it appears, thinks the best way to govern India is to listen to his own advice, and not to that of his council. That right hon. baronet, by all accounts, appears to treat them as if they owed their existence rather to the power of vested interests in impeding the passing of a useful measure, than to any specific merits of their own.

But, Sir, besides the instances to which I have referred, the recent case of the Education Commission furnishes me with another illustration of the advantages of the course which I am about to ask the House to sanction in the case of the art institutions. And, sir, I must once more direct the especial attention of my right hon. friend the Member for Cambridge University (Mr. Walpole), to the facts which I am about to lay before the House. Originally, every member of the Cabinet had, *ex-officio*, a seat at the Education Board, but yet there was no individual official responsibility. What was every one's business was no one's business; and we owe it to the sagacity and intelligence of my right hon. friend, the member for Droitwich, that that system was put an end to. A Vice-President of the Committee of Council is now present in this House, whose duties, I have no doubt, the right hon. member for Calne (Mr. Lowe) could tell us, is as far as supplying varied information, no sinecure at the present day. There have been many smaller changes and re-distributions made in the various offices of the State in the last few years, but all tending in the same direction.

Well, Sir, I hope I have now proved to the House this fact, that the whole tendency of modern legislation has been to sweep away Boards, as executive, and to increase personal and individual responsibility. It is scarcely necessary to guard myself against misapprehension, by stating that it is only as an executive that I wish to repudiate Boards. "In the multitude of councillors is wisdom," and, as deliberative or consultative bodies, they have most useful and valuable duties to perform.

. . . .

Well, Sir, and now I come to the National Gallery, and certainly the management of that institution was not in a satisfactory state; at the same time, I am willing to admit the salutary nature of the change which was made a few years ago by reducing the number of the executive Board. There is, however, still a shifting and uncertain responsibility: at one time it is the director and the trustees, and at another it is the Treasury. The estimates are moved by the Chancellor of the Exchequer, while the Chief Commissioner of Works is responsible for the brick and mortar work; and certainly, considering the shifting evasions and vague replies given last year by the Commissioner of Works to hon. gentlemen, and myself especially, respecting recent alterations and so-called improvements in the National Gallery, the House will well understand why I shall not, at the close of my speech, recommend placing these valuable institutions under the control of the Board of Works.

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The case of the British Museum, which I now approach, is rather an alarming one.

If I may judge from the terror which my proposal has excited in the lobbies, I could almost be tempted to suppose that it was of that radical and revolutionary nature which the Chancellor of the Exchequer said in 1860 could alone meet the difficulties and necessities of the case. I hope to prove, however, that I am not so revolutionary in my designs as either the Chancellor of the Exchequer or the Under-Secretary for Foreign Affairs.

There is an old saying that the State of Denmark is rotten, and I believe, Sir, that the management of the British Museum is much in the same condition. It has hitherto been viewed with superstitious awe, but I firmly believe that under the influence of a little daylight that pompous fabric will crumble away, as easily as did the Record Commission of former times. Now, Sir, I hope hon. gentleman with whom I have conversed in the lobby will not take it personal to themselves, if I say, that it is quite surprising the amount of ignorance which exists with respect to the British Museum, even among those members who profess to take an interest in these subjects. Considering that it has cost the country since its formation £3,000,000 or £4,000,000, it is astonishing that the gentlemen whom I see around me, and who represent the taxpayers of this country, should not have made themselves a little better acquainted with the origin and position of that great institution. First of all, then, the British Museum did not originate in a gift or legacy, but was founded at the beginning of the last century by means of a lottery. The Government of that day issued lottery tickets to the amount of £300,000. Prizes of moderate value were offered, and a large sum was obtained; with the £20,000 thus realised a purchase was made of Sir Hans Sloane's collection of books and curiosities, then located at Chelsea; and it was this, not any gift or legacy, which formed the nucleus of the Museum; and, Sir, this is an important fact for the House to bear in mind.

The first Act of Parliament handed this collection over "for *conservation*" to a numerous body of trustees; but even at that early period this was thought a cumbrous machinery for a governing body, and a Standing Committee was appointed.

To show how little attention at that period was paid to this matter, I will read to the House the title of the second attempt that was made at legislating for the British Museum.* The title of the Act of George II., ran thus—"An Act to prevent the destruction of turnpikes and other works erected by order of Parliament; to frame the table of fees to be taken by the clerks of Justices of the Peace; for empowering a certain number of the trustees of the British Museum to do certain acts; and to prevent certain persons driving certain carriages, from riding upon such carriages." The statutes under which the Museum was managed had been renewed eight or ten times in 1785, 1804, 1808, 1814, 1833, 1839, and various committees and commissions sat on the subject.

It would appear that dissatisfaction as to the state of matters had existed for some time, when in 1835 a Select Committee was appointed by the House of Commons. That committee included many of the leading Members of the House at that period, including Lord John Russell, Lord Morpeth (now Earl of Carlisle), the late Sir Robert Inglis, and others. At the end of the session of 1835 they presented a voluminous Blue Book, and asked for leave to sit again in the next session. The result was, that in 1836 they presented a second even more ponderous Blue Book, with a report, not so decided as the later ones, but expressing an opinion in favour of a less numerous governing body, and strongly urging that the post of secretary librarian should be abolished. This was followed by another Select Committee in 1838; and in June, 1847, a Royal Commission was appointed; and in 1848, "considering the various and grave subjects to be inquired into," a supplementary and more numerous commission was appointed, containing the names of some of the most illustrious in learning and literature. The late Earl of Ellesmere, Viscount Canning, Roderick Murchison, Joseph Hume, Samuel Rogers, Lord Langdale, Monkton Milnes, and John Shaw Lefevre served on that Commission. Evidence was taken with praiseworthy patience, and in 1850 the result was communicated to both Houses, in the shape of a very able and strongly worded report, and the 900 pages of evidence on the strength of which that report was founded. It was signed by all the commissioners excepting one, the late Lord Langdale, who entered a protest against this strong report for not being strong enough. But even these inquiries did not satisfy the country, and in 1860 another Select Committee was appointed at the instance of Mr. Gregory, and before which some most valuable testimony was adduced.

Now, if I wished to take my stand on any ordinary ground, I might say here was a *prima facie* case of mismanagement, evidenced by the number of inquiries which had been instituted and the strongly-worded reports which had resulted from them.†

I hope the House will not be alarmed at the mention of all these Blue Books; for knowing well how much the sight of one of them prejudices the House against any case, I have so arranged that nothing of the kind

* Anno vicesimo septimo. Georgii II. Regis. An Act for making perpetual several Laws for Punishment of Persons destroying Turnpikes, Locks, or other Works erected by Authority of Parliament; and that all Acts made for erecting Courts of Conscience, shall be deemed Public Acts; and to empower a certain number of the Trustees of the British Museum to do certain acts; and for confirming the Table of Fees to be taken by the Clerks to the Justices of the Peace for the County of Middlesex; and for giving further Time for the Payment of Duties omitted to be paid for the Indentures or Contracts of Clerks and Apprentices; and for filing Affidavits of the Execution of Contracts of Clerks to Attorneys and Solicitors; and for preventing Persons driving certain Carriages from riding upon such Carriages.

† "The numerous reports of the public departments which have been made by Commissions of Inquiry and Select Committees of the House of Commons, show that there is not one of them of which the organization is not extremely defective."—*Sir Henry Parnell, on Financial Reform.*

shall appear, and will ask in return the indulgence of the House, while I give them a few short extracts from them, and which I have transcribed into the unpretending volume which I hold in my hand. Now, want of time will not allow me to enter into any minute details to show the unsatisfactory state of the management of the British Museum; but I think the House will agree with me that I shall have sufficiently established my case, if I can show that I am corroborated by the report of the Royal Commission of 1850, and at a later period by the evidence of several eminent men, members of this House, and others; and, finally, by the evidence of all the principal officers in the British Museum, adduced before the Committee of 1860. Let us, then, examine the report of the Commission of 1850; and first we shall see the conclusions they arrived at, and secondly the remedies which they propose for such a state of things. The very first words contain a graceful tribute to the individual merits of those who compose the Board of Trustees; a sentiment with which I entirely coincide, and which, in feeble language, I have conveyed to the House regarding those who compose the executive in the three great art institutions of the country.

"Such a Board of Trustees, to any one who considers the individuals who compose it, with reference to their rank, intelligence, and ability, would give assuranee rather than promise of the most unexceptionable, and, indeed, wisest administration in every department. High attainments in literature and in science, great knowledge and experience of the world and its affairs, and practised habits of business, distinguish many of them in an eminent degree; and it would be unjust either to deny the interest which all of them feel in the prosperity of the institution, or refrain from acknowledging the devoted services which some of them have rendered in its administration. But, on the other hand, absorbing public cares, professional avocations, and the pursuits of private life, must, in many instances, prevent those individuals whose assistance might have been best relied on from giving anything like continued attention to the affairs of the Institution; and what is perhaps of more importanee, the large number of the Board, by dividing, or rather extinguishing, individual duty or responsibility, has, in a great measure, interfered with the superintendence and control which might have been usefully exercised by any smaller selected number specially charged with the duty. The inconvenience likely to result from the affairs of the museum being devolved upon so large a Board, appears to have been felt at a very early period."

Again:—

"It is not surprising that, in such circumstances, the Standing Committee should have been confounded with the general Board, without any practical distinction between their functions, and that the actual management of the museum should have devolved upon a fluctuating Board, having no special charge, nor direct personal responsibility; and all this in constant disregard of that precaution which the trustees very wisely established against themselves, by throwing the ordinary business of the museum upon a portion of their number, specially appointed and accepting."

And again:—

"To return to the Standing Committee, or to the Board of Trustees —for these may be spoken of together—the course of conducting business is unfortunately calculated not to correct, but to aggravate, the inconvenience."

And further on occurs the following remarkable passage, to which I beg the especial attention of the House:—

"On the whole, the conclusion has been forced upon us, that the mode in which the Trustees have exercised their function of government in the Museum has not been satisfactory; and that the inconveniences arising from so great a number of Trustees, and from the fluctuating nature of the Board, have been increased by the neglect of such precautions as, with reference to the accustomed modes of transacting business, we should expect to find strictly in observance. However admirably qualified the Trustees may be individually for the transaction of business, it is impossible to expect satisfaction in the conduct of their affairs, where they act not by a selected number, but at meetings—which they are left to attend as they please, and as leisure and inclination serve—to which they are called by summons announcing the time of meeting merely, but giving no notice of the business —at which business of great importance to departments is conducted without direct and personal intercourse with the officers at the heads of the departments, and in a manner so cumbrous and fatiguing as to be hostile alike to good decision and dispatch."

And the remedy which the Commissioners proposed to apply was given in the following words:—

"With respect to the executive management, your Commissioners are unanimously of opinion that a change should be adopted, involving the abolition of the offices of Principal Librarian and of Secretary as they now exist, and the establishment of a responsible Executive Council."

Two plans were suggested for carrying out this reform. The one proposes that the Executive Council should consist of seven—the chairman and two members being named, and the two latter paid, by the Crown; the remaining four to be named by the Trustees. The second plan was, that the Council should consist of five—the chairman nominated and paid by the Crown, and four unpaid assistants. Both these projects were recommended with the distinct purpose of "increasing direct and personal responsibility." But as I have said, this report was not unanimous, and Lord Langdale entered a protest, in forcible language, against what he considered was too feeble an expression of opinion.* Well, this report, like preceding ones and the protest, remained almost a dead letter. It was not to be expected that the Trustees would set to work to reform themselves; and the several Governments were either too supine or too timorous to attack so much wealth, power, and influence. The result would seem to have been, that mismanagement had gone on from bad to worse. In 1859, a gentleman, who was a great authority on this subject, Mr. Gregory, described the British Museum as being in a state of "hopeless confusion, and that valuable collections were wholly hidden from the public, and great portions of others in danger of being destroyed by damp and neglect:—" while Lord Elcho spoke of its being "highly discreditable." And besides these authorities, we have the invaluable testimony of a distinguished foreigner, who has paid great attention to the condition and management of our Art Institutions. The Baron Triquéti, an eminent French sculptor, in a letter written in 1860 to the Chancellor of the Exchequer (Mr. Gladstone), thus describes the state in which he found the British Museum:—"You might offer for study an admirable and complete collection; but all these elements are scattered or confused . . . . arranged without chronological order . . . . without any logical arrangement; and all this, because the *locale* is filled up with a curious and reprehensible mixture between Art and Natural Science—and although no reason can be given for the continuance of the system, this confusion still exists, notwithstanding that every person of taste is struck with its inconvenience."

Again:—"Whence comes it that with a nation the most gifted with common sense and love of order, so much reckless confusion should prevail, and, as it appears, prevail in this department of art and science alone."

Finally, there is the committee appointed at the instance of the hon. member for Galway, to inquire whether any separation should be made in the collections at the museum, and, as I have said, I find in that evidence the most ample corroboration of my views. The report, it is true, was silent as to management or mismanagement, but that was because it was considered not to come within the limits of the object for which the inquiry had been instituted. I find that almost every one of the servants of the British Museum gave, in strong terms, an opinion that some reform was necessary in the constitution and management of the museum. Professor Maskelyne said:—"The trustees should become a board of visitors."*

Again:—"The trustees should be more as a consultative than an administrative body."

Professor Huxley, in 1860, said:—"The trustees should merely have the power of approving or disapproving in particular cases; that they should exercise a certain general control as a board of visitors."

Professor Hawkins, after complaining that the trustees frequently act on the advice and use the services of a gentleman not on the staff of the museum, to the exclusion of the head of the department, goes on to say, "That he sees no improvement in the policy of the trustees since the report of the commission of 1850." He adds, as a result of the system, "That the arrangement of the Elgin marbles has remained incomplete for four years, owing to a squabble between the trustees."

He next expresses his conviction that one responsible head would be a better and more efficient government for the museum. He further states, in exemplification, that he wishes the British Museum were like that at South Kensington, where a moot question is referred to a minister of State, an answer is returned and acted upon without delay; and winds up by saying:—"I do not wish to supersede trustees as visitors, but wish them to act as a consulting body."

Baron Triquéti says:—"From this spring those eccentric decisions, those daily contradictions, those questions settled and unsettled, and this absence of progress inevitable, which all the world (except a few of the trustees) knows to be the true history of your board of trustees. If I were able to say all that has been confided to

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* Lord Langdale refused to sign the Report, as not strong enough. He entered a protest as, follows:—

"Many and considerable inconveniences have crept into the management of the Museum. The remedy must, as it seems, be sought for:—

"1. In the establishment of, or revival of, an executive government, vested in one person, solely responsible for the due execution of his duty, but assisted by a Council, to whom he might readily and on all occasions resort for advice and assistance.

"2. In the establishment of a Committee of Trustees, a standing committee, elected, and undertaking personally to perform all those duties of superintendence, investigation, and control, which seem to be the proper and peculiar duties of the Trustees, as distinguished from the duties of practical management and executive government, which seem to be the proper and peculiar duties of a Governor or Director."

* "I think it is a pity that things should be as they are. If I make a report for the trustees, that report has to pass through Professor Owen; he may adopt or condemn it, as he likes. It must then go before the principal librarian, who might differ from it, and might not even bring it before the trustees, I believe, if he chose, though I am sure he would; but he may make any observation he pleases upon it, and there would be no opportunity for the keeper to meet the objection or to state his opinion. It ought to be possible for the keeper to make a statement or to urge a point, without its being possible that that point should be smothered between them and the trustees. I consider administration much more important matter than removal."

Besides this, the professor distinctly recommends and contemplates as a responsible and ruling power a member of the government:—

"I consider the museum would stand in a different position, as to all the relations of its departments to the public, as to their improvement, as to the election of their officers, and many other things, if a direct administration could be substituted for the indirect and more complex one which we have now.—*Maskelyne, Keeper of Mineralogy and Professor of it at Oxford.*

me, and which, indeed, public rumour has already revealed, it would be easy to prove that this system of administration is a complete obstacle to all improvements."

But all these authorities become insignificant when contrasted with that to which I am about to call the attention of the house. It is the testimony of one who has not only given great attention to the affairs of, but has himself contributed largely to, the treasures of the British Museum. My hon. friend Mr. Layard, thus speaks. After objecting to the system of management, he goes on to say:—"The building selected (by that management) is the worst that could have been devised." And again:—"I think in principle, such a Board as the trustees is wrong, although much may be said in its favour; and I think that the principle is so essentially wrong, that public opinion must ultimately come to the conclusion that it is wrong and not right." And again:—"In the British Museum the vices of the system are fully exemplified, more especially at the present time, when certain trustees are supposed to represent the various antagonistic interests of the antiquities, the library and the natural history. I always thought highly of Panizzi, but with curtailed power and responsibility it would be impossible for him properly to manage such a vast institution. The result of this division of authority and want of method is a constant disagreement and rivalry between the different departments, arising from some real or presumed sacrifice of one to the other." And again:—"I do not object to a Board of trustees, if you like to call them so, to see that certain bequeathed collections are properly taken care of. I see no objection to a Board of Control, but having no authority in the actual administration." And when pressed by an hon. friend of mine (Mr. Monkton Milnes), who asked him, "Do you think any practical evil has resulted from the present condition of the administration of the British Museum?" the answer was a brief but decided one:—"Yes."

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The next point to which I wish, Sir, to advert, is to the vehicle by which, and the manner in which, the estimates for the British Museum are laid before this House. They are presented by a private member of the House, and not by a responsible Minister of the Crown. Now, Sir, I confess I feel, and always have felt, that this practice of a private member (however distinguished he may be) moving the estimates, is in the highest degree anomalous, inconvenient, and unconstitutional. I doubt not that in the instance of the British Museum it is brought within the form, but I confidently assert that it must remain antagonistic to the spirit of the constitution. That it is inconvenient all must admit, when we remember that we may express our gratitude to, but we cannot censure this distinguished volunteer.

Well, Sir, then as to the shape in which the estimates are presented to this House. It would seem that up to last year, they have appeared under three different heads. The first was for "British Museum Establishment, &c. &c.;" it was moved by a trustee, being a private and irresponsible member of this House; the gross sum was given, but no details were vouchsafed; the second was for "British Museum Buildings," which was moved for by the chief Commissioner of Works; and the third, for "British Museum Purchases," was moved for by our old friend the Treasury. Well, then, Sir, the House will see that over the two latter items they had some control, however inconvenient a one it might be in form. That inconvenience was felt, and last year the whole sum and the details of it were embodied in one estimate, which was and is moved by "the irresponsible trustee." So that, although in form it is more convenient, the present system is in fact a retrograde move, for it removes from the House even that control which it had over two items of expenditure in the British Museum.

But it is not only in a constitutional point of view that I object to the moving of the estimates by a private member of the House, for in practice it is most inconvenient, as furnishing an additional fold in "the screen of irresponsibility," behind which the trustees find shelter when they wish to disregard the expressed wishes of the House of Commons. In order to illustrate this more clearly, I will take two instances of the way in which those wishes have been treated by the trustees of the British Museum. It was in 1858 that a general wish was expressed in the House of Commons that increased facilities should be given to the working classes for visiting the museum; two extra days were named, and a suggestion was made that it should be opened occasionally in the evening. The answer to these expressed wishes, Earl Russell, then Lord John Russell, communicated to the House when moving the estimates the following year. The answer was not an elaborate one, and consisted of an expression of regret that the trustees could not comply with the wishes of the House of Commons! In 1860, when money was asked for the British Museum, the same expression of opinion took place, and a chorus of hon. members requested that increased facilities for visiting the museum should be afforded to the working classes. Well, Sir, at that time it fell to my right hon. friend the member for Cambridge University (Mr. Walpole) to reply, and, as the House will readily believe there was no one who could convey a refusal in more pleasant terms than he could; and accordingly he assured the House that "it was his duty to collect the suggestions that were made in that House when the estimate was brought forward, and to lay those suggestions before the trustees." Now, sir, I confess I was very much struck with the nature of that reply, and I remember saying to myself—It is all very well laying suggestions before the trustees, but is it they, or is it the House of Commons, that is to provide the required £80,000? because if it be the latter, I cannot but think that it is rather for the House of Commons to mention its wishes, and for the trustees of the British Museum at once to carry them out.

And now, Sir, let us see how differently matters turn out where you have a responsible Minister of the Crown to deal with. It was during last summer, that the Vice-President of the Council asked for the annual pecuniary grant to the Royal Dublin Society. On all sides it was admitted that it was a valuable and useful society; but my hon. friend the member for Galway (Mr. Gregory) complained that the Council had repeatedly refused to open their gardens at Glasnevin on Sunday afternoons to the public. A discussion took place, and it was eventually decided that the Vice-President should officially inform the Council of the Society that if they did not defer to the expressed wishes of the House of Commons, the subsidy would be withdrawn. That course was adopted, and the result was that the religious scruples of the council vanished, and the gates of Glasnevin gardens were thrown open to the public. If, Sir, I would ask the House, instead of having a responsible minister to look to in that case, we had had one of my hon. friends the members of the city of Dublin moving that vote, and in charge of that question, was it likely that the same result would have ensued? I trow not! No! the House would have been assured, in general terms, that its wishes should be laid before the Council of the Society, and nothing more would have come of it.

And now, Sir, I confess to feeling something akin to terror in approaching my next point; for by this time I have traversed the gloomy passages, and I find myself at the door of the Board-room! face to face with that "very incarnation of irresponsibility," the Board of Trustees itself!

It certainly is an alarming prospect to attack that most powerful body, entrenched as it is in a citadel, fortified by long occupation and by supposed prescriptive right! Well might many a one say to me, "What is the use of so humble an individual as yourself attempting to dislodge so much power, wealth, and influence?" But, Sir, I turned my thoughts to ancient history, and I said if David was able with sling and stone to destroy the giant Goliath, why should not I, with my sling full of truth and facts, attempt to make some impression even on the armour of this hitherto impenetrable body?

The trustees of the British Museum are composed of three classes. The first of them are styled *ex-officio* trustees, and include the Archbishop of Canterbury, the Speaker of the House of Commons, the Chancellor of the Exchequer, and two or three other leading members of the Government. It may indeed be questioned, whether efficiency is secured by placing on the Board of Trustees the very men who are already fully occupied with the most arduous duties, political, civil, and religious. The committee which sat on the Record Commission thought not, and I agree entirely with the words from that report.* It may be said that as members of the Government are to be found among the *ex-officio* trustees, that therefore we have got Parliamentary responsibility. That, however, I maintain is an entire fallacy. Look at the Board of Education. Why, every member of the Cabinet was, until lately, a member of that Board, and yet it had been felt by the House that a responsibility divided among so many was, in fact, tantamount to none at all. So, practically speaking, and excepting on extreme and grave occasions, the action of these *ex-officio* trustees of the museum was weak and unavailing. The second class of trustees is one so anomalous, that I hardly know how to describe them. They are, I believe, called "Family Trustees."† Of these gentlemen, two have the custody of collections presented by their ancestors to the nation; but the other four collections, which have two trustees each, represent property that has not been presented to, but has been actually bought by the nation, and at, in every single instance, a fair market price. So that it would seem that the Government has been in the habit of purchasing collections, and allowing at the same time a trustee to be appointed to take care of the property which his ancestor has disposed of, and the interest of which purchase-money is probably adding to his own material comforts. Why, Sir, I cannot do better to elucidate this point, than again draw the attention of the House to the evidence given by my hon friend the Under Secretary of Foreign Affairs in the committee which sat in 1860. That hon. gentleman was asked, "Do you think that trustees who represent families should interfere in the general arrangement of the museum?" To which he replied, "I have a very strong opinion on the subject. It appears to me, that when a testator appoints a trustee to look after his collection, it is his intention that that collection should be devoted to the purposes for which he bequeathed it, and that it should be properly taken care of. To carrying out these intentions alone, I should confine the duties of a family trustee. He should visit, at certain periods, the particular collection given by his ancestor or person he represents, to see that the wishes are carried out, and nothing else." What would the hon. gentleman the Under Secretary of Foreign Affairs do with those who sold, not left, their collections? The House will observe that my hon. friend here defines the duties of those family trustees whose trusts "were bequeathed" to the nation, and he suggests that they should be confined to visiting, at certain periods, the particular collection given by his ancestor or the person he represents, to see that his wishes are carried out, and nothing else! Well, Sir, then if these are the only duties which the greatest authority on such matters in this House would assign to trustees of collections bequeathed, I should be glad indeed to hear from him what, in the name of common sense, ought to be the functions of the representatives of those gentlemen who have not bequeathed but sold their property for its market value to the nation.

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* "The entrusting these duties to men merely because they have others to perform, appears to be tantamount to leaving work to be done by those who are known to have the least time to do it in."

† Sloane Collection—Earl of Derby, Earl Cadogan. Cotton—Rev. Francis Annesley, George Annesley, Esq. Harleian—Lord Henry Bentinck, Earl Canning. Towneley—Lieut.-Col. Towneley. Elgin—Earl of Elgin. Knight—F. W. Knight, Esq.

And now, Sir, it is time I should ease the minds of the trustees and assure them that I do not intend to propose to the House the revolutionary measure of abolishing them at once. No, Sir, I will leave them where they are, confident as I am that common sense and the growing intelligence of the public will prove far more fatal to them than anything that I can say or do. At present let them remain, and perform those consultative duties for which they are fitted, but nothing more. By all means let them meet to talk and discuss matters in the same style and at as great a length, but with no more executive powers than belong to the Houses of Convocation at the present day.

I have not the boldness to lay down exactly in detail what should be the laws which ought to guide the trustees. That has been done by their own servants, the heads of departments in the museum. Most of those gentlemen have recommended that the trustees should act as a "body of visitors," and others, that they should be a consultative Board. Another experienced witness said he should have no objection to them, provided they had "no sort of authority or control in the administration of the institution." Upon those terms I can have no objection to them myself.

And here, I suppose, I shall hear a cry about interfering with vested rights in interests which, Sir, I deny to exist. But even were it so, I have yet to learn that Parliament is very squeamish in such matters where the public good is concerned. A glance at what was done by the Oxford University Bill will show how much the House respects the wills of founders. But, Sir, I deny that vested rights exist. When the Sloane collection was bought, and the trustees appointed, there was no annual grant given by Parliament. Since then things have greatly changed, and the public funds on which the museum now subsists are as thirty to one in proportion to its private funds; * and yet these family trustees claim not only to manage collections sold by their ancestors but to administer large funds now annually voted, but which were never thought of at the date of their appointment. That is surely a good reason why the House should take the management of these funds out of private and irresponsible hands, and exercise an efficient control over the expenditure.

Thus much for the *ex-officio* and family trustees. There remain the elected trustees, against whom I have less to urge. They consist of men prominent for their ability, their learning, and their high social position, and well adapted for performing the only functions which properly belong to numerous Boards.†

The remedy I would suggest for the evils I have pointed out is the same as that which had been found to answer well for the army, navy, and other public departments—viz., to place the administration under one responsible Minister of the Crown.‡ Where that department shall be it is not for me, of course, to say; that must rest with the Government; but one's mind naturally turns to the Privy Council, which already has some Art collections under its supervision. I should be sorry to do anything that might mar the progress of Art in this country, and I should regret it above all at a time when the nation has not yet recovered from the loss of that illustrious Prince who had devoted his great mind to the cultivation of public taste. His was the head that planned. His the hand that had guided us in these matters for years; and no one would shrink more than I should from taking any step which could in any degree thwart or interfere with that great Prince's wise and beneficent schemes. Nothing can be more gratifying than that large numbers of persons should flock to see the collections to which I have been referring, but at the same time there is another side to the picture. How much does the country pay for these collections? At South Kensington every visitor costs the country 1s. 3¾d.; namely, salaries, 4d.; purchases, 5¾d.; building and miscellaneous, 6d. At the British Museum, with its model management, each visitor costs the country 3s. 2d., of which 1s. 1½d. was spent in salaries, 1s. 1d. in purchases, and 11½d. in buildings.

* The country has spent near £4,000,000 on the British Museum, and continues to vote annually a sum of £100,000.

Private Funds of the British Museum.

1. £30,000 Three per Cent. Reduced Bank Annuities, the annual dividend whereof amounts to £900.
2. The Bridgewater Bequest, the annual proceeds of which amount to about £415.
3. The Farnborough Bequest, the annual proceeds of which amount to £86 3s. 4d.

† Elected:—Marquis of Lansdowne, Sir David Dundas, M.P., Sir Philip Egerton, M.P., Duke of Somerset, Sir R. Murchison, Dean Milman, of St. Paul's, Earl Russell, W. E. Gladstone, M.P., C. Lewis, M.P., Spencer Walpole, M.P., Viscount Eversley, Lord Taunton, Duke of Northumberland, G. Grote, and Sir Thomas Phillips.

‡ "The whole expenditure ought to be under the control of one person, who would, of course, be responsible to that House for the manner in which the duties were performed. If a question was put to the Secretary of War, he could only answer on certain points; if more information was required, application must be made to the Treasury or Ordnance, and it was a very difficult matter to assertain to which department inquiries were to be made; and this system had thrown great difficulties in the way of checking the expenditure of the Army . . . . The present system was contrary to sound principles of finance, and calculated to throw difficulties in the way of a thorough investigation of the expenditure by Parliament." And Mr. Hume concluded by moving—"To place the whole under the superintendence and control of one efficient and responsible Minister of the Crown."—*Joseph Hume.*

"I want to have the various departments responsible to a Secretary of State, and a Secretary of State responsible to the House of Commons, so that the control of the House of Commons should be much greater over the expenditure, for which they had to call on the people to submit to taxation."—*E. Ellice.*

"Though the supplies can only be voted by the House of Commons and though the sanction of the House is also required for the appropriation of the revenues to the different items of the public expenditure, it is the maxim and the uniform practice of the Constitution, that money can be granted only on the proposition of the Crown. It has no doubt been felt, that moderation as to the amount and care and judgment in the detail, of its application, can only be expected when the executive government, through whose hands it is to pass, is made responsible for the plans and calculations on which the disbursements are grounded." Again—"It may be sufficient to say, that the classification of functionaries should correspond to that of subjects, and that there should not be several departments independent of one another to superintend different parts of the same natural whole." Again—"The entire aggregate of means, provided for one end, should be under one and the same control and responsibility."—*John Stuart Mill on Parliamentary Government.*

CORRESPONDENCE.

THE CHAIRMAN'S ADDRESS.

Sir,—The Chairman of your Council, in his opening address, reported in your last number, did me the honour to quote a paragraph "from the preface of a work recently published." As the name of that work was not mentioned, will you kindly permit me to say it is entitled "How to Make Money by Patents. London: E. Marlborough and Co., Warwick-lane."—I am, &c.,

Charles Barlow.

23, Southampton-buildings, W.C., Nov. 26, 1873.

WINE-MAKING IN ITALY.

Sir,—An immense mass of information has been afforded to the public in the course of Dr. Thudichum's Lectures, in regard to the processes followed in many countries of Europe, but I have seen no account of the system adopted by the best Italian wine growers. It is well known that the Italian Peninsula, though small in extent, is divided into numberless petty states and nationalities, having different customs, and speaking languages all diverging more or less from pure Italian.

Undoubtedly the Tuscans are in the most advanced state of civilisation, and it is their wine-making that I shall attempt to describe, more especially as it is by far the most simple and effective process.

The general practice in Tuscany is to keep the vines low, in the form of espaliers, and not more than three sprouting buds are left upon each branch. The grapes are gathered by many hands, as far as possible in dry weather, and quickly carried to the fermenting vats, called "tini" in Italian. The plains of Tuscany, however, do not generally produce good wine, and there is even an old proverb to that effect, so very little attention is paid to it; probably the large amount of salts and minerals in the soil may account for the coarseness of the grapes grown thereon.

Fine qualities of vines are only grown on the hillsides, and it is there that first-class wines are made, for each of which three sorts of grapes are used—the first for flavour, the second for sweetness, with little or no taste, and the third for abundant juice. All these combined produce excellent wines, but the value and name depends entirely upon the first-named.

For two or three days after the vats have been filled, the bunches are forced down with pitchforks once in the day, in order to ensure a perfect mixture; and then they are left alone to ferment for a period of ten or fifteen days, more or less, according to the weather and the nature of the wine intended to be made. Upon no account in making such wines is any treading or pressing allowed.

In former times the fermenting vats were large in

diameter and low, but of late, that is within the present century, they have diminished the diameter, and much increased the height, very greatly to the benefit of the quality of the wine produced.

They have also partly abandoned wooden staves, and now build up a high cone of brick $1\frac{1}{2}$ inches thick from top to bottom, plastered inside and outside with two coats, both the mortar as well as the plaster being made of Italian hydraulic grey lime, tempered with washed river sand, as described by me in another paper. Keyed light iron hoops are slipped on at intervals, in order to obviate the danger of bursting. When the wine has sufficiently worked, according to the judgment of the principal superintendent, two spontaneous operations have been going on, namely, the heavy fæcula has fallen to the bottom of the vat, and the must, or grape-skins and stalks, have risen to the top, and show a projecting body, perhaps two or three feet above the top edge. To all appearance the grapes in that mass seem to be full of juice, but on squeezing one between the finger and thumb, only a blast of wind escapes, showing that all the clear liquor is comprised between the fæcula at the bottom and the crown of must at the top. The exact point of time when this complete separation takes place only lasts, I may say, a few minutes, when the fæcula begins to rise, and the crown to descend, so as very shortly to convert the whole into a mass of mud.

It is the province of the "fattore," steward, or superintendent, to decide when the clear liquor shall be drawn off, and he mostly assists his judgment by a few tentative spill-holes. Fermentation, however, is not absolutely completed until the clear liquor is racked off into large hogsheads with loose bungs, previous to being turned off for keeping in the cellar. The remaining must is either submitted to mechanical pressure for affording the *Vino per forza*—not good for much—or it is diluted with water to make the *Vino piccolo*, or *Da poveri*. The still remaining dry must is put away for three or four weeks, when by a second pressing an excellent vinegar is afforded.

When I speak of really fine Italian wines, it must not be supposed that they can be bought at the wine store, or at the wine merchant's. They are not sold, and can only be tasted at the tables of the rich landowners and nobles, where any foreign wines of pure Italian make may be asked for—not produced by sophistication, but solely by choice of grape and clever manipulation.

For delicate lady's wine, and wines of a light order, the grapes are picked wholly or in part from the stalk. Constantia is equalled and exceeded by the Italian vine of a similar kind, and the same with all other foreign wines of France and Spain, without fraudulent additions.

It is true that the butts intended for receiving sweet wines are slightly sulphured, but nothing like to the enormous extent to which it is carried by the Constantia farmers of the Cape of Good Hope; and be it known that you cannot buy prime Constantia at the vineyards, for the wine you taste is not sold, but only kept for testing; and they direct you to purchase what you want of their wine agents in Cape Town, which turns out to be very far from being equal to that you chose at the vineyards.

Some of the proprietors of the Constantia farms add somewhat to their income by painting grotesque scenes in body colour upon prepared ostrich egg-shells, which they offer for sale to the visitors, and they are legion, who come to taste their Constantias.

The Neapolitans make some good wines, as "Lacrima Christi," but they might make much better, as their soil and climate is everything that can be desired. The Romans generally make sad stuff with their boiling and mixing all sorts together, but better cannot be expected —for after you leave Florence south you find the country people rather tending to semi-barbarism. I must observe, however, that Orvieto, a Roman town on the eonfines of Tuscany, produces a singular natural champagne, which preserves its qualities with only a drop of oil in the neck and a stopper of rush.

The noted Italian wines, are naturally good wines, but only to be obtained of exquisite quality at private vineyards.—I am, &c.,

HENRY W. REVELEY.

Reading, November 1, 1873.

OBITUARY.

Mr. Thomas Baring, M.P., F.R.S.—By the death last week of Mr. Thomas Baring, the Society lost a most active and energetic member. Though of late years he did not take a very prominent part in the Society's action, it is yet indebted to him for valuable assistance in the carrying out of many of its objects. He was a Commissioner of the 1851 Exhibition, and one of the five Commissioners nominated by the Society and incorporated by Royal charter for the management of the Exhibition of 1862. When the Society undertook to raise a fund in aid of the memorial to the Prince Consort Mr. Baring was intimately associated with the movement, and rendered practical help in the arrangement of the details. He was a Vice-President of the Society for many years, having become a member in 1863. He was the second son of the late Sir Thomas Baring, Bart., of Stratton-park, Hampshire, and was born in September, 1800. He was a director of the Bank of England, of the East and West India Dock Companies, and for nearly 40 years Chairman of Lloyd's. He was also one of the Neutrality Law Commissioners, and a fellow of the Royal Society and Royal Geographical Society. He was a Commissioner of Lieutenancy for the City of London, and represented the borough of Huntingdon in Parliament for nearly 30 years.

GENERAL NOTES.

The Resources of Paraguay.—His Excellency Senor Don Gregorio Benites, Minister Plenipotentiary of the Republic of Paraguay, has appointed Mr. Charles Twite, M.E., late reporter to the Royal Commission on Mines, who also explored the mineral resources of Siam; M. Balanza, botanist, late Commissioner of the French Government to Nova Caledonia and Egypt; and Mr. Keith Johnston, F.R.G.S., members of a scientific commission to inquire into and report on the natural resources of Paraguay. Dr. Leone Levi, F.S.S., Professor of Commercial Law in King's College, Consul-General of Paraguay in London, will edit the reports and exhibit them in relation to the economic condition of the country. The reports will be published towards the end of next year.

Maps by Telegraph.—A very ingenious invention has recently been exhibited by M. Dupuy de Lome, at the French Academy of Sciences. It consists in a mode of sending a plan or topographical sketch by telegraph, without necessitating a special drawing for the purpose. Over the map already made is laid a semicircular plate of glass, the circumference of which is graduated. On the centre is a radial arm, also graduated, which carries, on a slide, a piece of mica marked with a blade point. The latter, by its own movement along the arm, and also by that of the arm itself, can be brought over every point in the glass semicircle. Just before the plate is a fixed eye-piece. Looking through this, the black dot is carried successively over all the points of the plan to be reproduced, and the polar co-ordinates of each noted. The numbers thus obtained are transmitted by telegraph. The receiving device is analogous to that part described, but a simple point is substituted for the mica dot, and by it the designated positions on the glass are successively marked.

Colonial Manufacturers.—The New Zealand Government have offered the following bonuses to stimulate colonial manufactures:—£5,000 for the production of 1,000 tons of pig iron of marketable quality. No bonus will be given for less than 100 tons. £2,000 for the production of 250 tons of sugar, manufactured in the colony from the beetroot.

A New Route from North and East Europe.—The opening of the new harbour of Flushing has suggested the advisability of directing the continental passenger and post-office traffic to England *via* that port, taking advantage in the meantime of existing railways, and extending the outer harbour so as to afford room for the reception of steamers large and powerful enough to make the ports of Dover or Harwich in sufficient time to effect the mail and passenger traffic from Flushing to London in about six hours. It is calculated that by this scheme, assuming only the rate of speed now attained by express trains in Germany, and express steamers between England and Ireland, passengers and mails may be carried from London to Hamburg in 16 hours, to Berlin, Dresden, and Munich in 18, to Cologne in 10 or 11, to Vienna in 26, and to Constantinople in 48 hours, employing for such trains suitable sleeping and living carriages.

Public Libraries in Italy.—The libraries richest in modern works are those of Turin, Milan, Florence, and Naples. For works on natural science, the library of Pavia is probably the best in the kingdom, and from 1,500 to 1,600 new works are purchased annually. The number of new works purchased yearly at Turin amount to 2,000; Naples follows next with 1,700; Florence, 1,100; and Milan, 1,200. The number of readers frequenting the public libraries of Italy in 1872 was 853,901, and the number of works consulted 1,230,000, of which 206,489 were literary and philogical, 140,997 historical, 125,005 on jurisprudence and legislation, 104,499 on natural sciences, 103,709 medical, 82,921 mathematical, 65,619 poligraphical, 62,232 philosophical, 56,619 novels and romances, 54,002 journals, 51,343 works on geography and travel, 49,629 political economy and statistics, 38,342 theology, 34,134 fine arts, 21,500 technical, 14,318 educational. At Turin the greatest number of works on medical and natural science are in demand, whilst at Naples and Venice the greatest number of works on theology are read.

The Eucalyptus.—The French Academy of Sciences has received an interesting communication from M. Gimbert, who has been long engaged in collecting evidence concerning the Australian tree, *Eucalyptus globulus*, the growth of which is surprisingly rapid, attaining besides gigantic dimensions. This tree, it now appears, possesses an extraordinary power of destroying miasmatic influence in fever-stricken districts. It has the singular property of absorbing ten times its weight of water from the soil, and of emitting camphorous effluvia. When sown in marshy ground, it will dry it up in a very short time. The English were the first to try it at the Cape, and within two or three years they completely changed the climatic condition of the unhealthy parts of the colony. A few years later its plantation was undertaken on a large scale in various parts of Algeria, and complete immunity from local fever has been maintained by it. In the island of Cuba, paludean diseases are fast disappearing from all the unhealthy districts where this tree has been introduced.

NOTICES.

THE LIBRARY.

The following works have been presented to the Library:—

Easy Introduction to Chemistry. By the Rev. A. Rigg, M.A. Rivingtons. Presented by the Publishers.

Sikhim, with notes on Mountain and Jungle Warfare. By Col. J. C. Gawler, F.R.G.S. E. Stanford. Presented by the Publishers.

A Treatise on the Law of Trade Marks. By F. M. Adams, B.A. G. Bell and Sons. Presented by the Publishers.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

ORDINARY MEETINGS.

For the Meetings previous to Christmas, the following arrangements have been made:—

December 3.—"On Australian Vines and Wines," by J. T. Fallon, Esq. On this evening Sir Daniel Cooper, Bart., will preside.

December 10.—"On Mechanical Processes for producing Decorative Designs on Wood Surfaces," by Thomas Whitburn, Esq.

December 17.—"Whitby Jet and its Manufacture," by John A. Bower, F.C.S., Science Master, Whitby School. On this evening Thomas Chapman, Esq., F.R.S., will preside.

CANTOR LECTURES.

The first course of Cantor Lectures for the ensuing Session is "On Spectrum Analysis as aided by and aiding the Arts," by J. Norman Lockyer, Esq., F.R.S. It consists of two lectures, of which the second will be delivered on Monday evening, the 1st December.

Lecture II.—December 1st, 1873.

On Spectroscopy in its quantitative relations.

MEETINGS FOR THE ENSUING WEEK.

Mon.....**SOCIETY OF ARTS**, 8. Cantor Lectures. Mr. J. Norman Lockyer, F.R.S., "On Spectrum Analysis as Aided by and Aiding the Arts."
Royal, 4. Annual General Meeting.
Social Science Association, 8. Mr. Henry Carr, "On the Mode of Selection of Beneficiaries to Charitable Institutions."
Royal Institution, 2.
Society of Engineers, 7½. Mr. Charles J. Light, "A New Method of Setting Out Slopes of Earthwork."
Entomological, 7.
British Architects, 8.
Medical, 8.
Victoria Institution, 8. Rev. R. Mitchell, "The Identity of Reason in Science and Religion."
London Institution, 4.

Tues....Civil Engineers, 8. Discussion on "Braye Bay Harbour, Alderney."
Pathological, 8.
Biblical Archæology, 8½.
Zoological, 8½.
Sculptors of England, 7.
Anthropological Institute, 8.

Wed....**SOCIETY OF ARTS**, 8. Mr. J. T. Fallon, "On Australian Vines and Wines."
Geological, 8. 1. Mr. H. G. Fordham, "Notes on the Structure sometimes developed in Chalk." 2. Mr. R. Pinchin, "A Short Description of the Geology of the Eastern Province of the Colony of the Cape of Good Hope." Communicated by Mr. H. W. Bristow. 3. Lieut. A. W. Stiffe, "On the Mud-craters and Geological Structure of the Mekran Coast." Communicated by Prof. Ramsay.
National Union for Improving the Education of Women of all Classes, 4. (At the House of the Society of Arts.) Annual Meeting.
Microscopical, 8.
Pharmaceutical, 8.
Obstetrical, 8.
London Institution, 7.

Thur....Antiquaries, 4.
Linnæan, 8. Mr. J. G. Baker, "Revision of the Genera and Species of *Tulipeæ*."

Fri......Geologists' Association, 8.
Philological, 8.
Archæological Institute, 4.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,098. Vol. XXII.

FRIDAY, DECEMBER 5, 1873.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

PRINCE CONSORT'S MEMORIAL.

The following letter has been received by the Secretary, accompanied by a presentation copy of the work in question :—

Buckingham Palace, December 2nd, 1873.

Sir,—Her Majesty the Queen has commanded me to forward to you the accompanying volume, illustrative of the Prince Consort's National Memorial, to be placed in the library of the Society of Arts, as a mark of her Majesty's appreciation of the past exertions of this Society in promoting the erection of this memorial to her beloved husband.

I have the honour to be, Sir,
Your most obedient humble servant,
T. M. Biddulph.

P. Le Neve Foster, Esq., Secretary Society of Arts.

NATIONAL TRAINING SCHOOL FOR MUSIC

H.R.H. the Duke of Edinburgh has appointed Thursday, December 18th, for laying the first stone of the building for the school. The site is to the west of the Royal Albert Hall. A *conversazione* and concert will be given by the Society in the evening, in the Albert Hall, the use of which is lent by the Council of the Hall. Cards of invitation will be issued to members in due course.

INDIA COMMITTEE.

The Committee met 2nd December. Present—Hyde Clarke, Esq. (in the chair), Dr. Boycott, Andrew Cassels, Esq., Dr. Campbell, Col. Gawler, W. Lloyd, Esq., S. Ward, Esq. Arrangements were made for the renewal this session of the conferences on subjects connected with India, to be commenced on Friday, 12th inst., and the offer from the Right Hon. Sir Bartle Frere, K.C.B., to state his views on the threatened Indian Famine was accepted with thanks.

ESSAYS ON THRIFT.

For this prize fifty-three essays have been sent in.

HALL-MARKING OF JEWELLERY.

For this prize seventeen essays have been sent in.

PURCHASE OF RAILWAYS BY THE STATE.

The following memorial has been addressed by the Council to Mr. Gladstone :—

To the Right Honourable W. E. Gladstone, M.P., First Lord of the Treasury.

1. The Council of the Society for the Encouragement of Arts, Manufactures, and Commerce, incorporated by Royal Charter, desire to direct the attention of her Majesty's Government to the very unsatisfactory state of the law as regards Railway amalgamation, and to the necessity of an inquiry into the results which might be expected from the amalgamation of the great railway companies as compared with the acquisition of the railways by the State.

2. Last year Bills were introduced by the London and North-Western Company for their amalgamation with the Lancashire and Yorkshire Company, and by the Midland with the Glasgow and South-Western Company; and as these Bills, if passed, would undoubtedly be followed by those of other Railway Companies of a similar kind, the result might ultimately be expected that a monopoly of the whole traffic of the country would be divided between four or five great Companies.

3. Government, having been of opinion that amalgamations of such a nature and extent should not be sanctioned without special inquiry to consider how far such amalgamations were consistent with public interests, had a joint committee of the leading members of both Houses of Parliament appointed to investigate the subject. After a lengthened inquiry, the subject of State acquisition of the railways being only incidentally touched on, the committee declined to express an opinion as to whether or not these amalgamations should be sanctioned by Parliament, but they came, *inter alia*, to the following conclusions :—

"1. That combination between railway companies is increasing, and is likely to increase, whether by amalgamation or otherwise.

"2. That it is impossible to lay down any general rules determining the limits or the character of future amalgamations.

"3. That combinations between railways, effected with or without legislative sanction, may lead, in the end, to the creation of corporations, so few, so large, and so powerful as to render it expedient, on political if not on commercial grounds, that a fundamental change should take place in the present relations between the railways and the State.

"4. That so far as the evidence offered to this Committee has touched on the subject, the only remedy suggested for such a state of things is the acquisition of the railways by the Government. It does not, however, appear to us that any present necessity exists for entering upon the full and prolonged inquiry which so great and difficult a question would demand."

4. The committee, after making certain very excellent recommendations for the improvement of railway management, go on to say that even—

"If the above recommendations are adopted by Parliament, they will not have the effect of preventing the growth of railway monopoly, or of securing that the public shall share, by reduction of rates and fares, in any increased profits which the railway companies may make."

5. In the last session of Parliament the great Companies again brought forward their amalgama-

tion bills, which were referred to a committee, and their preambles, by an unanimous vote, were declared not proved. This state of affairs is most unsatisfactory, both to the public and the companies, as the question is still unsettled whether or not these great amalgamations should be sanctioned by Parliament, or, if sanctioned, on what conditions. On the other hand, although the Act of 1844, authorising the purchase of the railways by the State, could have been made available for several years past, no inquiry has yet been authorised by her Majesty's Government or either House of Parliament as to the necessity or desirability of such an organic change as that contemplated by the Act of 1844. It is admitted by all parties that, under proper provisions, the public would benefit largely by the saving and improved working arrangements that would be effected by unity of management, but the question for consideration and decision is, whether in the interests of the public that object would be more efficiently carried out by the Companies or by the State. The joint-committee state that, as the law at present stands, the public would derive no advantage from the proposed amalgamations, and under such circumstances it is very improbable that Parliament would sanction them. It is therefore the interest alike of the Companies, who are put to such heavy expense by fruitless applications to Parliament, and the public, who are deprived of the benefits resulting from unity of management, to have the subject thoroughly investigated and disposed of without further delay.

6. The joint-committee appointed in 1872 had no instructions from Parliament to consider the alternative they refer to in their report of State purchase, and, as already stated, declined to express any opinion on the amalgamation of the great Companies. But the reduction of fares and rates, in a financial point of view, is one of the greatest importance to the nation. The payments of the public to the Companies last year exceeded £53,000,000, and as the annual increase in these payments amounts to about £4,000,000, no very long period may be expected to elapse before they will equal the whole revenue of the kingdom.

7. Under these circumstances your memorialists respectfully request that, in justice to the public and the Companies, either a Royal Commission be appointed or the joint-committee which so fully investigated the subject of amalgamation should be reappointed in the ensuing session of Parliament to undertake that "full and prolonged inquiry" as to questions of general management, amalgamation, and the acquisition of the railways by the State, to which they refer, and which inquiry appears indispensable to a proper settlement of this important question.

Sealed with the seal of the Society for the Encouragement of Arts, Manufactures, and Commerce, this 4th day of December, 1873, in the presence of

(L.S.) P. LE NEVE FOSTER, *Secretary.*

In the *Journal* for November 28, page 35, first column, six lines from top—for "of brick, 1½ inches"; read, "of brick, 4½ inches."

PROCEEDINGS OF THE SOCIETY.

THIRD ORDINARY MEETING.

Wednesday, December 3rd, 1873; Sir Daniel Cooper, Bart., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Brown, Ralph, Brunswick-terrace, Wednesbury, Staffordshire.
Cleaver, Edward Lawrance, 20, Ladbroke-road, Notting-hill, W.
Darlow, William, 435, West Strand, W.C.
Giles, Benjamin, 2, Royal-parade, Blackheath, S.E.
Gilles, Malcolm, 4, Waddington-terrace, Windmill-street, Stratford, E.
Hart, Edward, 57, Moorgate-street, E.C.
Heath, Robert, J.P., the Grange, North Staffordshire.
Jenkinson, James, 229, Grange-road, Bermondsey, S.E.
Lloyd, Edward J., Hatton-hill, Warwick.
Murdoch, William Buchan, 115, Cannon-street, E.C.
Richards, W. Phelps, Messrs. W. and F. Richards, brewers, Kensington, W., and The Poplars, Shepherd's-bush, W.
Slate, Archibald, the Brewery, Chiswell-street, E.C.

The following Candidates were balloted for and duly elected members of the Society:—

Abbott, Samuel, 72, Wilson-street, Derby.
Aird, John, jun., 14, Hyde-park-terrace, W., and Belvedere-road, Lambeth, S.E.
Allen, Thomas Bull, 7, Billiter-square, E.C.
Ansell, Charles, jun., 2, King William-street, E.C.
Arrol, Archibald, 16, Dixon-street, Glasgow.
Bain, Robert A. D., Albert Embankment, Lambeth, S.E.
Baldwin, Houghton, Elmstead, Chiselhurst.
Banister, Frederick D., Engineer's-office, London, Brighton, and South Coast Railway, London-bridge, S.E.
Bartlett, William, 39, Canning-street, Liverpool.
Behr, F. B., 27, Marloes-road, Cromwell-road, S.W.
Blackburne, J. W., Ivy-cottage, Burleydam, Whitchurch, Salop.
Blakiston, Matthew, 18, Wilton-crescent, S.W.
Blockley, Frederick M., 42, Pall-mall, S.W.
Bloomer, John, 69, Upper Gloucester-place, N.W.
Brundell, Benjamin Shaw, Hall-gate, Doncaster.
Buck, Joseph Haywood Watson, London and North-Western Railway, Engineer's-office, Watford.
Burgess, Edward James, 29, Palmerston-buildings, Old Broad-street, E.C., and Pittville-house, St. James's-road, Brixton, S.W.
Calderon, Don Abelardo Alvarez, Ivyhurst, Edge-hill, Wimbledon, S.W.
Calvert, John, F.G.S., Kulu Valley, Punjab, India.
Cawkwell, William, Euston-station, N.W.
Chance, James T., Four Oaks Park, Sutton Coldfield, Warwickshire.
Coulthard, H. C., C.E., 25, Duke-street, Westminster, S.W.
Craufurd, George Ponsonby, Buenos Ayres, Rio da Prata.
Craven, Mr. Councillor, Woodland-house, Whalley-range, Manchester.
De Tivoli, Professor Vitale, Oxford, and 94, Stockwell-park-road, Brixton, S.W.
Donaldson, William, 41, London-street, Reading.
Dorman, Mark, J.P., Melbourne-crescent, Northampton.
Douglass, James N., Trinity House, E.C.
Edwards, William, 366 and 368, Euston-road, N.W.
Emden, Walter, 8, Adam-street, Strand, W.C.
Eunson, John, Gas Light Company, Northampton.

Fairbank, Josiah Forster, C.E., 18, Abingdon-street, Westminster, S.W.
Farwig, John F., 36, Queen-street, Cheapside, E.C.
Faviell, W. F., Down-place, near Guildford.
Forbes, J. S., London, Chatham, and Dover Railway, Victoria Station, S.W.
Franklin, J. W., 3, Pemberton-road, St. John's-park, Upper Holloway, N.
Gooch, John Viret, Reform Club, Pall Mall, S.W.
Goold, J., 8, Forbes-road, Penge, S.E.
Govett, Charles Albert, 10, King's Bench-walk, Temple, E.C.
Gray, John William, C.E., 16, Southampton-buildings, W.C.
Greck, P., 56, Hereford-road, Bayswater, W.
Green, Charles James, Rushall, near Walsall, Staffordshire.
Grierson, James, Great Western Railway Company, Paddington, W., and 4, Holland-villas-road, Kensington, W.
Hamand, Arthur S., Stephenson Chambers, New-street, Birmingham.
Harker, William, Norwood, Beverley.
Hart, Henry Neville, 107, Harley-street, Cavendish-square, W.
Hartley, Frederick W., 55, Millbank-street, Westminster, S.W.
Healey, B. D., Swansea.
Heron, John, Bandon, County Cork, Ireland.
Hogg, Col. J. M., M.P., 26, Grosvenor-gardens, S.W.
Innes, Lieut.-Col. P. R., 59, St. George's-square, S.W., and Junior United Service Club, S.W.
Johnson, Frank, 110, Cannon-street, E.C.
Johnson, Henry William, 331, Camden-road, Holloway, N.
Langley, Alfred A., Great Eastern Railway, Stratford, E.
Livesey, George T., South Metropolitan Gas Light and Coke Company, 589, Old Kent-road, S.E.
Lund, George, 42, Pall-mall, S.W.
Lydgate, Robert, 20, Clayton-place, Peckham, S.E.
Macey, George Robert, 2, Holland-road, Kensington, W.
Mackinnon, Alexander K., Belgrave-mansions, Grosvenor-gardens, S.W.
Marillier, Robert A., 1, Harrow-terrace, Stepney, Hull.
Martin, H. O., 7, Adam-street, Adelphi, W.C.
Martin, James A. N., Tizpore, Assam, India, care of Messrs. Denny, Bailey, and Co., 29, Great St. Helen's, E.C.
Milligan, Robert, C.E., 6, Brockley-buildings, South John-street, Liverpool.
Mitford, Robert Sidney, Downshire-hill, Hampstead, N.W.
Moorsom, L. H., Manchester Central Station Railway, Engineer's office, Windmill-street, Manchester.
Newman, Thomas, Bell-lane, Spitalfields, E.
Noakes, Thomas Joseph, 195, Brick-lane, Spitalfields, E.
Paddon, J. B., Hove, near Brighton.
Palmer, John B., C.E., 57, Gracechurch-street, E.C.
Peacock, Richard, Gorton Foundry, Manchester.
Plevins, C. H., Dunston-hall, near Chesterfield.
Pope, Frederick, 14, Upper Montagu-street, Montagu-square, W.
Poppleton, Henry, College Boarding School, Farnham.
Potter, W. A., Cramlington-house, Cramlington, Northumberland.
Ravenhill, John Richard, Glass-house-fields, Ratcliffe, E.
Read, W. T., 207, Maida-vale, W.
Reynolds, James, 174, Strand, W.C.
Robertson, D. F., Dundee, care of the African Barter Company, 30, Gracechurch-street, E.C.
Robertson, George, F.R.S.E., 47, Albany-street, Edinburgh.
Ross, Owen C. D., 41, Craven-street, Strand, W.C.
Sullivan, D., 6A, Sylvan-grove, Old Kent-road, S.E.
Thin, J., Ormiston-lodge, 169, Brixton-road, S.W.
Tombleson, Henry William, 184, Camberwell New-road, S.E.
Trevor, Henry, the Plantation, Norwich.
Tucker, G. A., Ph.D., Bay-view-house, Cook's River, Sydney, care of C. L. Tucker, 24, Sutherland-place, Wolverhampton.
Turner, John, Crown Brewery, Lewisham, S.E.
Wade, C. G., 46, Strand, W.C.
Walburn, Edmund, Grosvenor College, 366, Brixton-road, S.W.
Welsh, Edward, Witham-office, Boston, Lincolnshire.
West, James, 151, Poplar High-street, E.
Whitaker, Frederick, Horton-street, Halifax.
Whitwell, Thomas, Stockton-on-Tees.
Wigan, James, Cromwell-house, Mortlake, S.W.
Williams, R. P., 9, Great George-street, S.W.
Winder, Thomas R., Pentewan, St. Austell, Cornwall.
Woodward, T., Plough Brewery, Wandsworth-rd., S.W.
Worssam, Samuel William, Oakley Works, King's-road, Chelsea, S.W.

The paper read was :—

AUSTRALIAN VINES AND WINES.

By J. T. Fallon (Melbourne, Victoria).

In having the honour of appearing before this Society, and reading a paper "On Australian Vines and Wines," it is not my intention to praise the wines of Australia by asserting their superiority over those of other countries; but, in plain and straightforward language, to lay before the members, and through them the public at large, a short history of the advance made in the cultivation of the vine in the colonies of Australia, and in connexion therewith the growth of the industry of wine-making.

In taking upon myself this task, I trust that no one here present, or any other who may hereafter peruse this paper, will think that I have been induced to do so by any selfish motive; but, on the contrary, give me credit for having a desire to benefit the *vignerons* of Australia; and, by so doing, bring under the notice of the mother country the importance of this growing colonial industry.

When I left Melbourne a few months since, I had not the slightest idea of occupying my present position. My then sole object and intention was to visit all the vineyards of known celebrity in the wine-growing districts of the continent, with a view of personally inspecting the several modes and operations pursued by the various wine-producers, and comparing their methods with those already in general use in Australia; that, on my return, I might introduce and recommend those which I conceived would be an improvement in the mode of wine-making in my adopted colony.

In furtherance of this intention I visited, amongst others, the vineyards of Johannisberg, Steinberg, Rudesheimer, Berg-Berg, situated in the Rhine district of Germany, the Chateau Lafitte, the Chateau Margaux, and the Grand La Rose in the Medoc district of France, besides all the distinguished vineyards in the Burgundy, Charente, and Champagne districts of that country, and, subsequently, the Vienna International Exhibition, where, making the wine collection my especial study, I must say that I was surprised and extremely regretted to see such a poor display of Australian wines exhibited. In fact, the whole productions of the colonies were so miserably represented, that

a stranger, looking at the display made by the Australias, could form no idea of the advancement made in the manufactures of those colonies, and of the importance of that portion of her Majesty's possessions. However, what wines were shown, I found were highly spoken of, especially some "Riessling," exhibited by the Acclimatisation Society of Victoria. Seeing such high merit awarded to the colonial wines by such competent judges as those acting at the Vienna Exhibition, and comparing the recent experiences gained on my continental travels, I formed the opinion that there are millions of acres throughout the Australasian colonies which, from their situation as regards climate, aspect, and soil, are especially adapted for the culture of the grape. There is far less to be apprehended from bad seasons in Australia than in Europe; the fruit now obtained is equal to any in the world, and with experience gained year by year, and greater care and attention shown to the niceties of the cellar management, and sufficient time being allowed for the wines to mature before sending them to market, an article can be produced which will be in no way behind many of the productions of Europe. In forming this opinion, I am proud to say I am confirmed by professional wine-tasters of great eminence, persons far more competent than myself to form a judgment, who, on tasting the colonial exhibits of wine, have given it as their opinion that these wines would bear favourable comparison in every respect with the wines of a similar description produced on the continent of Europe.

Finding that the merits of good Australian wine were not recognised in England, and that a prejudice existed—in consequence of certain wines manufactured in the colonies by persons having little or no experience, and over which no proper care had been taken, and of an immature age, being introduced into the English market—I have determined, in the interests of those Australian wine-producers who have embarked their capital in this new industry, and who have a reputation to maintain in producing and introducing a good, sound, mature wine for consumption, to come forward, and, in an humble manner, state the qualifications of Australian wines in England, where their merits and qualities are so little known and recognised. I feel assured that the matter only wants to be properly ventilated to be appreciated; and if this end be attained through any remarks of mine, I shall be amply repaid, and shall in after life feel proud of the position accorded me this evening in being privileged to come forward in the interest of the wines of Australia.

Having thus introduced myself and my subject to your notice, and given my reason for undertaking the task, I shall proceed to give a brief sketch of the introduction of the vine, and the rise, advance, and progress of wine-making in Australia. Prefacing my remarks with the statement that, on account of the great distance from my adopted home and the limited time of my visit in England, I have relied entirely on my own resources, and such official statistics as could be furnished me through the courtesy of Sir Charles Cowper, the Agent-General of New South Wales; the Hon. Archibald Michie, the Agent-General of Victoria; and the Hon. Francis Dutton, Agent-General for South Australia, to whom I now take the opportunity of returning my thanks.

To the late Sir William M'Arthur must, I believe, be accorded the credit, praise, and thanks of Australians, for first introducing the vine into that continent. This gentleman, an early settler in New South Wales, was one of its early benefactors, and spent large sums of money in introducing many sources of its present valuable exports. Perceiving that the climate and soil of New South Wales were peculiarly adapted for the growth of the vine, he ordered, through his manager, the late Mr. Bushby, a large selection of the best kinds of plants from the district of the Rhine.

During my late travels in the wine districts of that country, I learnt from Messrs. Deinhardt, Jordon, and Co., of Coblentz, that the first parcel of vines was ordered by Sir William M'Arthur from their now celebrated firm. These plants, on their arrival in New South Wales, about the year 1840, were planted on Sir William M'Arthur's Camden-park estate, situate about forty miles from Sydney. This importation was from time to time supplemented by various other selections from Europe. In the course of time, the first parcel of wine in Australia was manufactured from grapes grown on the same estate. From that time to the present period, Sir William M'Arthur has obtained for himself a name in the Australian colonies for the "Camden wines."

The next step was the establishment of vineyards in the Hunter River District, in the northern division of the colony of New South Wales, by the late Mr. Wyndham, Dr. Lyndeman, Messrs. Doyle and Carmichel, all of whom have now large and extensive vineyards, and are celebrated for their produce. From the success attending the efforts of the late Mr. Wyndham on the Hunter River, that gentleman planted and laid down in vines a fine piece of land, then occupied by him on the M'Intyre River, and established his name for the "Bakullah wine." This wine, both red and white, is well known, and justly renowned for its excellences.

While the vine was gradually spreading in the north, Mr. John Smith, an old colonist of Kyamba, also in New South Wales, seeing that the land of his district was equally suitable for the culture of the grape, obtained from Sir William M'Arthur a small quantity of vines, and planted them on his estate. In consequence of the success attending the experiment, Mr. Smith obtained vines direct from Europe, and to him must be accorded the praise of first introducing German *vignerons* into the southern district of New South Wales. At the period of their arrival in Sydney, travelling into the interior of the colony was difficult, dangerous, and expensive. Notwithstanding these obstacles, Mr. Smith determined to brave the difficulties of road and flood. He started with the Germans from Sydney, over unformed roads, crossing rivers without bridges, and after encountering all the difficulties of a colonial journey, arrived at his destination; the time occupied being as long as that now taken by the postal communication of the colony with England.

When these Germans had completed and served the time agreed on with Mr. Smith, they pro-

ceeded to Albury, a township situate on the north bank of the Murray River. Finding the soil and climate well adapted for the growth of the vine, they made arrangements with the Messrs. Crisp to take a portion of their freehold land, ten acres in extent, on an improving lease. This piece of land they planted with vines in 1851.

These Germans, Messrs. Schubach, Fraunfelder, and Rau, may justly be called the pioneers of the vine in the valley of the Murray. This district is considered the garden of the vine, and the river may be called the Rhine of Australia. When the first operations were commenced, they had a kind of celebration at the planting of the first vine in Albury. Fraunfelder produced a bottle of sherry, and, after partially covering the cutting with earth, poured a portion of the contents of the bottle upon it; and on drinking success to the future of the undertaking, made an effective speech in his native language, wishing good fortune and prosperity to the extension of the vine on the Murray, which he said so much reminded him of his beloved Rhine and Fatherland. After enduring and struggling against poverty for two years, the efforts of these three enterprising men were rewarded by an abundant crop in the third year. At this period great excitement, arising from the discovery of gold, prevailed, and they were in consequence enabled to realise high prices for their produce, and not only surrounded themselves with the comforts of life, but also laid by money before the termination of their lease with the Messrs. Crisp. With this money they purchased the sites of their present well-known vineyards in New South Wales at Albury, and erected suitable buildings and appliances for wine making.

I may mention that the plant, the subject of the vinous baptism before-mentioned, was taken up by the late Mr. Fraunfelder at the termination of his agreement with Messrs. Crisp, and is still to be seen hung up under the verandah of his cottage, where it is kept as an heirloom by his family, and a memorial of the first vine planted in the valley of the Murray.

The success attending the labours of those esteemed and well-respected colonists induced them to send home to Germany for their friends and relatives, and on their arrival in Australia they applied themselves to the culture of the vine on the hills and slopes bordering on the neighbourhood of the Murray river. In a few years a great change was wrought by their industry—the wild bush was cleared and converted into blooming vineyards, orchards, and gardens. A large influx of German population followed, their friends settling down about the locality originally fixed upon by the pioneers.

While the Germans were thus turning their attention to vine culture, the English settlers were not far behind in taking advantage of this valuable industry. Seeing the advantages derived from the labours of his German neighbours, Mr. John Mildred Sanger, an enterprising colonist, put his energies to work, and planted a vineyard at Corowa, about 40 miles below Albury, on the banks of the Murray.

Then, in about 1858, followed the formation of the well-known "Murray Valley Vineyard Company," an association formed under the provisions of the Joint-Stock Companies Act of the colony. This company obtained the privilege from the then government of selecting a section of land 640 acres in extent, that being the fullest quantity then allowed, and purchased it at the upset price of £1 per acre. Availing themselves of this great advantage, the association selected the best position for the company's operations within four miles of Albury, and commenced work on a large scale, the aercage now in bearing being about 150 acres. The wine produced from this vineyard is second to none in the colonial market. That vineyard has since passed, by purchase, into my possession, and is now worked by myself.

While this company was carrying on operations, Messrs. S. A. Meyer, Ford, Whitehead, and Brown Brothers, of Corowa, planted large vineyards, as also did Messrs. Reid and Burrow Brothers, of Moorwatha, situated about twenty miles below Albury, on the Murray River. The outlay expended by these gentlemen has given them profitable returns, and the wines produced have proved of very superior quality. Many others followed their example, and the industry, not known in this portion of the colony eighteen years ago, now extends a distance of 150 miles along the banks of the Murray River, yielding abundant crops, and producing various wines now celebrated as "Murray wines."

While the cultivation of the vine was thus rapidly spreading in the colony of New South Wales, cuttings taken from the original stock imported by Sir William McArthur, and planted on his Camden estate, were, at a very early date, introduced into the Port Philip district, now familiarly known as the colony of Victoria. These cuttings were, I believe, first planted in the Geelong district, and from the adaptability of the soil and climate of that locality for the cultivation of the grape, the experiment was practically tested, and ultimately success crowned the undertaking, and the vine was established. Another portion of the plants was obtained direct from the wine districts of Spain, Portugal, and France by enterprising settlers in South Australia. From these importations several vineyards were formed in Victoria by cuttings being obtained from that colony. It has been stated that some of the vineyards on the Barrabool Hills, near Geelong, were originally planted with cuttings brought direct from Germany and Switzerland by immigrants from those countries; but how far this is correct, and to what extent the produce of such vines has spread, it would be impossible for me to say. The multiplicity of names given in different countries, and in some instances in the same country, to a particular kind of vine, renders it difficult to trace it back to its original introducers. But though the fact had been proved beyond doubt that the vine would grow with the greatest luxuriance in Victoria, yet the efforts to produce a good wine were not very successful at the time of its early introduction. The Hon. Dr. Hope, of Geelong, as early as the year 1851, had fair vineyards in full bearing, and producing a drinkable wine.

With the change in colonial society in the year 1852, consequent on the discovery of gold in the colonies, and the rapid influx of population attendant thereon, the colonial wine industry was nearly destroyed. The enormous prices obtainable for fruit of all kinds, the comparative

cheapness and abundance of imported wines, as compared with the demand, and the great scarcity and high price of labour, rendered it folly to think of converting grapes into wine. In consequence of these drawbacks, for several years little progress was made in forming vineyards, as shown by the fact that in the year 1856 the Victorian vineyards only comprised 276 acres, from which 11,000 gallons of wine were manufactured.

About the year 1858-9, an attempt was made by the late Mr. Ralph Hutchinson, at that time the Sydney agent for Sir Wm. McArthur's "Camden Wine," to sell a few small parcels in the Melbourne markets, so as to form the nucleus of a trade; but he could hardly get them off his hands, even at a sacrifice. Notwithstanding this failure, another gentlemen appeared in the field, in the person of Mr. Blake, well known as the first successful introducer of the New South Wales wines into the Melbourne market. By perseverance and assiduity that gentleman succeeded in gradually overcoming the prejudices of the popular taste, and establishing the well-known brands of "Camden Park," "Irrewang," and "Kaludah." The superiority of quality and flavour of these wines created a good demand, and a trade was established. The supply at the time being small, Mr. Blake found it impossible to obtain samples of sufficient age for his purposes.

To the endeavours of this gentleman, the *vignerons* of Victoria owe no small debt of gratitude. Profiting by the success attending his attempts, and by the experience of former years, and recognising more fully the great importance the production of the vine had already gained in the neighbouring colonies, there was a marked increase of land planted with vines. In the year 1861 there were already 1,138 acres laid down, which, in 1865, five years later, had increased nearly fourfold, that is to say, to 4,078 acres, on which 8,199,618 vines had been planted, producing 176,959 gallons of wine, and 795 gallons of brandy, as well as 18,063 cwt. of grapes sold for table purposes.

Although the district of Geelong may claim to have been the first to introduce the vine on the south side of the dividing range, there are other localities where the extension of its cultivation has been carried on to a far greater extent. The principal one is Yering, near the township of Lillydale, about forty miles from Melbourne.

Many fine vineyards are established here. Amongst the principal are those of Messrs. Rubert and Paul De Castella, and Messrs. De Pury and Langdon. The two former have vineyards of upwards of 100 acres each in extent, all in full bearing; with first-class cellars and appliances for wine-making. The latter have about sixty acres of vineyard with the requisite conveniences for wine making. These estates produce a first-rate quality of light wines, which are celebrated for their pleasant flavour and fine bouquet.

There is in the Sunbury district the vineyard of the Hon. J. G. Francis. This vineyard clearly shows care bestowed in the cultivation of the vine, and the cellars give evidence of the skill possessed by the manager in maturing and bringing his wines into a marketable condition.

From Riddell's Creek, I have also tasted some fine samples taken from the estate of Messrs. Knight Brothers.

In the year 1862 the vine was introduced into the Sandhurst district, a locality situate on the north side of the dividing range, thoroughly protected from the chilling blast of the south wind, and having its natural sun-heat much increased by radiation from the broad, treeless plains stretching to the banks of the Murray. This district is one of the largest and best adapted for the production of generous wine. It enjoys immunity from all danger of a fall of rain during the vintage season, and consequently the fruit is ripened to perfection, and fermented at an even temperature. In fact, the climate of Sandhurst differs widely from any south of the dividing range in most of those characteristics which distinguish one climate from another. It is hot and dry, but not too dry for the vine, resembling, in a great measure, the climate of the Upper Murray; and consequently the wines produced are entirely of a different character to those made in the southern side of the dividing range, and are similar in quality, in many respects, to the wines of the Murray River.

Though mentioned last, the best, and by far the most important wine-producing locality of Victoria is the Murray and Ovens district. Here large tracts of country have been converted into vineyards, for which the soil and climate have been proved to be well adapted. In those localities every farmer cultivates his vineyard.

The growers who first introduced the vine into this part of Victoria were Messrs. Lindsay Brown, whose estate is situate on the banks of the Murray River, the late Rev. J. Docker, of Bontherambo, on the Ovens River; Mr. Curtis Reid, of Reidsdale, on the same river; and Mr. Piper, of Benalla.

Another enterprise is the Barnawatha vineyard, at present the property of Mr. Philip George Gherig. This undertaking was originally planted by a joint-stock company, under the title of "The Barnawatha Vineyard Company." It is situate on the banks of the River Murray, about fifteen miles from Albury. Planting was commenced about the year 1859, but, owing to the high rate of labour, and some mismanagement, the association was compelled to dispose of its property. The present owner is working the vineyards profitably, and producing some excellent wine. The property consists of about fifty acres, and is favourably situated.

Mr. McIlree, of Wadonga, and Dr. Mueller, of Yachandandah, have also fine vineyards, from which well-known prize wines are produced. At Brown's Plains, on the Murray River, 25 miles from Albury, there are a great number of vineyards. Messrs. Morris and Frazer are the largest growers. The late Mr. Graham planted a large area of land with vines, which is now cultivated by his family. Excellent wines are also produced by several others in this locality. From the nature of the soil and climate of this part of the colony, situate, as it is, on the banks of the Murray River, the grapes arrive at great perfection and produce large returns. During and before the vintage there is little or no rain. The result is that the fruit arrives at a higher state of perfection, and a far higher amount of saccharine matter is obtained than in almost any other part of the colony. This produces the result that a fuller-bodied and more

generous wine is made, which, from its natural strength, will bear transporting to any part of the world—a feature, it is needless to say, of especial value.

The few names I have here introduced can give no idea as to the number of persons immediately interested in this important product; but when I say that for one hundred miles along the banks of the River Murray are to be found thriving vineyards, it may convey some little idea of the extent to which the industry has grown, and yet it is only in its infancy, for there are hundreds of thousands of acres, all adapted for vine culture, waiting the skill and industry of the *vigneron* to develop their resources.

In referring to the vine culture in the colony of South Australia, I regret extremely that it is not in my power to give a very distinct history of the rise and progress of this industry in that colony. Unfortunately, my travels and experiences have been chiefly confined to the colonies of New South Wales and Victoria, so that I have no resources within my own knowledge to fall back upon, and the shortness of time at my disposal has prevented me from having proper opportunity for reading up the subject.

That this part of my paper is short and meagre, is entirely attributable to my want of knowledge. I therefore trust that the colonists of South Australia, interested in vine culture, will give me credit for this, and not think it is done with any intention to slight or misrepresent their interests, or to exclude their colony from the leading position it deserves to take in reference to wine making. It is to South Australia I must give the palm of doing more than any other of the Australian colonies in the advance of this industry.

In referring to the first introduction of the vine, I believe I am correct in saying that South Australia was originally indebted to the efforts of the late Sir William McArthur. After his experiment had been fully tested in New South Wales, the early settlers of South Australia became fully alive to the great advantage to be derived from vine culture; and, seeing a great future return for their outlay, embarked largely in the undertaking. They ordered selections of plants from the wine countries of Germany, Spain, Portugal, France, and Switzerland, at the same time importing foreign labour from those countries to superintend and manage the industry. Among the first who took advantage of this were Dr. Kelly, who subsequently wrote several interesting and useful works upon the management, culture, and treatment of vines; Mr. P. Auld, of Auldina; Mr. E. J. Peak, of Clarendon; Mr. David Randal, of Glen Para and Randallsen; Messrs. R. and J. Scott and Mr. D. Fisher.

Such has been the rapid growth of this industry that vineyards are now thickly planted around and within a radius of fifty miles of Adelaide, also on the Barossa range, and in many other parts of the colony.

The wines produced in South Australia are of much promise. They show, in many cases, great care and attention in their preparation, and are pure and good. Their variety is striking, and their range of spirit strength surprising. Their keeping powers are excellent, but more time should be allowed for the wine to mature. In character some of the wines of this colony closely resemble the Rhenish wines, while others approximate more to the finer descriptions of white Portugal wines and the red wines of the Rhone. A few present more distinctive features, attributable, no doubt, to the peculiarities of soil and climate. Wherever these wines are exhibited, they have obtained many first-class medals, and are generally highly and favourably spoken of by competent judges.

It must be borne in mind that although the Colonies possess every variety of climate and soil obtainable in any of the wine-producing countries, yet they have not been fully prospected as to their capacities for yielding wines. The vines best suited to each locality are yet by no means clearly ascertained, and the system of making wine must for some time longer be experimental rather than fixed. I will now proceed, in a few words, to point out the advantages of the vine culture in Australia.

I believe that wine will become one of the staple commercial exports of Australia. This, of course, will be wholly a matter of time, and it is entirely in the hands of the wine-growers of Australia when that time shall arrive. It only requires proper care, and attention in the selection of plants suitable for the adaptabilities of the soil, in keeping the various grapes separate and distinct in the preparation of must, and allowing proper time for the maturing of the wine to elapse before bringing it into the market, to make Australian wines successfully compete with those of European countries.

Many of the mistakes of the early *vignerons* have been lately avoided, and a vast improvement made in the character and flavour of the wines, so much so that their productions now command a ready sale in the colonial market. To such an extent has the demand increased that the colonial article has now a prominent place, and is consumed to a far greater extent than the ordinary imported wine. It is now a common practice to introduce the colonial wine bottle instead of the stereotyped port or sherry. No dinner-table in the colonies is complete without there being two or three different kinds of native wines represented, and these are generally preferred by the guests. The consumption of colonial wine increases year by year, and in consequence its production has become a very profitable branch of business.

The extension of the cultivation of the vine and wine-making will doubtless have a most salutary effect on the prosperity of the colonies generally. By acting as a check upon the use of ardent spirits, the use of wine produces a good effect upon the morality of the people, particularly in the rising generation. Before the introduction of Australian wines, the bulk of the people in the colonies, especially the working classes, drank nothing but strong rum or brandy, &c., of inferior quality. I need not here state the demoralising effect the unrestricted consumption of these liquids produced. But since the introduction of wine, manufactured from the pure juice of the grape, a very sensible change for the better has taken place in the drinking habits of the people. The labouring classes now prefer colonial wine, which can be obtained by them at colonial wine-shops in Melbourne, at the cheap rate of two-pence per glass, instead of bad

brandy and worse "square gin." Not only can this be said of spirits, but also of the stronger fortified wines imported from the continent of Europe, as will be seen from the following statement taken from the *Melbourne Argus* of the 13th of February of the present year:—

"The decrease in the import to Victoria of wines from £213,852 in 1862 to £64,776 in 1867, is clearly to be traced to the manufacture of wines in the colony, forced upon us by the extension of our vineyards and by the drinking habits of our people. Our imports of wine in 1871 were 188,150 gallons, as against 629,219 gallons of colonial manufacture, which increased to 713,589 gallons in 1872."

These figures, which only relate to the Victorian colony, must be highly gratifying to the producer.

Among the varieties of grapes to which I have devoted more than ordinary study in the colonies producing white wines, are the Riessling, the Verdeilho, the Aucarot, Pedro Ximenes, Chasselas, and Brown Muscat.

The Riessling, in my opinion, is one of the most desirable grapes to cultivate. Although not a large bearer, the vine is hardy; the fruit, being in small, conical bunches, is far less liable to danger from wet before vintage than other kinds. The wine produced from this grape is not to be surpassed in quality by any other white wine manufactured in the colonies.

Verdeilho or Madeira produces a generous, rich wine, of fine bouquet; like the Riessling, it is a shy bearer, and easily affected by cold winds during the blossoming season.

The Aucarot grape makes a wine equal to any of the colonial white wines; but, like the Verdeilho, it is tender and delicate while in flower, and a full crop cannot always be relied on.

The Chasselas is a hardy plant, and generally bears a large crop, and from it pure, light wine of a delicate flavour is made, which is much liked as a dinner wine.

The Pedro Ximenes is a large bearer; a good yield may invariably be relied on, as the vine is hardy, and produces a strong wine of good keeping qualities, but rather coarse in flavour, not unlike sherry.

Among the red varieties, I prefer the Shiraz, Maalbec, Carbinet, Burgundy and Rousillon.

The Shiraz is a hardy vine, a moderate bearer, yielding a fair crop, and makes a fine strong wine of good quality and flavour; in the colony it is highly recommended by the medical faculty for invalids and persons requiring a strengthening beverage.

The Maalbec and Carbinet are both hardy varieties. The plants yield a larger crop than the Shiraz, and produce wine of excellent flavour and bouquet. It is also greatly used for hospital purposes, and recommended as the best wine that can be taken by persons of a weak constitution.

The Burgundy is a small producer, but an excellent wine is made from the grape; the bunches are small and conical, like the Riessling; a fair average crop may be relied on.

The Roussillon is a prolific bearer, a hardy vine, not subject to blight, producing a wine of light quality, but of good flavour, and considered a most agreeable dinner wine.

Another popular and deserving wine is Brown Muscat, a large bearer, and producing a rich and luxurious wine.

One most special feature in connection with all these wines deserves the attention of European buyers. The wines can all be produced in any required quantity, as the demand springs up in England, and at such prices as to place them within the reach of all. It should be remembered that only a few years ago the public taste in Australia was as much averse to Australian wines as is that of the majorityof the British public of the present day. Better acquaintance with the wines, however, dispersed the unfounded prejudice in Australia, and I hope to see in England a similar degree of appreciation grow up for these magnificent beverages.

It is much to be regretted that so little is known of our Australian wines in England. This is due to the taste of the public, who have been accustomed, not only to wines imported from the Continent, but also to the strong-brandied and fortified wines of Spain and Portugal, or spurious articles manufactured to please the public taste. There can be little doubt that the wines in general consumption in England, to a very great extent, are of the latter class. If our Australian wines were better known and more generally used, the taste would become educated—the something new in flavour in our colonial wines, not to be found in adulterated wines, which causes them to be condemned, would be a high recommendation, and in time would be liked and highly appreciated. The pure wines obtainable from Australia would take a permanent position among the beverages consumed in this country, and conduce much to the health and enjoyment of the public. Many of them will be found to possess the requisite qualities of strength, flavour, and excellence, to make them in every respect adapted for consumption in this country. I feel confident that the wine manufactured in most of the large cellars in Australia at the present time, over which great skill and care are exercised to produce a good article, will bear favourable comparison with that of European manufacture now in general consumption, and may be obtained at a reasonable rate if a regular market could be found. Some samples of Australian wine which have hitherto been sent to England have been imperfectly made, and can give but a very inadequate idea of the wine now produced.

I am of opinion that many of the judges who are called upon to pronounce upon the merits of Australian wines find a something new they had not before discovered in the wines of other countries, and this leads them to form an adverse judgment. Upon further acquaintance they would arrive at a different decision. As a matter of fact the wines of every country have something in flavour peculiar to themselves.

It is owing, I believe, to the great demand from high sources for continental wines, and the enormous prices which they command, that scarcely a single bottle of it is ever allowed to come within the reach of the general consumer, as the quantity of wine sold in one year as the produce of these vineyards would far exceed what they could produce in ten years. The natural conclusion, therefore, must be that an imitation, in every way inferior, is daily made to supply its place. A little reflection will show consumers that it would be quite a matter of impossibility to supply the demand, from the small quantities produced in the

cellars of these celebrated *vignerons*, and in consequence another wine is substituted. In making this statement I do not mean to insinuate that the substitute is a bad article, for it may possess fine qualities; but I maintain it cannot be the article it is represented to be, and if known in its true name it would not be of the same value. This being so, I am clearly of opinion that an article in the shape of a pure unadulterated wine can be supplied from the Australian Colonies, not only equal, but superior to the wines now in general consumption imported into this country from the Continent of Europe.

Having, to the best of my ability, given a short historical summary of the rise and progress of this infant industry, I will endeavour to show the rapid strides taken in its advancement. These returns are taken from such government papers as I can find so far away from home, and are taken up to the 31st day of March in each year referred to. I place those of South Australia first, as that colony is the largest producer.

The year 1850 shows that 282 acres were under cultivation, 1854 shows 408 acres, 1858 shows 1,055 acres, 1860 shows 3,180 acres, on which 1,874,751 vines were bearing, and 1,948,510 unbearing, and from which 182,087 gallons of wine were produced, and 23,398 cwts. of grapes sold.

In 1861 the planting of the vine progressed vigorously in that colony.

The year 1864-5 shows 6,364 acres under cultivation, on which 6,586,009 vines which were bearing, and 2,831,971 unbearing, and from which 798,647 gallons of wine were produced, and 30,627 cwts. of grapes sold for table use.

In this year one-tenth more land had been planted. Nine years ago only 753 acres of land were cultivated with vines. During the then past five years the area had been doubled. Up to the last season the proportion of bearing vines to those not productive was nearly equal.

The year 1871 shows 6,131 acres under cultivation, on which 5,783,674 vines were bearing, and 385,084 unbearing, and from which 801,694 gallons of wine were produced, and 85,847 cwt. of grapes sold.

The acreage given represents well-established vineyards. The quantity of wine made shows 801,694 gallons, as compared with 182,007 gallons in 1860.

Next in order come the statistics of Victoria:—

The year 1855 shows 274 acres under cultivation, producing only 11,000 gallons of wine.

The year 1855 shows 4,078 acres under cultivation, on which 8,199,618 vines were planted, from which 176,959 gallons of wine were produced, and 18,063 cwts. of grapes sold.

The year 1872 shows 5,523 acres under cultivation, on which were planted 9,671,292 vines, producing 713,609 gallons of wine, and 30,896 cwts. of grapes sold.

During sixteen years the acreage increased 5,244 acres, and the quantity of wine increased 702,609 gallons.

The next in order are the New South Wales statistics:—

The year 1863 shows 1,459 acres under cultivation, producing 144,888 gallons of wine, and 420 tons of grapes sold.

The year 1867 shows 2,281 acres under cultivation, producing 242,183 gallons of wine, and 668 tons of grapes sold.

The year 1872 shows 4,152 acres under cultivation, producing 413,321 gallons of wine, and 508 tons of grapes sold. Besides this quantity, there were 607 acres of vines unproductive.

In the above statement is included a portion of the Murray district, in which there is at Albany, 614 acres producing 140,638 gallons of wine, and 10½ tons of grapes sold, besides 363 acres of vines unproductive.

During the nine years shown, the acreage increased 2,673 acres, and the quantity of wine increased to 268,433 gallons.

On comparison of the various figures, it will be found that the colonies of South Australia and Victoria far outstrip the older colony of New South Wales. It is also shown that the colony of South Australia stands first and foremost as the fosterer of the vine and wine-making.

Taking the various returns for the year 1872 of the several colonies, it will be seen that South Australia has 1,372 acres in excess of New South Wales, and produced 388,373 gallons more of wine. Likewise, it has 608 acres in excess of Victoria, and produced 88,055 gallons more wine; while Victoria exceeds New South Wales by 764 acres, and 299,288 gallons of wine.

The importation of wine into Great Britain has been regulated as much by the duties as by the taste of the consumer, and this goes to prove the great disadvantage in which the Australian producer is placed, as compared with those of France, Germany, and Hungary. Australian wines, as a rule, range above the maximum strength fixed by the Customs' tariff, by from one-half to three per cent., and, therefore, have to pay 2s. 6d. per gallon duty, whereas Continental wines generally range under 26 per cent., and therefore come within the lower range of duty, and are admitted at 1s. per gallon. The effect of this difference in duty is to exclude almost entirely the Australian produce from the English market. It appears to me that the Australian *vignerons*, as I will endeavour to show, have a right to ask the Government of this country for a change of tariff, whereby their wines may be admitted at such a rate of duty that they may compete with Continental wines on an equal footing, or, at all events, on such a scale as will allow of a *pro rata* advance upon the extra strength.

I have looked through the statistics of the Board of Trade of England for the last ten years, and I cannot find, amongst all the dependencies of the British Crown (British India excepted) any trade that approaches in extent to that of Australia. It may be interesting here to show what rank the Australian colonies take amongst the British possessions in their trade with the mother country. To prove this I will take leave to quote the following figures from the statistical abstract for 1871:—

Imports into Great Britain in 1870 :—

British India	£25,090,163
Australia	14,075,264
North American Colonies	8,515,364
West India Islands and Guiana	5,949,199
Ceylon	3,450,974
Cape of Good Hope	2,873,910
The Straits Settlements	2,547,320
All other possessions	2,330,219
Total	£64,832,413

The total value of imports from British possessions, in the year 1871, is set down at £73,267,156, but the value of the exports had not been ascertained.

Exports from Great Britain in the Year 1870 :—

British India	£20,093,749
Australia	10,735,481
North American Colonies	7,548,427
West India Islands and Guiana	3,639,011
Hong-Kong	3,570,733
The Straits Settlements	2,407,577
Malta	1,156,982
All other possessions	4,240,995
Total	£55,391,332

It will be seen from the above figures that the imports from Australia were 22 per cent. of the whole, and the exports of Australia 19 per cent. of the whole. You will, perhaps, excuse this digression, but it occurred to me that the information might be interesting to many who have never realised the important commercial position her Majesty's Australian possessions occupy, second only to British India, with its teeming millions of inhabitants, and far in advance of the North American Colonies, with a population three times that of Australia.

The people of the Australian colonies are either originally inhabitants of this country or their descendants, with purely British feelings. Large sums are expended annually by the several Australian colonies for the introduction of the surplus labour of Great Britain, thereby opening up new fields for those of her Majesty's subjects who choose to avail themselves of the opportunity. Our public institutions, our educational establishments, and our commerce, are all founded on the institutions of Great Britain; our laws are based on those of this country, and passed subject to the approval of the home government. In fact we are as entirely British subjects as the residents of the counties of Middlesex, Surrey, or Kent; and as such have a right to great consideration at the hands of the Government. Further, on account of the commercial relations between the Australian colonies and the mother country, in my opinion these matters should be taken into consideration, and every encouragement afforded to the extension of the growth of this new and important industry. If this were acceded to, it would only be reciprocating the feeling and desire of the colonists generally towards the mother country, as will be seen from the fact that Australia has sent, since the year 1851, not only large quantities of gold and other minerals, but also supplied wool, tallow, and other important productions, and in return taken as payment goods manufactured in England, thereby supporting and encouraging the working manufactures of this country.

In order that the public may have an opportunity of tasting the wines of South Australia, exhibited this summer at South Kensington, the Commissioners have placed these wines in the hands of Mr. P. B. Burgoyne, of 50, Old Broad-street, at whose cellars they may be sampled free, on presentation of a visiting card, until Monday week, after which date the remainder will be handed over to the hospitals.

DISCUSSION.

Mr. P. L. Simmonds said this subject had come considerably under his notice during the charge he had had of colonial products at various exhibitions, and was one both of colonial and imperial importance. It was pretty well known, although not in detail, to the public at large, that Australia was a country flowing with corn, wine, and oil, and produced the finest wheat in the world, and its wines had received high commendation at every exhibition. At Paris he had put them to very severe tests in competition with the products of other large wine-producing districts, and they carried off many medals, which must have been very satisfactory to the colonists, especially as they had to contend against many difficulties, the wines not being really in first-class condition. Notwithstanding that, the red wine of Wyndham had carried off the silver medal. Again, four bronze medals were given to South Australia, and four to New South Wales, and the wines of the Chairman had also received favourable notice. Besides this official recognition, he himself gave a dinner at which these wines alone were used; and although the wines were not in good condition, having been exposed for many months to the sun, still they universally obtained a high opinion, and the Academie Nationale awarded a silver medal on their recommendation. He had already had them at Dublin, London, and other exhibitions, and there the same character was given to them. He had not been officially connected with the Vienna Exhibition, and therefore could not speak so positively with respect to it, but he believed that there they were not quite so successful. He had with him a very favourable report of Dr. Bleasdale, on the Colonial Exhibition at Melbourne, which he would recommend to the perusal of those who had not yet seen it. It was interesting to know that great and rapid progress had been made in these colonies, and it appeared that the greater part of the continent of Australia was well suited for the culture of the vine. In Queensland some 300 acres were now under cultivation, and South and Western Australia were also taking rapid strides. What had been done, therefore, might be looked upon as an augury of still greater success in the future; and now that the gold mania, which had given a check to the culture for some time, had ceased, and that the character of the wines had been elevated and maintained, the only requisite being that an export trade should be obtained and encouraged, he thought there was no doubt as to the future prospect of the industry.

Mr. D. Tallerman said he could corroborate what had been mentioned by the last speaker, and having recently visited Vienna, he was able to say that the Australian wines there took a larger per-centage of prizes in proportion to the number of exhibits than any other, and that notwithstanding the great amount of deterioration done to the wine by travel and being exposed for months to a climate to which they were not accustomed. So high was their character, in fact, that one of the jurors in the French department asserted most distinctly that they were French wines, which had been taken out to Australia and brought back again. It was very gratifying to find that after the efforts made by the Society many years ago, although the prize they then offered for importation of wine from Australia had not been taken, still something was now being done in this way, and no doubt the efforts then made had stimulated the efforts of the colonists to this subject. He hoped the Council would still devote their attention to the development of this trade, especially considering that the difficulties attending the production and the introduction of wine were far greater than in the case of any other subject. There were difficulties in the selection of the soil, the kind of grape, the mode of planting, of making the wine, of treatment, and of transport; and

the success already obtained he thought spoke very highly for the enterprise of the colonists, who, although knowing little or nothing of the trade at first, had succeeded so well. If some means were now taken for collecting the best technical information from the continent of Europe, and transmitting it, he thought very good results would be obtained. With regard to the Customs' tariff, that was hardly a subject with which the Society could deal, but it would be taken up independently, and no doubt if they could assist in any way they would do so.

Mr. Edward Wilson said there were one or two points on which he had the misfortune to differ from Mr. Fallon. In the first place he thought he was not quite right as to the time when the vine was introduced, because he recollected the vineyard planted on the Murray by Mr. Ogilvie, which was in a good fruity condition in 1842, so that it must have been planted before 1840. There was another point which was of considerable importance. He had himself grown the vine on a small scale, and knew something about it, and he had always felt that the time must come at which wine would become a very large product, and eventually one of exportation. In some of the dry seasons, when the hot wind blew so that even indigenous trees showed signs of drooping under its influence, he had seen the vine holding out its leaves to the heat, and really appearing to enjoy it. Whenever you saw a plant accept so readily as that the site into which it was introduced, you might be pretty sure that plant meant business. Now they had seen what had been done with the vine by the French, by the Germans, and other nations, but hitherto they had not seen what could be done with it by the Anglo-Saxons; but remembering what had been done by this race with all natural products with which they had an opportunity of dealing—what they had done with the short-horn oxen and the Southdown sheep, it was most interesting to look forward, and see what they would do with the vine. In Australia there was a territory available for it, extending to hundreds of thousands of miles, of every conceivable variety of soil, climate, and aspect, everything, in fact, that could be wished; and if out of all that, and all those varieties of vines, they could not produce, not merely a good drinkable wine, but something really exceptionally excellent, he, for one, should be very much surprised. His own belief was that some day something very remarkable would be produced in the way of wine, perhaps almost accidentally, as had been the case with Johannisberg, and some of the other great vineyards of the continent. With regard, however, to the strength of the wine, and the duty which it ought to pay, he could not quite agree with the statements in the paper, though no doubt Mr. Fallon had taken great care in the preparation of his facts. A short time ago an exhibition was held in Melbourne, at which a very large collection of colonial wines was shown, and he had seen a statement issuing from the Government Board of Agriculture, in which it was reported that out of 300 samples exhibited on that occasion only four were above the strength which would enable them to come to England at the 1s. duty. He considered it very important that wine should be produced wholesome, drinkable, and not too strong. He had been in the habit for a long time of drinking this colonial wine, and he never paid more than a 1s. duty upon it. It would come in that duty up to 26 per cent. of alcohol, and he believed that a wine, honestly made containing that per-centage, unless it were exposed to some very curious treatment during the voyage, would stand the transit perfectly well, and would be fit for any one to drink. It had been stated over and over again in the *Times*, that even in Spain the natural production of sherry only showed a per centage of 25, 26, or 27 of alcohol, though it was raised much higher by the addition of certain compounds for the purpose of tickling the English palate. They did not want, however, the Australian wines to be above that standard, and he thought it would be a great mistake, for the sake of the four samples he had referred to as being stronger, to deprive the other 296 of the advantage of coming in at the cheap rate. It would be a great pity if the idea got abroad that there was any difficulty in their wines coming to England at the lowered duty, and for his own part he should be very glad to see the 2s. 6d. duty continued to be imposed upon the more highly brandied article.

Dr. Thudichum had listened with great pleasure to the interesting paper, Mr. Fallon's name being well known as that of the most important producer of Australian wine, and he also was pleased to add that those wines which bore his name were unquestionably the best. If, therefore, he felt bound to make some observations antagonistic to what had been already stated, he hoped no one would suppose that he did so in anything but the very best feelings towards Australian producers, because for many years he had held those kind of feelings, as he had stated in print on more than one occasion. As regards the introduction of the vine into Australia, Mr. Fallon was not quite correct. The gentleman who first introduced the plant was Mr. Busby, who brought wines from New South Wales before the year 1830. He travelled a good deal in Europe, and took over 20,000 vine cuttings; and in 1831 he again undertook a similar journey, and collected from the Botanical Gardens, Montpelier, 437 varieties, and also another collection from the Jardin de Luxembourg, which were planted in the Botanical Gardens at Sydney. From these vines most of those now in Australia had been obtained. No doubt both Sir William and Mr. James McArthur had taken a great interest in the cultivation of the vine, and there was little doubt that the varieties which had been mentioned in the paper were about the best which could be selected. The Aucarot grape, however, was an unknown name to him, but probably it was a well-known variety under another name. The Chasselas gave a light wine of delicate flavour, and he found from Dr. Bleesdale's report that he thought, in the future, that it would be the best wine for Australia. He must say, however, he entertained some doubt on that point. As to the Pedro Ximenes, it was a very sweet grape, and the Australians must not expect to get any very good wine from it. At Xeres it was only grown as a subsidiary variety for producing those sweet liqueurs which were mixed with wine for flavouring purposes. The other vines suitable for red wine he thought were well calculated to produce a thoroughly good article. The Tintella was a grape grown in Dr. Kelly's vineyard, and it was the same grape which prevailed on the eastern Mediterranean coast of Spain. The selection of grapes had therefore been made with the greatest scientific care, and if they were well adapted to the climate they must produce something good. With all that, they must remember they had still a great deal to learn in the cultivation. He had gathered what information he could from those who had visited the districts, and he had also seen some photographs in the Exhibition, from which it appeared there were two classes of vineyards in Australia—one the vineyard of the rich man, splendidly cultivated and kept in most excellent trim, in which no doubt a good wine could be produced, though there might be some doubt as to the price at which it could be sold. On the other hand, there were vineyards planted simply for production and sale, and he was sorry to say that some of them were very badly kept, being full of weeds two feet high, the grapes being to a great extent hidden by these weeds, which would destroy some of the best fruit. He should, therefore, strongly urge the Australians to thoroughly weed the vineyards, to keep the vines as closely cut to the ground as possible, and to adopt some of those cheap systems which prevailed in Spain, where there were no stakes or anything to keep up, except a short stump from which the branches grew, the grapes hanging very nearly to the ground. As regards the proposition that Australian wine was produced from a must which would yield a larger per-centage of alcohol than twenty-six per

cent., he must enter his polite protest. The musts had been measured by one of the Australian companies, and the results had been published in the *Australian Mercury* for May 6th, 1865. From the density there given, by simple calculations, it was easy to be seen there was no grape in Australia—as there was none anywhere else—which, by the ordinary method of vinification, gave wine of the strength mentioned. That led directly to the question of the alcoholicity of the wine, and he could confirm what had already been said, that of the wines exhibited at Melbourne very few only were above 26, and the great majority were very low indeed, ranging from 17 to 20 or 24. Very few passed that standard, and one of 32 was a muscat wine, which had evidently been brandied. What was proved, therefore, by the density of the must was also proved by the analysis of Dr. Bleesdale. He must differ with some of the statements made as to the results at the Exhibitions, and particularly of that at Vienna. Statements had been published in the *Times* that the Australian wines had taken the diploma of honour at that exhibition, but he did not find that statement verified by a reference to the official records. The fact was, that no single diploma of honour of any kind was given to any one single wine whatsoever. There were six different classes of prizes, viz., diplomas of honour, medals of progress, merit, and other recognitions, and the result as regards Australian wines was that they came just where any one acquainted with them would have placed them, about eighth or ninth at the utmost, reckoning Hungary, Styria, and Austria as one only. But if these countries were divided into different districts, then the Australians would come about the 17th, and that was a very honourable position. It was, above all things, necessary to be accurate in making statements of such a character, and that was the only way to push the Australian wines properly, because if they were set up as being the best of all the wines in the world, and were brought to England with that character, and people who knew anything about wines bought them, they would see they had been deceived, and the trade would be more damaged by that than anything he could conceive of. He had examined, on the part of the Society, a great many of the wines at South Kensington, and had published a report in the *Journal*. To that report he had added a statement that the wines were not in good condition, having been left standing for a long time in the Exhibition upright and some badly corked, and therefore many, or all of them, had much deteriorated. At the same time he had been bound to state what their quality was at the time of his examination, and in this he had been confirmed by a report made at Mayence by a committee of gentlemen whose opinion with regard to white wines was of the very highest value possible. At the same time, no doubt the wines they examined had also been exposed to some deteriorating influences. As to the prices, he must say that some few samples he had purchased bore a very high price; in fact, at the present prices, he did not think they could be consumed by the middle classes of this country. He would therefore say to the Australian producers, that they ought to use their best endeavours to make the wines much cheaper, and to import them under the 26 per cent. standard, and then there was no doubt England would take hundreds of thousands of pipes of wine every year. As to the duty, he could not assume that the Australian wines were ever above 26; for though no doubt there was wine imported and advertised as at the standard of 29 per cent.—wine of Dr. Kelly's—to which he was assured no alcohol had been added, still he had insisted, and must again strongly insist, that if that were the fact, and if in Australia there were grapes which, by a natural course of fermentation, produced the wine with 29 per cent. of proof spirit that ought to be established by a scientific commissioner and thoroughly authenticated, because it would simply upset the whole scientific facts hitherto established throughout the world. He had no objection to accept the fact when it was proved, but as yet it had not been so, and when it was remembered that the British Parliament in 1858 appointed a committee, which inquired into this subject and sent its emissaries into all the wine-producing countries of the world, the result being that nowhere was any wine made which naturally had above 26 per cent. of proof spirit, and very many had not anything like it, he might be excused for insisting upon strict proof of so extraordinary a statement. If Australians could only produce good wine, not too dear, there would be no fear of the British public not drinking it, and he was happy to add his testimony to that which had been already said, that nothing was so good for the public health as a cheap and plentiful supply of good wine, which would no doubt remove a great deal of those horrible distilled poisons which were now sold. He had already shown, in the Cantor Lectures he had delivered, that there were cogent reasons why some of the producers in the South of Spain should be allowed to brandy their wines up to the extent of 29, or even 32 per cent., in order to destroy certain diseases in the wine, and therefore he thought if the duty were kept as at present, 1s. up to 26 per cent., 1s. 6d. up to 32, and 2s. 6d. from 32 to 42, every end would be accomplished.

Mr. Dutton (Agent-General for South Australia), with regard to the wine duties, said he believed it was about three years since the subject was brought to the notice of the Chancellor of the Exchequer by a deputation. That gentleman then took a very fair view of the matter, saying that there was a principle in the figures of 26, but that there was a principle in the protection of the spirit duties in England which he was bound to look after, and he asked for some evidence that 26 was not the right figure. He understood the deputation promised to furnish the evidence, but, so far as he could learn, it had not yet been forthcoming; at any rate the duties remained the same as before. Last year a conference was held at Sydney, attended by delegates from all the Australian colonies, and, amongst other things, the important question of the wine trade was brought under discussion, and a memorial was adopted to the Secretary of State, pointing out that Australian wines ranged considerably above 26 per cent. of natural alcoholic strength, and praying that steps might be taken to raise the standard at which wines would be admitted at 1s. a gallon duty. This memorial he had been asked to support, but he must say he felt some alarm at the statements he had just heard from Dr. Thudichum, which seemed to show that it was impossible for any natural wine to be above the 26 per cent. standard. He thought, therefore, that one of the first things necessary on the part of those who were urging the alteration of the duty should be to collect evidence to lay before the Treasury on the subject; and he asked all those interested in the wine trade to be so good as to furnish him with any evidence they had of the Custom-house tests of alcoholic strength of the wines they imported. It was no use going to the Treasury without evidence of that kind, and he must say at present he utterly despaired of producing evidence in support of this memorial that the limit for alcoholic strength of Australian wines should be raised as high as 35 per cent.

Mr. Michie said Mr. Fallon had been altogether silent on the important point just referred to, of the strength of the wines, and he should like him to enlighten the meeting upon it. He must say there was a discrepancy in the report which had reached him from Vienna, and the rather depreciatory report of Dr. Thudichum, which he had read with some interest and more dismay, because, although he only brought to the subject the limited experience of a wine drinker, still he thought in future they would have to resort to the judgment of the public palate in prefence to any scientific tests. He had been consuming colonial wine for something like 20 years in blissful ignorance that it was of the extraordinary objectionable character so circumstantially set forth

by Dr. Thudichum. At the same time he received that gentleman's opinion with the highest respect, or otherwise he should not feel so uncomfortable about it. It seemed to him somewhat difficult to reconcile the extraordinary statements which reached him from Vienna, that certain diplomas of honour had been given, of very high character indeed, to the Australian wines, with the account given of the same wines by Dr. Thudichum. No doubt this difference was to some extent accounted for by the circumstance that the wines had been exposed to unfavourable conditions, but even making allowance for all this, it appeared to him very difficult to explain. At any rate, he did not know how to reconcile the scientific results he had referred to with his own experience for so many years in drinking this wine with great satisfaction to himself. For instance, Dr. Thudichum concluded his remarks on one of these wines with these words—"It stinks." Possibly that might be a paraphrase for a bouquet, but it certainly was an expression which took him aback, and had lodged rather tenaciously in his memory. He hoped, however, it was the result of being exposed to the sun, and there was no doubt that many of the wines were very delicate, and possibly that would acconnt for a little extra spirit being added to them for the voyage. He, however, was disposed to place considerable confidence in large human experience, particularly in the face of the strong prejudice of which all were conscious, and which for a long time existed against any colonial wine, yet year by year the consumption had continued to increase, until it was now so great in the colonies of Victoria and New South Wales that there was no dinner at any club or private table at which these wines were not brought out, and frequently preferred to those imported from Europe.

Mr. E. C. Booth remarked that he had had personal experience of Australian vineyards, and did not base his knowledge on photographs, which might easily mislead, as they seemed to have misled Dr. Thudichum. With reference to the diploma of honour awarded to wines at Vienna, he had been there when the award was made. It could not be made to any individual or to an exhibitor, and it was given to the Acclimatisation Society of Victoria—not because it had made wine, but because by its influence it had conduced more to the excellence of the wine than any individual or body. Besides that, the wines of Australia obtained prizes to the extent of 32½ per cent. of the whole exhibits at Vienna. He could also corroborate what had been already stated by Mr. Tallerman, that one man turned round and said—"I do not believe this wine ever came from Australia; these are very fine French wines that have been sent abroad and brought back again, and so matured." That showed the effect they produced, and they were not tried under favourable circumstances, having been exposed for a long time to a broiling sun in the height of summer. Mr. Wilson had referred to the peculiar excellence which characterised the Australian wines, and in this he quite concurred. There was a long strip of country called the Mallee, about 1,500 miles long by an average breadth of 100, a long stretch of scrub, but he believed it would produce a fine grape from which a wine would be produced eminently characteristic of Victoria. Some day that tract would be all planted with vines, and would send wine to England which even Dr. Thudichum would pass a very different opinion upon to that which had been referred to.

Mr. David Randall said he knew personally the character of the Australian vineyards, having himself produced wine which had gained medals at the London and Paris Exhibitions, and, though here and there one might be found in which the weeds were allowed to grow, it was not generally the case, for on the contrary, they were well attended to and kept clear. As to the remark that the vines should be kept as near the ground as possible, it was found by experience in South Australia that the plan did not answer, because the sun was often so hot that the fruit got scorched and dried up. As to the alcoholic strength, he felt pretty sure that many of the finest lands would, in good seasons, produce wine of a higher strength than 26 per cent., and he should be very glad if steps were taken to ascertain the density of the saccharine matter when expressed from the must, for this had not yet been done. At the Melbourne Exhibition there were many vineyards unrepresented, and possibly some of those might produce wine of greater strength. Dr. Kelly he knew personally, and so satisfied was he of his high integrity and honour, that if he stated that the wine from his vineyard was of the strength of 29, he was quite sure that statement was true. In view of these facts it would only be fair that Australian wines of a higher strength than 26 should be admitted at the 1s. duty, for it seemed rather hard that because nature had done more for Australia than for Europe she should be placed at a disadvantage by fiscal regulations. If her wines were naturally of a greater strength, they ought to be admitted on equal terms. At the same time he thought it a mistake to attempt to raise the standard so high as 35 per cent., but he thought 29 would be a fair and just figure, which would cover all natural wines.

The Chairman, in proposing a vote of thanks to Mr. Fallon for his able paper, said he was himself probably one of the oldest colonists in the room, and remembered grapes in Sydney in 1829. He believed there were five or six persons, amongst whom were Sir William McArthur, Mr. James McArthur, Mr. Busby, Mr. Blaxland, and several others, who were all aiming at the establishment of the vine and the production of wine in South Australia at a very early period. Sir William, however, was still alive; and, as he had devoted much time and money to the subject, his name stood out more prominently than some others who had died earlier. In 1861 he (the chairman) came to England and brought ten or twelve kinds of wine, which he exhibited from time to time, but he must say he did not think much of these Exhibition testimonials. He much preferred to go by the public taste, or by the opinion of those qualified to judge, and not by that of a jury just brought together to pronounce upon a wine, no matter in what condition the wine might be. In 1862, when he had some authority over the wines, he insisted on their being locked up for four or five weeks in a cool place before they were tried, instead of being tasted just as they came from the docks in the hot weather, and when they were sick. They were thus tried properly, and the experts gave a very high opinion of some of the wines. Of course, they did not say they were better than any other wines in the world, but they said some were very fine wines, and that in the course of years, if properly treated, they would become still better. He was glad to see that the wine was rapidly improving in public estimation, for when last in Australia, in 1870, he scarcely saw any European wine in use at all.

The vote of thanks having been passed unanimously,

Mr. Fallon, in reply, said he had not any statistics as to the date when the vine was introduced into Australia, but he still thought he was not far wrong in his statement. No doubt vines had been introduced at a much earlier period, but they were confined for a long time to a few grown simply for table use, and he believed Sir William McArthur was the first who really formed vineyards in New South Wales. He had no figures or statistics to prove that Australian wine exceeded a strength of 26 per cent., but nevertheless he asserted most strongly that he had produced grapes from his own vineyard which, in favourable seasons, gave a higher strength of alcohol than that mentioned. The grapes he had mentioned in the paper, the Riessling, Verdeilho, Aucarot, Shiraz, Burgundy, and Carbinet, gave wines which he had tested, and found to yield

from 26 to 29 per cent. of proof spirit in good seasons. He was not at all surprised to find this was not the case with the majority of the wines exhibited at Melbourne, because most of them came from the southern side of the range, which did not produce wine with so high a per-centage of alcohol. He might add that although he was one of the exhibitors, and his name appeared in the list given by Dr. Bleesdale, and thought his wines were placed there at a lower rate than 26, yet when he brought them to England he was compelled to pay 2s. 6d. a gallon duty upon them. He had endeavoured to furnish the true tests of the Australian wines sent to the Exhibition, but from the delay experienced in obtaining the particulars asked for, his paper was deficient in that respect. He had no doubt, however, that many gentlemen from South Australia would bear him out that the climate there being very similar to that on the Murray, in good seasons their wine would show a higher per-centage of alcohol than 26. The style of cultivation had been referred to, and it had been said this was sometimes conducted in a slovenly manner, but after visiting nearly all the principal vineyards in Europe he was able to say that he had seen vineyards in Australia as nicely cultivated as any. The man who went into the culture of the vine largely, and as a special industry, took care not to allow the weeds to grow; and whoever had been foolish enough to send over the photograph which had been referred to, he did not think it could be taken as a fair representation.

EXHIBITIONS.

A War Exhibition.—One of the most curious exhibitions is reported open for a few days in the Imperial Library, Berlin; it consists of all that could be collected, whether written, drawn, or painted, illustrative of the late Franco-German war; technical works, poetry, songs, articles from journals and other publications produced in Germany and other countries. All the branches of military literature are represented, and each has its own special division, from the most important to the most trivial productions, from works on ambulances to military romances, novellettes, and verses. The collection is divided into thirty-four classes, twenty-eight of which are devoted to printed matter, and six to engravings (one of the latter being assigned to caricatures) which form a very large series.

PUBLIC MUSEUMS AND LIBRARIES.

The following returns of the numbers of visitors for November have been made up to the present date:—

	No. of Visitors
National Gallery	
Kew Gardens and Museum	7,707
South Kensington Museum	
Bethnal-green Museum	
Geological Museum, Jermyn-street	3,739
Patent-office Museum	17,143
Edinburgh National Gallery	none*
Edinburgh Museum of Science and Art	26,392
Edinburgh Museum of Antiquities	none†
Royal Dublin Society:—	
Natural History Museum	4,946
Botanic Gardens, Glasnevin	5,376
Dublin National Gallery	
Zoological Society, Dublin	
Museum of Irish Society, Dublin	
Tower of London	
Royal Naval College, including Greenwich Painted Hall	26,341

* Gallery shut. † Museum shut.

PEAT.

As is not uncommon in the economic history of mankind, the scarcity and high price of an article indispensable to human comfort and prosperity have called into existence numerous cheaper substitutes. Since coal reached a famine price, great efforts have been made to produce fuel which, if not altogether equal to coal in compactness and calorific power, might not inadequately supply its place at a lower cost. It is true that the laws of demand and supply have already shewn their power by attracting an enormous addition of enterprise and capital to the production of coal. In the North of England old pits are being reclaimed from the water, new borings are in progress, extensive submarine mines have been projected, and general activity prevails. Not less vigour is exhibited in other districts. The famous Silkstone and and Barnsley seams are subjected to fresh attacks. Cannock Chase will shortly abound with new collieries, while in South Wales new companies are forming, and new shafts are being sunk almost daily. Within the next two years the output of English coal will probably be enormously increased, but in the meanwhile fuel is at a price which seriously compromises many of the most important departments of industry.

Great attention has been given to the manufacture of various kinds of artificial fuel. The majority of these are composed of coal-dust mixed with ashes and refuse, and supplied with carbon by the addition of tar or bitumen, mixed in one case with a small per-centage of farina. It is impossible to overlook the obvious truth that fuel made from coal refuse must, to a considerable extent, depend upon the coal supply, and sympathise in price with the fluctuations of the coal market, but this remark will not apply to peat, a material drawn from the surface instead of the bowels of the earth, and supplying, without any admixture of foreign matter, fuel of a high quality.

In its crude form, peat has been in use from time immemorial, and probably succeeded wood when the diminution of the primeval forest compelled man to seek for other fuel. Peat, from its greater accessibility, naturally preceded coal as a caloric agent, and although requiring preparatory treatment, was more available to the needs of the early races than coal, which requires the employment of labour and skill to withdraw it from the storehouses of nature. But no sooner had civilisation supplied means for the extraction of large quantities of coal, than peat naturally fell into disuse, especially in this island, where abundance of coal on the one hand, and the difficulty of drying peat on the other, contributed to invest coal with extraordinary advantages. Coal, however, is very unequally distributed, and in many countries, notably Ireland, Holland, Westphalia, Bavaria, France, and Italy, peat, in its crude or in its prepared form, has long supplied a large proportion of the fuel of the people.

Arising from the annual growth and decay of marsh plants, peat forms the most recent link in a long chain. Wood and woody fibre are the origin and substance of peat, lignite, common or bituminous coal, and anthracite. These all mark gradual transitions from the vegetation of primeval ages to the anthracite of to-day, and are all compounds of carbon, hydrogen and oxygen, but contain these elements in very different proportions. Peat contains water to a much greater extent than coal, and as this water is, of course, opposed to combustion, its removal is the prime difficulty in the preparation of peat for fuel. Peats vary considerably in the proportion of water contained by them, but it may safely be put down as ranging from seventy-five to ninety per cent. As this large quantity of water is retained in multitudinous minute cells, great difficulty is experienced in getting rid of the aqueous particles.

As this is the main object of all peat preparation, the drainage of peat bogs assumes great commercial importance. An undrained bog contains about 90 per cent. of water, while a drained one holds about 80 [per cent.

This difference of 10 per cent. is the difference between success and failure. With equal labour applied to raising the wet peat, the out-put of a drained bog will be exactly double thatof one undrained, or twenty per cent. of perfectly dry peat against ten. Not only in the proportion of water contained by them, but in other equally important respects, peats vary very much. In structure, specific weight, and admixture with mineral matter, the product of one bog differs greatly from that of another, and indeed the several strata of the samo bog vary widely in quality. Nothing can be more absurd than to speak of peat, either scientifically or commercially, as if it were one uniform substance, and this consideration becomes of great weight when tests and figures are referred to. In all reports of trials the quality of peat and the precise kind of coal used should be distinctly stated, as by trying very superior peat against very inferior coal, results might be arrived at on which it would be very unsafe to rely.

As a general rule, peat improves in proportion to its depth below the surface, owing partly to the more perfect decomposition of the woody fibre, and partly to the pressure of the superincumbent mass towards the bottom of the bog; it is darker in colour and denser in composition than towards the top, where it is light-brown in colour, and full of imperfectly decomposed fibre. The upper part of a high bog also suffers deterioration by exposure to the air. As peat is formed by the decomposition of successive layers of vegetable matter growing on the surface, bogs grow higher year by year. In Ireland and elsewhere it is customary to divide peat fields into "high" and "low." In ponds, lakes, and sluggish streams, "low" peat is formed of reeds and aquatic grasses. This peat is often of very good quality, is tolerably homogeneous, and is comparatively free, excepting at the surface, from coarse fibre and roots of trees. High peat fields are found on mountain tops, or more frequently in slight depressions in hilly countries, and are principally composed of mosses, and vary very much in quality, from the admixture of small roots, trunks of trees, and other objects preserved by the tannin contained in the peat. Men in armour, in a high state of preservation, have been dug out of the Solway peat mosses; and Mr. Ralph Richard mentions an instance of a Scotch Covenanter having been exhumed from a bog in Dumfriesshire.

Owing to varying conditions of formation, the quality of the peat bogs of the Scottish Highlands varies very greatly. The uppermost portion, from one to ten feet down, according to circumstances, is light and open, and possesses but little heating power. On a hill top the inferior quality of the "flow," as it is called, is very marked, owing to the wearing influence of atmospheric agents, which exercise a similar deteriorating power on bituminous coal when that mineral is exposed to their influenee for any length of time. Beneath the "flow" is found a stratum of a much closer and denser substance, producing sound fuel, giving a good flame, and yielding a large amount of heat. Beneath this is the most valuable stratum of all. Powerfully compressed by the weight of the two upper layers, and thoroughly protected from the atmosphere, the bottom of the bog approaches much nearer to coal, and, when dried and stacked, becomes hard, black, and weighty, burning with a red ash.

It will thus be seen that while tho upper and most accessible layers are hardly worth the trouble of preparation, the lower stratum of the majority of "high" peat fields richly rewards any reasonable amount of labour spent in preparing it for the fire.

Unfortunately peat combines with many valuable qualities some very serious defects. Perhaps the greatest of these is its enormous bulk, necessitating so much labour in "winning" and preparing it as to prove fatal to all commercial ventures but those undertaken under exceptionably favourable circumstances. So far as peat industry has hitherto been prosecuted, cheap labour has been shown to be an indispensable condition of success, not, however, so difficult to fulfil as might appear at the first glance, inasmuch as peat is generally found in the greatest abundance in lonely and unfrequented spots, where such unskilled labour as is to be had can generally be purchased at a low price. Of the quantity of labour required, a clear idea may be formed from the consideration of a few simple facts. Peat in its wet state—as cut from the bog—contains, as has been shown, from seventy-five to ninety per cent. of water, with which it parts very reluctantly. Therefore, to produce a ton of perfectly dry peat, it would be necessary to raise from four to ten tons of wet material. Practically, however, it has been found impossible to dry turf in the air beyond a certain point. Even when ground, macerated, rubbed down, and compressed by most of the machinery in use, and carefully dried, peat generally retains about fourteen or fifteen per cent. of water, while crude peat, roughly dried in the sun, contains at least twenty-five per cent. when apparently "dry," and if used in that condition possesses, as opposed to ordinary coal, a calorific power of 1 to 2, weight for weight. An additional disadvantage exists in the lightness and bulkiness of crude peat; thus 1 to 4 would nearly represent the effect of peat as compared with that of coal, bulk for bulk. A cubic yard of solid coal weighs about a ton, whereas a ton of common turf would, according to quality, occupy from three and a half to four times that space. A moment's reflection on these facts will produce the conviction that rough dried peat can never be available for other than local purposes, inasmuch as, in plain English it is simply "not worth carriage" to any great distance. From time to time improvements have been introduced in the method of treating peat, with the object of ensuring more perfect desiccation and greater weight and compactness. In Ireland, where one-seventh of the surface, or nearly three millions of acres, is covered with peat, furnishing the almost universal fuel of the peasantry, by far the greater proportion is prepared in a barbarous manner. Cut with a "slane" into clumsy masses, the turf is spread for drying on the undrained surface of a wet bog. It is then reared in small heaps. often packed far too closely to admit of further desiccation, and is finally built up into large piles. In some districts, however, a superior description is made. This is known as "hand turf," "foot turf," and "stone turf," and is made of block peat taken from the bottom of the bog, "footed" into mud, shaped by hand, and dried, when it acquires great solidity. In Holland and the Netherlands a somewhat similar course is pursued. As much of the peat lies under water, it is raised by dredging, conveyed to a kneading and treading floor, where it is freed from roots and other foreign substances, and is subjected to a kneading operation by workmen, who, aided by pieces of board attached under their feet, break it up, and tread it down into a uniform mass of peat pulp. This is spread on the drying ground, and after undergoing a further treading and levelling process, is shaped into a stratum about eight or ten inches in thickness. This is cut up into bricks, allowed to remain on its bed to shrink, until firm enough to be handled, and is then made into small piles for drying. The spreading ground, which receives the kneaded peat, is carefully levelled, and is strewn over with a layer of dry reeds or sedge, whieh facilitates the escape of moisture, Both the Dutch kneaded and the Irish "footed" peat are greatly superior to the crude turf, but innumerable attempts have been made to attain absolute perfection by the aid of machinery, not only in this country, but in Germany, where more than eighty attempts have been made during the present eentury to render peat-making a commercial success.

The main objects aimed at in the construction of the innumerable peat-making machines that have from time to time been patented, are the reduction of the peat to a homogeneous pulp by maceration, and the extraction of foreign matter. By maceration—breaking up as it does

the cellular structure—more perfect desiccation can be achieved than by the hand processes previously alluded to, thereby ensuring greater compactness and portability. Almost every kind of cutting and kneading machine has been tried, and a few years ago a plan was tried for rubbing the peat through a sort of colander. Very good results were attained, and excellent peat was made; but for some reason—possibly the expense of production—the venture failed to secure commercial success. From the absence of roots and coarse fibre, and the reduction of the aqueous portion by ten per cent., the quality of machine-made peat is greatly superior to the rough-dried and hand-made varieties. Compression has been tried, but it has been found that along with the water forced from the peat-pulp were ejected certain valuable constituents, notably a gelatinous substance of great importance to the validity of the fuel. Maceration having been carried far enough, it has generally been found advisable to trust to the natural shrinkage of the peat, during the drying process, to produce sufficient condensation. The difficulty from which escape seems practically impossible is in the drying process. Peat, after due sifting and maceration, could, of course, be dried by artificial heat; but the expense of this process interposes an apparently insuperable bar to its adoption, while the climate with which the British islands are blessed or afflicted—according to opinion—renders any attempt at simple open-air drying practically useless for commercial undertakings on a large scale. Both in England and in Germany drying under sheds has been tried with considerable success, and to the construction of these sheds much ingenuity has been devoted. Shelter from the rain, and the preservation of a thorough circulation of air, are the objects to be achieved in countries where the whole year probably produces not more than a hundred good drying days.

Among the many peat-making systems now in operation, that patented by Mr. Clayton is one of the most recent. On being cut from the bog, the turf is filled into "squeezing trucks." A piston is forced against the peat in the squeezing truck by the aid of a screw and lever, effecting such pressure upon the body of the peat as to force much of the loose or "free" water out of it. The great bulk of the water, however, is locked up in the cellular structure of the fibre, and cannot be got rid of by compression, and the peat is, therefore, next subjected to a masticating process. The trucks run upon a tramway from the peat-bog to the masticating machine, and are lifted from the tramway by hoisting gear. The machine consists of a vertical chamber, in which revolves a shaft, having fixed upon it a series of screw-like blades, the action being somewhat similar to that of an ordinary pug or tempering mill. The rough peat from the squeezing trucks is fed into the hopper of this chamber, and by the action of the blade is broken up and forced downwards into the comminuting apparatus. A screening apparatus may here be introduced when necessary. Connected with this vertical chamber is a horizontal cylinder, which completes the "pulping" operation. This cylinder is fitted with a central revolving shaft, upon which are fixed propelling screws, and also a series of curved arms or discs, so arranged upon it that in their whole length they form a dissected double helix with increasing spiral. Along the bottom of this cylinder, and projecting upwards towards the shaft, are arranged cutting blades of hardened steel, between which the discs pass in their revolution. Thoroughly masticated and reduced to homogeneity during its passage through the machine, the peat is expelled by the continued screw motion in continuous streams on to a special receiver. This consists of a number of rollers, which receive the peat and conduct it to a portable lathed tray, suitably located under the rollers, and carried on fixed wheels, of which there is a continuous forward series. The moving peat imparts motion to the tray, thus pushing it forward from under the rollers until the tray is filled with peat. This is afterwards cut up into bricks, and dried in sheds specially constructed for the purpose. These sheds are made of timber, with louvres all round, and opening in the roof, and differ very materially from the smaller sheds in use in Germany. The machine is driven by an 8 horse-power engine, requires three men and three boys to tend it, and is said to be capable of working up from 60 to 100 tons of wet peat per day.

In Germany, where peat is very well understood and extensively used for railway and other purposes, small hand-machines have long been in use for "macerating" the raw material. For mountain districts, where the manufacture of peat may be pursued with great advantage, these small machines appear to be peculiarly adapted. Six tons of wet peat, producing from a ton to a ton and a half of fuel when dried, can be prepared in these handy little contrivances in a day. An improved hand-machine, specially adapted to the requirements of the Scottish highlands and islands, and of Ireland, has just been perfected by Mr. J. A. Simpson, and combines with the simplicity of the German machine several improvements for ensuring complete "mastication." The introduction of hand-machines into districts where the "footing" process now prevails, cannot fail to confer great benefit on the inhabitants, who now waste infinite time in the preparation of their winter stock of fuel.

In Canada an ingenious machine for making short work of peat-bogs was introduced several years ago by Mr. Hodges, well known in connection with the Victoria Bridge at Montreal. A large barge, fitted with suitable apparatus for cutting, cleaning, lifting, and distributing the peat, floats in a channel of water which it forms as it proceeds. Two screws in front cut and draw in the peat, and, working in opposite directions, draw the barge forward at the same time. The peat cut and sucked in is subject to a masticating process, and the pulp is ejected through a long telescopic tube over the bog on each side of the channel, where it is left till dry enough to be cut and stacked.

This system appears to require the hot sun of Canada to give it a fair chance of success, and also seems to labour under the disadvantage of attacking mainly the "flow," or upper and least valuable stratum of the peat-field.

The peat-coal, as it is called, recently introduced into this country by M. Challeton de Brughat, is remarkable for its great weight and density. Although "uncompressed," it is hard, heavy, and compact in the extreme. As ordinary condensed peat resembles, when cut, a piece of oak, so does the peat-coal resemble coal itself. The compactness of this new fuel, and its greater calorific power, render it very superior to the ordinary preparations of peat, but at the same time it is more costly, as some twenty shillings per ton are talked about as its selling price.

Stated broadly, the position of peat industry on a large scale is as follows:—Inasmuch as most preparations of peat (condensed or uncondensed) only possess, weight for weight, half the calorific power of coal, the successful production of bog-fuel depends upon its being sold for less than half the price of coal. Were it certain that the present price of coal could be maintained for a length of time, the manufacture of peat would offer many allurements to the capitalist. But as many high authorities agree that the influx of labour and capital into the coal trade, and the introduction of coal-cutting machinery cannot fail, within two or at most four years, to exercise a powerful influence on the market, it is not impossible that peat may once more be severely tried by the competition of its ancient rival. One department of peat industry, however, presents a flattering aspect, be the future price of coal high or low. Peat charcoal can be produced for little more than half the price of wood-charcoal, and when used in conjunction with other fuel, affords an admirable agent for the reduction of iron ore. The quality of peat charcoal, easily produced by smothered combustion, is excellent. Being free from

sulphur, the quality of iron manufactured with it is of a very high class. In former times it was the practice among the Scottish Highlanders to convert large quantities of black peat into charcoal for the use of smiths in their forges; and modern scientific authorities also attach a high value to peat charcoal, considering it for certain purposes preferable to all other fuel. Presenting an admirable field for enterprise, the manufacture of peat-charcoal offers attractions other than those of a purely commercial nature. It surely seems better, both for contemporary mankind and for posterity, to clear off the peat-bogs, and convert unhealthy wastes into cornfields, than to destroy magnificent forests, which are not only grateful to the eye and valuable for innumerable purposes, but—as certain nations have found to their cost—exercise climatic influences of the most important kind.

THE FOREIGN TRADE OF INDIA.

According to the last number of the Statistical Abstract for India, the progress of trade in that empire during the past ten years has not been very satisfactory. In dealing with the facts presented to our notice we must not, however, forget that, during the decade to which they relate, the foreign commerce of India was much disturbed by the occurrence of the cotton famine in the United States. It is true that, owing to the high price of cotton in the English markets, the great staple product of India was vastly stimulated, thereby tending to increase the value of exports from that country. On the other hand, as the chief branch of the import trade of India consists of manufactured goods, the value of the imports was also abnormally augmented. On the cessation of the civil war in America the price of cotton in England declined, and rendered its cultivation less remunerative to the Indian planters. The consequence was a rapid decline for some years in the exports of this article. Another disturbing cause was that, as the consumptive power of India did not keep pace with the increased exports, the latter were paid for in specie instead of in goods. The following figures show the general results:—

Imports.

	Merchandise. Million £.	Treasure. Million £.	Total. Million £.
Average—1863-5....	$25\frac{9}{10}$	$21\frac{6}{10}$	$47\frac{5}{10}$
„ 1870-2....	$32\frac{4}{10}$	$10\frac{3}{10}$	$42\frac{6}{10}$

Exports.

Average—1863-5....	$60\frac{5}{10}$	$1\frac{2}{10}$	$61\frac{7}{10}$
„ 1870-2....	57	$1\frac{5}{10}$	$58\frac{5}{10}$

In order to form an estimate of the progrsss or retrogression of trade under such circumstances, it is necessary to refer to the quantities of goods imported and exported. As regards imports, the table of quantities is imperfect, but it still contains sufficient facts to afford an indication of the direction of trade. As regards cotton piece goods, the imports remained almost stationary during the five years ending with the year 1872. It also appears that there was a diminution in the imports of metals and of railway materials. There was also a remarkable falling off in the importation of malt liquors during the period, amounting to more than fifty per cent., namely, from 3,638,000 gallons in 1863, as compared with 1,499,000 gallons in 1872. The imports of spirits and wines, on the other hand, increased. Coals and coke also exhibit an increase, having amounted to 374,000 tons in 1872, against 127,000 in 1863. The imports of salt nearly doubled. There was also, towards the close of the period, some improvement in the articles of raw silk, silk manufactures, sugar, and woollen manufactures, but not of sufficient extent to exhibit an important expansion of trade.

As respects the decreased value of exports, a considerable portion of it is explained by the fact that, notwithstanding that more raw cotton was exported in 1872 than in 1866 (806 million lbs. against 803 million lbs.), the value was only 21 millions sterling in 1872 against 35 millions sterling in 1866. The greatest value received for cotton, however, was in 1865, when only 525 million lbs. were exported, valued at 37 millions sterling. As a set-off against this diminution there was an increase in the quantity and value of the following exports, viz.:—Opium, tea, coffee, jute, hides and skins, spices, and some other articles.

India draws the greater part of her supplies from this country, and the interchange is of great importance; but it must still be admitted, on contrasting the total trade of the Indian empire, even with that of some of the least advanced states of the western hemisphere, that in proportion to the extent of her territory and the number of her population, her foreign trade is insignificant in amount. How far this is due to the long duration of the monopoly system of the old East India Company is not easy to ascertain. That it cannot be owing to the present customs' tariff must be evident from the fact that, with the exception of the duties on salt, and on beer, and wines and spirits, the import duties do not exceed seven and a-half per cent. *ad valorem*.

CORRESPONDENCE.

MANUFACTURE OF CAST IRON INTO IRON AND STEEL.

Sir,—I was unable, at the discussion which followed the reading of my paper at your last meeting, to hear distinctly all that fell from some of the speakers, and my reply to their observations was therefore less full and complete than I could have wished.

As some of the statements and opinions then given ought not to be passed over *sub silentio*, I request your permission to refute them in the present number.

I ought to have expressed my surprise that Mr. Lowthian Bell should have expected to find free sodium or potassium in the blast furnace, in the presence of unlimited quantities of carbon and nitrogen at a very high degree of heat, conditions quite unlike those which obtain in the Heaton converter, where, except in the metal, carbon is absent. That he must have utterly misunderstood Baron Gruner as to the Heaton process, the phenomena attending it, and its results, will be evident from the following quotations, which I make from M. Gruner's essay* (a formal report published with the sanction of the French Commission), p. 65:—"Mais l'acide azotique n'est pas le seul réduit dans le converter. Une partie de la soude se transforme en sodium, au moment ou l'alkali passe en filets minces au travers du bain de fonte. Le sulfure de sodium et le sodium même, que l'on trouve allié au fer dans le métal raffiné, ne peuvent à cet égard laisser la moindre doute." In page 66 he says:—"La fumée du converter est nécessairement complexe; on doit y retrouver les composés phosphores volatils mêlés au sodium," &c. He then (p. 67) gives Professor Miller's analysis of the refined metal as containing both calcium and sodium. Mr. Lowthian Bell has chosen thus to raise a collateral issue between us as to the merits of the Heaton process, whereas I cited the evidence of M. Gruner and Professor Miller only as to the reduction of the sodium during the use of the salts of soda as re-agents. But, as he has done so, I will farther give him M. Gruner's words (p. 8):—"L'épuration de la fonte par le procédé Heaton est fondée sur la reaction à la fois oxydante et basique, du nitrate de soude. L'acide nitrique oxyde le silicium, le phosphore le souffre; la soude s'empare des acides ainsi formés, et les

* "Etudes sur L'Acier, Examen du Procédé Heaton, par M. Gruner. Paris.

soustrait à l'action reductive du fer." In p. 72 he says:—"Faut-il en conclure que le procédé Heaton n'a aucune valeur, que son application semble ne devoir offrir aucun avantage? Telle n'est pas ma conclusion." He then goes on to point out the proper mode of applying the process, and comes to the conclusion that it would save from 15 francs to 20 francs a ton on the iron destined for rails and ordinary purposes. Nothing can be more conclusive against Mr. L. Bell's assertions than these extracts; indeed the whole tone and drift of this admirable investigation (which I commend to Mr. Bell as a model) is favourable to the nitrate of soda process; a process (as M. Gruner justly says in a note, page 6) really due to myself. I will say more—and I am able to prove it to the satisfaction of the whole trade—"that, if the Heaton Company had, like Mr. Bessemer, confined itself to pure selected brands of iron, free from phosphorus and sulphur, they would have found the supplement of Mr. Bessemer's process, and made the finest iron at a low cost." I hope soon to accept Mr. Evans' invitation to try it on one of the Bowling puddling furnaces in an improved mode of application, but I shall stipulate for the worst metal of Middlesborough (grey or not pasty), and I hope that Mr. Williams may try the same metal in his rotary furnace. We shall then have a fair comparison of results. Mr. L. Bell then introduced to the notice of the meeting a proposal of M. Shintz, to blow carbon, *i.e.*, oxide prepared from limestone, into blast furnaces. My plan of using it was published before that of M. Schintz, and differs materially from it. The conditions are altogether dissimilar, and I should like to see Mr. L. Bell's calculations as to the number of acres of ground and of retorts which he ascribes to M. Schintz. In the report of Dr. Playfair and Chevalier Bunsen "On the Gases evolved from Blast Furnaces" (British Association, 1846) it is stated that 84 per cent. of the fuel is wasted. In such cases it may be just possible that the use of carbonic oxide by appropriate means, and under suitable conditions, would more than supply the 16 per cent. of efficient heat, without such an army of retorts. I give no opinion on the subject, for so far as my method is concerned, neither the success nor the failure of M. Schintz's in any way touches it. But as to mine, let us come to figures. We have seen that one ton of limestone yields 42 per cent. of carbonic acid, so that in cwts. we shall have $\frac{42 \times 20}{100}$ or 8·4 cwts. This requires $\frac{6}{22}$ of its weight in carbon to convert it into 8·4 $(1 \times \frac{6}{22})$ or or 8·4 $\times \frac{14}{11} = 10·7$ cwt. (nearly) of carbonic oxide.

Now 10 tons of iron, for their conversion consume, at most 3,024 lbs. of pure carbonic oxide in mixture with the cupola gas (making up 75 per cent. of C O.) This corresponds to $\frac{3{,}024}{10·7 \times 112}$ tons of limestone, or just 2·5 tons (omitting the second decimal place), being ·25 or 5 cwts. per ton of iron. To convert 100 tons of metal, therefore, we must have 25 tons of limestone. The specific gravity of limestone is about 3,000, that of water being 1,000. A cubic foot of water weighs 1,000 oz. avoirdupois, so that one cubic foot of limestone weighs 3,000 oz., or about 188 lbs. avoirdupois. Dividing by this the weight of limestone due to 10 tons of metal, or $2·5 \times 2{,}240 = 5{,}600$ lbs., we obtain the number 30 for its cubical content in feet. The cubical content of a cylindrical retort, 18 inches in diameter and five feet in height, will be $(1·5)^2 \times 5 \times ·7854$, or 8·83 cubic feet. Thus, four such retorts would have a content of above 35 cubic feet, which again would allow amply for the insterstices between the stones. Double this number for the adjoining retorts, and we have in all eight retorts. Let us be liberal to Mr. Lowthian Bell, and make him a present of two more, which makes a total of 10. These will (it is known) discharge their gas as carbonic oxide in two hours—the time of converting 10 tons of metal, so that we want only two hours' start for our retorts. And now, I will ask my indulgent critics how many puddling furnaces it would require to turn out this 10 tons of iron with the puddlers and their under-hands? I make it 50, which, I fancy, would require more land than my 10, or even 20, retorts. This result proves, not for the first time, how unsafe guides in such matters are vague exaggerating guesses; only touch them with a little wholesome arithmetic and they at once collapse.

Mr. Williams puts the case as between oxide of iron and nitrate of soda, whereas I have clearly laid it down that the use of the nitrate is with me exceptional, like that of the permanganate, or at most concomitant with the oxide of iron. But, in the main, I use a pure caustic soda (which I obtain at a moderate cost) conjointly with rich oxides of iron or of manganese. Mr. Williams says that "unfortunately" rotary puddling is too dear, while hand puddling is no puddling at all, in the case of these impure brands of cast iron. Well, this is the very hitch that I contend will be untied by my proposed method. When I have my lining of six inches thick, made of Bauxite and Naxos emery, cemented with a little caustic soda, I may easily introduce above it a good coat of soda and oxides of iron, the latter to oxidise the sulphur and phosphorus; the former, as Baron Gruner says, to seize on the acid formed, and to prevent its reduction by the iron.

I am obliged to Professor Tennant for his hint as to iserine. I was aware of its volcanic origin; but the samples from Taranaki Bay, which I have examined, had no impurity except about five per cent. of silica, and I suppose that the action of the sea-water for so long a time had eliminated the phosphoric acid, if any was present. It is, however, a good caution, and, fortunately, we can obtain a pure artificial "iserine" magnetic oxide with 10 per cent. of titanic acid, by grinding up one ton of "ilmenite*" with three tons of rich magnetic oxide, a very efficient re-agent, and much cheaper then "iserine."—I am, &c.,

Francis Charles Knowles.

Mayfair, Ryde, Nov. 29, 1873.

NOTES ON BOOKS.

An Easy Introduction to Chemistry. Edited by the Rev. A. Rigg. (*Rivingtons.*)

There cannot be many members of the Society, or certainly not many who habitually attend its meetings, to whom the name of Mr. Rigg is not familiar. To him the Society is indebted for several courses of Cantor Lectures, the latest those given last session on "The Energies of the Imponderables." Any book, therefore, which appears with his name on the title-page, is likely to attract favourable notice amongst members of the Society of Arts. It is stated that the present work is based on a book by Dr. Worthington Hooker, an American chemist, but it is not mentioned how much is due to Mr. Rigg, and how much to his American *collaborateur*, still it may, perhaps, be justly considered that, as the book is put forward under Mr. Rigg's auspices, he is answerable for all therein contained. As this is decidedly a *first* book on the subject, it is couched in the simplest possible language, so that it may be suitable to the very youngest students of chemistry. It would be difficult to condense into a space fitted for these columns any account of the matter contained in this little treatise. The author has evidently intended to summarise, as far as possible, the leading facts of the science, and to throw them into a form available for young people. The great difficulty in preparing books of this nature is to avoid at once the Scylla of abstruseness and the Charybdis of over-simplicity; and there are, perhaps, not

* "Ilmenite" costs about 30s. a ton at the eastern ports of England and Scotland.

very many scientific books for children which do not fall into one or other of these excesses. Hence there is always plenty of room for good elementary treatises, numerous as are the attempts to supply the want.

GENERAL NOTES.

Technical Education.—The Council of the Art Union of London have offered two premiums, one of £35, and one of £15, to be competed for by past and present students in schools of art in which painting on pottery is taught. The subject proposed is a design for decoration of a bazaar of specified form and dimensions. The designs are to be sent in to the house of the Art Union, on any day from the 1st to the 7th May next.

Sulphur in Sicily.—The quantity of sulphur ore still remaining to be excavated in the island of Sicily is estimated to be from 40 to 50 millions of tons. Taking the average annual production to be 160,000 tons, and supposing, by the present rude process of extraction from the ore by kilns *(calcaroni)*, that one-third is lost, the quantity of ore raised would be 240,000 tons annually; and at this rate, in 200 years, the mines of Sicily will be completely exhausted.

The United States Mint.—The Director of the United States Mint, in his first annual report, estimates the amount of gold coin in the United States at 135,000,000 dollars, and that of the silver coin at 5,000,000 dollars. The silver circulates principally in California, Oregon, Nevada, Idaho, Arizona, and Texas. The increase of coin has been proceeding at a very fair rate since April 1, and it is anticipated that it will gradually go on until an amount is secured sufficient to enable the country to resume specie payments.

Street Pavements.—The whole of Ludgate-hill, from top to bottom, has recently been paved with wood. It has been laid with blocks of Memel fir timber a little larger than ordinary bricks, all made to measure, and placed edgewise on a bed of gravel previously prepared, into which the blocks are beaten into position by heavy paving rams. That done, hot molten tar is run into the interstices of the blocks, and the whole surface of the roadway thus welded together, so to speak, is afterwards covered with gravel and arched in the ordinary way so as to carry off the surface-water in wet weather to gutters on either side.

Australian Gold.—The value of the gold imported into the United Kingdom in October from the Australian Colonies was £566,600, against £514,631 in October, 1872, and £747,781 in October, 1871. The aggregate value of the exports was £7,570,081, against £5,034,281 in the corresponding ten months in 1872, and £5,801,458 in same period of 1871. The quantity of gold received by escort at Sydney from the New South Wales fields amounted in August to 24,698 ounces. The total yield of gold in Victoria, in the quarter ending 30th June, 1873, was 283,248 ounces, of which 159,605 ounces were from quartz of the balance from alluvial mining.

Museum and Library at Massa Marritima.—The little town of Massa Marritima (Tuscany) sets an example which would be well to be followed by many larger and better known towns, both in Italy and this country. In 1867 the municipality of Massa purchased the interesting collection of minerals, models of mining machinery, and specimens of tools used in mines from various countries from Signor Teodoro Haupt, a well-known mining engineer of Florence, together with a complete series of maps and plans of most of the mines in Tuscany. This forms the nucleus of the museum, which has since been enriched by a collection of the birds and animals found in the province, the donation of a medical man residing in the town, and their value is considerably enhanced by being well arranged and tabled with both common and scientific names. The library now contains about 6,000 volumes, some of which are of great value, as being extremely rare, and relating to the history of the republic of which Massa was once the capital. The archæological department contains a very beautiful Etruscan funeral urn.

Queensland Railways.—Surveys for the Stanthorpe extension of the Southern and Western Railway of Queensland have been completed. A portion of the country from Stanthorpe up to within eight miles of Warwick is extremely wild and rugged, the line between these points being skirted by basaltic and granitic outcrops of the most formidable character. The fall from the shoulder of the Dividing Range into Warwick is 1,500 feet, and the length of the line between 45 and 46 miles.

The Sugar Trade of New Orleans.—The total crop of Louisiana sugar during the last 38 years is estimated at 6,972,371,638 lbs., of the value of 372,129,172 dollars. The crops have varied very considerably in different years, owing to various causes. The largest crop was in 1861, when the quantity reached 528,321,000 lbs., value 25,093,271 dollars. During the war the yield fell off very much, but has risen from 42,900,000 lbs. in 1866 to 176,906,125 lbs. in 1871. The yield of the crop 1872-3 promised well, but has not resulted so, owing to the long drought that has been experienced; the precise yield of the crop is not yet known. The machinery employed in the manufacture comprised 907 steam-power engines, 317 horse-power, 90 portable mills, 918 open kettles, 114 open pans, and 58 vacuum pans. The number of sugar-houses was 1,224, of which 760 are built of wood entirely.

Paris Academy of Inscriptions and Belles Lettres.—M. Duruy, formerly Minister of Public Instruction under the Empire, the author of "The School History of France," and many other works, has been elected a free member of this academy in place of the late M. Viset. The other names put up for election were those of M. Nisard and M. Francisque Michel.—The academy, at its annual meeting on the 8th ult., distributed its rewards for the current year. The Committee of the Antiquities of France awarded the three annual medals in its gift to M. G. Demay for his "Inventory of the Seals of Flanders," from the public archives, museums, and public collections; to M. Charles Gérard for two works, "Essays on the Original Mammalia of Alsace," and on the artists of the same country during the middle ages; and to M. Edouard Aubert, for his work on the "Trésor of the Abbey of Saint Maurice d'Aqaune." The Numismatic Committee awarded its medal to M. Jacques de Rougé for his work on the "Monnaies des Nomes de l'Egypte."

Floating Baths for the Thames.—A new floating bath has been brought before the Society by its inventor, Mr. Alfred Rae. It consists essentially of two twin barges, bearing between them a central hull with grated or latticed sides and ends. This is moored so as to lie "end on" to the sea, the shore end resting on strong wheels or rollers. Boxes or cabins for bathers surround the central hull, as in an ordinary public bath, and passages along the length and breadth of the saloon are provided for the use of both bathers and attendants. When used on the Thames or any other impure river, instead of the grated or latticed surface referred to above, patent filters would be fitted to the sides and bottom, and the water in the central float thus rendered perfectly clean; and by converting what are now in the model graduated depths or platforms into watertight caissons, the slight additional weight to be lifted by the central hoisting gear would be neutralised. The utilised or dirtied water would find egress by graduated gates, valves, or pipes, as the float rose, and by its depression a fresh supply of clean filtered water be obtained. By the adoption of a ship's bottom scrubber the outer bottom of the central float, or bath, can be kept clean; the inner bottom and the filters are always accessible. A false bow, or kind of shield, is adaptable to the sea end of the double hull, so as to obviate any inconvenience due to swell or surf, and a deck covering all, railed in and fitted with seats and awnings, forms a promenade.

Advices received recently from New York state that blast furnaces are about to be established at 12 points upon the Chesapeake and Ohio railroads. One of the furnaces will be in the neighbourhood of Richmond.

A recent geological survey reveals the important fact that on the line of the Northern Pacific Railroad, in the Rocky Mountain district, there exists a coal-bearing region of 250,000 square miles in extent, the strata of available fuel buried there varying in thickness from 5 feet to 35 feet.

NOTICES.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

The Book of Hall-Marks, by the manager of the Liverpool Assay Office. Presented by Edwin W. Streeter.

Reports of the Inspectors of Factories for the half-year ending 30th April, 1873.

Report of the Meteorological Reporter to the Government of Bengal. Meteorological Abstract for 1872.

De l'Enseignement des Arts du Dessin en Suisse, par Charles Menn. Presented by the Author.

The Teeth in Infancy and Age, by L. B. Pillin. Presented by the Author.

Boletin de la Esposicion Nacional en Cordoba (Argentine Republic), vols. 1 to 7, and La Esposicion Nacional, publicacion autorizada por la comision directira de la Esposicion, año 1871. Presented by Carlos Olivera.

The following work has been purchased for the Library:—

Les Grandes Usines études industrielles en France et à l'étranger. Par Turgan, vol. x.

ORDINARY MEETINGS.

For the Meetings previous to Christmas, the following arrangements have been made:—

December 10.—"On Mechanical Processes for producing Decorative Designs on Wood Surfaces," by Thomas Whitburn, Esq.

December 17.—"Whitby Jet and its Manufacture," by John A. Bower, F.C.S., Science Master, Whitby School. On this evening Thomas Chapman, Esq., F.R.S., will preside.

INDIA COMMITTEE.

A conference will be held on Friday, the 12th inst., at 8 p.m., on the threatened famine in Bengal, and the means of preventing or alleviating famines in India, when the Right Hon. Sir Bartle Frere, K.C.B., will open the discussion.

Members are entitled to attend these conferences and to admit two friends to them.

CANTOR LECTURES.

The second course will be on the "Chemistry of Brewing," by Dr. Charles Graham (University College, London), and will consist of seven Lectures' to be commenced on Monday, the 8th December; two to be delivered before Christmas, and the remaining five after Christmas, as follows:—

Lecture I.—December 8th, 1873.

Historical and Preliminary.—History of brewing. Varieties of grain used. Chemical examination of the properties of cellulose, starch, dextrine, grape sugar, gluten, &c. Action of nitrogenised substances on starch.

Lecture II.—December 15th, 1873.

On Malting.—The germination of seeds. Chemical changes produced. Examination of the processes of steeping, germination, and kiln-drying. English and Bavarian methods contrasted. Chemical examination of malts, with some analytical methods adopted for the use of the master brewer (Braumeister).

Lecture III.—February 2nd, 1874.

On mashing.

Lecture IV.—February 9th, 1874.

On Boiling. Hops, their properties and uses.

Lecture V.—February 16th, 1874.

On fermentation. (Primary.)

Lecture VI.—February 23rd, 1874.

On fermentation. (Secondary.)

Lecture VII.—March 2nd, 1874.

The beer of the future.

These lectures will include a chemical examination of the chief features of the methods of brewing adopted in England, Scotland, Germany, Belgium, and Norway, with proposals for the prevention of acidification and other destructive changes which occur in beer. The lectures on fermentation will include an account of the nature and chemical functions of the various yeast plants. During the course, chemical tests will be described for the guidance of the brewer in the mashing, boiling, and fermenting processes, and for testing the purity of the water and utensils used.

Other courses will also be given during the Session, one by Professor Barff, M.A., having been already arranged. These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture.

On Monday last Mr. Lockyer's short course of two lectures on the "Spectroscope" was concluded. They will be published in the *Journal* in due course.

MEETINGS FOR THE ENSUING WEEK.

Mon.....**SOCIETY OF ARTS, 8.** Cantor Lectures. Dr. Graham, "On the Chemistry of Brewing."
Farmers' Club, 5½. Mr. C. S. Read, M.P., "The Agricultural Labourer and the Poor Law."
Geographical, 8½. Sir Samuel W. Baker, "On the Khedive of Egypt's Expedition to Central Africa."
Medical, 8.
London Institution, 4.

Tues....Civil Engineers, 8. Mr. Joseph Prestwich, "On the Geological Conditions affecting the Construction of a Tunnel between France and England."
Medical and Chirurgical, 8½.
Photographic, 8.
Anthropological Institute, 8. 1. Mr. J. Park Harrison, "The Hieroglyphics of Easter Island." 2. Professor T. McKenny Hughes, "Exploration of Cave Ha, near Giggleswick, Settle, Yorkshire." 3. Rev. D. R. Thomas and Professor T. McKenny Hughes, "On the Occurrence of Felstone Implements associated with extinct Mammalia in Pontnewydd Cave, near St. Asaph, North Wales." 4. Professor Busk, "Notice of a Human Fibula of unusual formation discovered in Victoria Cave, Settle."

Wed....**SOCIETY OF ARTS, 8.** Mr. T. Whitburn, "On Mechanical Processes for Producing Decorative Designs on Wood Surfaces."
London Institution, 7.
Graphic, 8.
Royal Literary Fund, 3.
Royal Society of Literature, 4½.
Archæological Association, 8.

Thur....Royal, 8½.
Antiquaries, 8½.
Royal Society Club, 6.
Mathematical, 8.

Fri......**SOCIETY OF ARTS, 8.** India Conference. Right Hon. Sir Bartle Frere, "On the Threatened Famine in Bengal."
Astronomical, 8.
Quekett Club, 8.
Clinical, 8½.
Literary and Artistic, 7. Annual Meeting.

Sat......Royal Botanic, 3¾.

JOURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, DECEMBER 12, 1873.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

NATIONAL TRAINING SCHOOL FOR MUSIC.

Royal Albert Hall, Conversazione, 18th December, 1873.

The following programme for the evening has been arranged:—

1. Doors open at eight.
2. His Royal Highness the Duke of Edinburgh, with the Council of the Society and the Council of the Royal Albert Hall and Mr. Freake, will proceed across the arena to the front of the organ.
3. His Royal Highness the Duke of Edinburgh will call upon the Rev. Canon Brookfield, her Majesty's Chaplain in Ordinary, to read a statement.

A vote of thanks will be proposed to his Royal Highness.

His Royal Highness will reply and move thanks to the Society of Arts.

The Chairman of the Council will reply and move thanks to Mr. C. J. Freake.

4. His Royal Highness will then return to his box.
5. A series of musical pieces, under the direction of Mr. Barnby, will then be performed.

(1) National Anthem—"God Save the Queen."
(2) Chorus—"In these delightful pleasant groves" —*Purcell.*
(3) French Song—Madame Sherrington.
(4) Cantata—"Athalie"—*Mendelssohn.* Madame Sherrington, Miss Antoinette Sterling, Miss Catherine Poyntz.
(5) English Song—Miss Sterling.
(6) Overture—"Il Barbière"—*Rossini.*

There will be intervals between the pieces, and the audience are particularly requested not to move about during the performance.

JUVENILE LECTURES.

It having been determined by the Council to provide a short course of lectures suitable for a juvenile auditory during the Christmas holidays, arrangements have been made with Mr. Frank Buckland, M.A., her Majesty's Inspector of Salmon Fisheries, to deliver two lectures "On the Structure and Habits of Beasts, Birds, and Fishes, as showing Beauty and Design," on Friday, January 2nd, and Friday, January 9th, at 8 p.m. The lectures will be illustrated by specimens. Tickets, each to admit a member and two children (under 16) have been prepared; and it is requested that those members who wish to avail themselves of the lectures for their children will make early application to the Secretary. The issue of tickets will be strictly limited to members, and none will be sent except to those applying for them. As the lectures are intended specially for the children of members, it is hoped that the number of adult visitors may be as far as possible restricted; and that only ladies accompanying the children will make use of the tickets. Only one ticket, as above, will be issued to any one member, and no person will be admitted without a ticket.

NATIONAL MUSEUMS AND GALLERIES, AND PUBLIC EDUCATION.

The Executive Committee held their first meeting on the 10th December, 1873. The names of the noblemen and gentlemen and of the chairmen of Schools of Science and Art were read, who have agreed to join the Committee for the purpose of giving effect to the following resolutions:—

1. To form a Standing Committee for the purpose of bringing under Parliamentary responsibility the National Museums and Galleries, so as to extend their benefits to Local Museums, and to make them bear on public education. The following are the several objects in view for effecting this purpose:—
2. All Museums and Galleries supported or subsidised by Parliament to be made conducive to the advancement of Education and Technical Instruction to the fullest extent, and to be made to extend their advantages to the promotion of original investigations and works in Science and Art.
3. To extend the benefits of National Museums and Galleries to Local Museums of Science and Art which may desire to be in connection, and to assist them with loans of objects.
4. To induce Parliament to grant sufficient funds to enable such objects to be systematically collected, especially in view of making such loans.
5. For carrying out these objects most efficiently, to cause all National Museums and Galleries to be placed under the authority of a Minister of the Crown, being a member of the Cabinet, with direct responsibility to Parliament; thereby rendering unnecessary, for the purpose of executive administration, all unpaid and irresponsible trustees, except those who are trustees under bequests or deeds, who might continue to have the full powers of their trusts, but should not be charged with the expenditure of Parliamentary votes.
6. To enter into correspondence with all existing Local Museums and the numerous schools of Science and Art, including Music, now formed throughout the United Kingdom, and to publish suggestions for the establishment of Local Museums.
7. Also, to cause the Public Libraries and Museums Act (18 and 19 Vic. c. lxx.) to be enlarged, in order to give local authorities increased powers of acting.

The Executive Committee ordered the names of persons joining the Committee to be published in the *Journal*, as well as the resolutions passed by them. These will be given in next week's *Journal.*

TECHNOLOGICAL EXAMINATIONS.

In addition to subscriptions already acknowledged, the following has been received:—

J. W. Peters, Esq............. £3 0 0

For a prize in the Advanced Grade, Carriage Building.

PROCEEDINGS OF THE SOCIETY.

FOURTH ORDINARY MEETING.

Wednesday, December 10th, 1873; Robert Rawlinson, Esq., C.B., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Barker, Albert, 41, Edwardes-square, Kensington, W.
Barker, William, 164, New Bond-street, W.
Bevis, Restel R., Birkenhead Iron Works, Birkenhead.
Billing, Charles Eardley, 14, Neville-terrace, South Kensington, S.W., and 90, Hatton-garden, E.C.
Chubb, John Charles, 57, St. Paul's Church-yard, E.C., and Teddington.
Clapham, R. Calvert, Earsdon, near Newcastle-on-Tyne.
Coulson, Frank, 34, Elm Bank-crescent, Glasgow.
Cumming, Samuel Fraser, 52, Montagu-square, W.
Draper, George, 66, Old Broad-street, E.C.
Eldridge, James, Richmond Gas Company, Richmond, Surrey.
Faulconer, Robert Stephen, Clarence-road, Clapham, S.W.
Fawcett, Joseph, 16, St. James's-row, Sheffield.
Hewett, Henry North, Larkhall Brewery, Larkhall-lane, Clapham, S.W.
Hill, Hamilton Andrews, M.A., 11, Lee-park, Blackheath, S.E., and 13, Queen Victoria-street, E.C.
Holmes, Mrs., 21, Holland-villas-road, Kensington, W.
Hughes, Jabez, 49, Camden-square, N.W.
Jobson, John, Derwent Foundry, Derby.
Kirtley, William, Midland Railway (Locomotive Department), Derby.
McMaster, James S., Mitcham, Surrey.
Penton, George, London and Burton Brewery, Ratcliff, E.
Ray, Richard, Brewery, Camberwell-park, S.E.
Renshaw, Arthur Dallison, Lovell's-court, Paternoster-row, E.C., and 11, Cedars-road, Clapham, S.W.
Reynolds, W. P., London and Southwark Insurance Corporation (Limited), 73 and 74, King William-street, E.C.
Rhodes, Jehoida A., Britain Works, Howard-street, Sheffield.
Routh, Leonce, Moss-hall-grove, Finchley, N.
Stanbridge, Sidney, Hutton-lodge, 62, Wiltshire-road, Brixton, S.W.
Ward, Edwin, York-house, 69, Avenue-road, N.W.
Westhorp, Theophilus, Holmhurst, Loughton, Essex.
Whitehead, Dr., 54, Hamilton-square, Birkenhead.
Wittmann, Sidney A., 42, Great Marlborough-street, W.

The following Candidates were balloted for and duly elected members of the Society:—

Alliott, James B., Bloomsgrove, near Nottingham.
Beasley, Charles, 30, Upper Hamilton-terrace, St. John's-wood, N.W.
Brown, William Ray, Forest-hill, S.E.
Cramp, Charles Courtney, 87, Litchfield-road, Grove-road, E.
Denman, James L., 20, Piccadilly, W.
Fairfax, Henry, 435, West Strand, W.C.
Garrett, Edmund, Bow Brewery, Bow, E.
Hodson, George, C.E., 6, Park-lane, Loughborough.
Kenward, Henry, 1, Market-street, Bloomsbury, W.C.
Kitt, Benjamin, Vernon-house, Tiverton, Bath.
Liddell, Henry, 9, York-terrace, Beverley-road, Hull.
Mackay, John, Mountfields, Shrewsbury.
Malcolmson, Captain John Grant, V.C., 17, Kensington-gardens-square, W.
Mansergh, James, 3, Westminster-chambers, Victoria-street, S.W.
Myers, S., 1, Vale-terrace, Sutherland-gardens, Maida-vale, W.
Simpson, George, Lovell's-court, Paternoster-row, E.C., and Shortlands, Kent.
Stevenson, David, F.R.S.E., 84, George-street, Edinburgh.
Strina, M., 4, Bute-crescent, Cardiff.

The paper read was—

ON MECHANICAL PROCESSES FOR PRODUCING DECORATIVE DESIGNS ON WOOD SURFACES.

By Thomas Whitburn.

The subject of decorative art is so extensive and so fascinating, that to discuss it with any approximation to completeness would require many evenings, and the united efforts of many minds; but I am necessarily limited to one, and that a narrow branch of the subject, namely, the mechanical processes for decorating wood surfaces; besides, my duty is not so much to criticise, or attempt to pass judgment on the comparative merits of seemingly conflicting styles of art, or even on the merits of the different methods of expressing these styles on the surface of wood, as briefly to describe such processes as seem to have distinctive character, and to invite attention to one among them, which may, perhaps, possess novelty and utility. The mechanical processes for decorating wood surfaces may be conveniently divided into such as imitate graining, or produce change of colour by staining, and such as use the wood as a ground for the production of designs, and thus enter the domain of imaginative or fanciful art. Of mechanical methods for imitating graining by reproducing the markings existing on the natural wood itself, four have obtained publicity in the *Journal* of this Society, the first to call attention to the process having been Signor Felix Abate, of Naples, who, on January 23, 1854, speaking of his discovery, says:—"This invention constitutes a new art, by means of which natural or artificial objects can be represented and imitated, by printing directly from the objects themselves upon any suitable substance. * * * Suppose a sheet of veneering wood be the object from which impressions are to be taken; I expose the wood for a few minutes to the cold evaporation of hydrochloric or sulphuric acid, or I slightly wet it with either of those acids diluted, and then well wipe the acid off from the surface. Afterwards it is laid upon a piece of calico, or paper, or common wood, and by the stroke of the press an impression is taken, which is, of course, quite invisible; but by exposing this impression immediately after to the action of a strong heat, a most perfect and beautiful representation of the printing wood instantaneously appears. In the same way, with the same plate of wood, without any other acid preparation, a number of impressions, about twenty or more, are taken; then, as the acid begins to be exhausted, and the impression grows faint, the acidification of the plate must be repeated as above, and so on progressively, as the wood is not in the least injured by the working of the process for any number of impressions. All these impressions show a general wood-like tint, most natural for the light-coloured woods, such as oak, walnut, maple, &c.; but for the woods that have a peculiar colour, such as mahogany, rosewood, &c., the impression must be

taken, if a true imitation be required, on a stuff dyed of the light colour of the wood. Such," states Signor Abate, "is thermography, or the art of printing by means of heat." Of similar intention, but differing somewhat in detail, is the process of Mr. William Dean, described by him on Jan. 27, 1869, as follows:—"Select a piece of wood of fine quality, about five feet long, twelve inches wide, and a quarter of an inch thick; it is, to use the technical phrase, cleaned up by the cabinet-maker on both sides, and is well sand-papered down. By having both sides of the board cleaned up, two patterns are obtained from the same board. A chemical preparation is then applied to it, which has the effect of opening the pores of the wood, and, at the same time, of hardening the surface, and, when the board is thoroughly dry it is ready for use. * * * The material used for taking the impression is prepared in oil, and is specially adapted for the purpose of transferring. The paper, too, is manufactured for the purpose, and is very thin but tough, so that it can be successfully applied to any irregular or moulded surfaces, and it is sized, to prevent the colour from becoming incorporated with the body of the paper. A small wood roller is used for spreading the colour on the board, and a large, broad, flexible palette-knife is used for taking the superfluous colour off. That being done, the sized paper is placed on the board, and both are turned through a small machine having turned iron cylinders, the upper one being covered with double-milled flannel; the paper is then taken off the board, its printed surface is applied to the article to be decorated, the back of the impression is lightly rubbed with a piece of soft flannel, and the paper is removed, and an exact *fac-simile* of the board from which the impression is taken is given." It will be observed that while Signor Abate's process is one for printing direct from the wood itself, Mr. Dean's is that of obtaining an impression on wood or other substances by means of transfer. It is by transfer, also, that the small fancy articles made of wood, such as trays, saucers, &c., known as "Tunbridge ware," are ornamented with views of buildings and landscapes. Among recent methods of staining wood, that patented by Messrs. Trollope and Sons, under the title of Xylotechnography, deservedly attracted attention in the London International Exhibition of 1871. It is described as "staining by hand or stencil a light-coloured, but not necessarily soft, wood with certain transparent colours, producing a result when polished similar to inlaying." Of the mechanical processes by which wood is decorated with designs, stencilling is so well known that description is superfluous. For rendering broad, simple effects, its utility is indisputable, but it is manifestly unequal to the representation of designs expressing the qualities of delicacy and intricacy. Pretty imitations of sepia drawings have been executed on wood with hot irons, and a method for the mechanical production of such effects was introduced by Mr. Brigg, in 1859. His method, as described in the *Journal of the Society of Arts*, "is that of charring the surface with engraved cylinders, heated with gas, which enables the degree of heat to be regulated, and the extent of char to be controlled. * * * After the surface has been charred sufficiently to yield the greatest amount of shadow required, the whole surface is rubbed down to a flat surface, which is then polished or varnished. By this means imitation-grained surfaces are obtained of great durability, and at a cost not exceeding grained work produced by the ordinary process of painting and varnishing." One more process, which I believe to be novel, and which it is my privilege to introduce to your notice this evening, remains for me to describe, but before doing so, I will, with your permission, make a few comments on the style of art out of which, I may say, the process has grown, and which it may be calculated to disseminate. The art of design, reduced to its simplest elements, resolves itself into *line* and *mass*. These, in the works of all primitive ancient nations, tell with absolute distinctness. By them form is never, as in the pictorial art of more modern times, partially lost or concealed. Art was then regarded, not as a refinement of imitation, but as a language to be intelligible to all. Indeed, art was then a substitute for written language. It was so used, nay, may perhaps still be used by such savage nations as have not met with "the schoolmaster abroad." The American Indians having been especially expert at "picture writing" on the bark of the birch tree, and on deer and buffalo skins. There is this important distinction, however, between the rude art of savage, or unprogressive nations, and of those who either merge into, or are the pioneers of higher forms of civilisation, namely, that the former kind, although expressive of ideas and characterised by some essentially decorative qualities, such as firmness of line, flatness of colour, and absence of shade, is deficient in elements without which beauty of form cannot exist, namely, refinement of outline, proportion, and symmetry. I speak, of course, especially with reference to figures; for some of the simple running patterns of savage nations are unobjectionable in treatment, and, occasionally, even extremely pleasing. The chief value of this primitive style of art is that it has recorded for our edification the characteristics of the most ancient epochs of civilisation. These antique works, however, are, for the most part, not on wood, but on walls, or pottery; nor do they consist solely of effects in light and dark, but are many of them in colours. Still, in either case, the strong contrasts of dark figures on light, and light figures on dark grounds, are constantly present. Firm outlines surround them with absolute impartiality. But the earliest designs, although they possess the indispensable quality of distinctness, together with recognition of the principles of proportion, repetition, and symmetry, are not always regarded apart from language and symbolism, and with reference to abstract exemplifications of composition in line and form, beautiful. For supreme beauty of decorative design we must turn from Egyptians, Assyrians, nay, even Etruscans, to that nation in whom all the æsthetic susceptibilities of the ancient world would seem to have been concentrated—the Greeks; and in the works of that wonderful people we find that the art of decorative design meets with exquisite expression in their painted vases, and especially in those of the finest period comprised between 440 and 336 years before the Christian era. Of these, an invaluable collection is accessible in the British Museum. Here again,

art is used as a language, and finds its simplest possible expression, but with this simplicity is combined as much beauty as the nature of the material, and the limitation of the intentions, are capable of conveying. But the beauty is of a kind that appeals not to vulgar tastes, indeed not so much to the senses as to the intellect. It results, not from brilliancy or harmony of colours, nor from delicate gradations of shade, but from exquisite refinement of outline, combined with most admirable arrangement of symmetry, proportion, and mass. But, in claiming for these vases the very highest qualities of decorative beauty, I am quite aware that the opinions of many may be adverse to me. In fact, I recollect being on one occasion in the vase room containing the finest specimens at the British Museum, when a well-dressed, and doubtless well educated-spectator, on passing through, remarked to a friend, "These things are very curious, and very old, but they are certainly not beautiful." Possibly he was unaware that whilst beauty is based upon fixed and eternal laws, the ideas respecting it vary according to the natural capabilities and acquired knowledge of the individual who may contemplate it; and that they are, in addition, liable to be biassed by a certain, or rather uncertain, influence, emanating from a very fickle goddess indeed, whom we ignorantly worship under the name of fashion. Let us hope, however, that ere many years have passed, the schools of art, which seem now firmly rooted throughout the country, will have so leavened public taste as to make a speech such as that which I have recorded impossible. At present, unluckily, the style and supposed requirements of modern civilisation would seem to have forced art to take refuge from streets and squares in galleries and museums, whence it is regarded by many, not so much as a necessity of daily life, to be present in all things that we see or use, but as a curiosity to be wondered at, or a luxury to be coveted. It is in this that the difference between the towns in England and the Continent, and especially in Italy, is strikingly apparent. Here we have stupendous evidence of material prosperity, and witness most marvellous vitality and energy all around us. There we get, in all the old portions of the towns at least, the most delightful quaintness, picturesqueness, and varied beauty. Every old house, or church, or shrine, or fountain, is a study. Let any one of artistic tastes, who has travelled, compare his impressions on entering Florence, or Padua, or Verona, or Venice, or the many cities in Germany or Flanders, with those he has experienced on returning to our great metropolis, or on visiting the multitude of prosperous and highly respectable towns and villages with which our fortunate island is studded, and can he forbear asking why our comparatively monotonous streets should not be enlivened by a little quaintness and beauty too, and why should individuality in decorative art and architecture be driven off the face of the civilized earth by stucco? But let us indulge the pleasant belief that a decided and healthy reaction has now set in, that deathful monotony is doomed, and decoration will once more assume its legitimate function, and gratify the eye by being applied to every surface or object fitted to receive it.

And here, at the risk of being charged with discussing matters foreign to my subject, I cannot refrain from touching on those extraordinary manifestations of artistic energy which resulted in the creation of two distinct, and, it has been vehemently and mistakenly asserted, absolutely antagonistic styles of art, the Gothic and the *renaissance*. They differ widely in form, it is true, but beneath the form is similarity of artistic principle. Each has all the characteristics of vital art. They are not mere tame, weak, vapid, mechanical hashings up of works of previous ages, but are magnificent artistic manifestations of the intellectual and emotional energies of powerful races, who possessed the faculty not merely of using the materials gathered by others, but of thinking for themselves—the only condition under which the quality we term originality is conceivable or possible. Once it was the fashion to call the Gothic a barbarous style. Gothic has survived it. Lately there has been a tendency in some quarters to give it undue exaltation; to consider it the only true and virtuous style. This estimate errs on the other side. Certainly, as exemplified in our churches and cathedrals, it has become inseparably connected with Christian theology. It is a style which, less perfect in detail than other styles, surpasses all, perhaps, in sublimity of aspiration. It is a style which would seek to express in concrete form all the mysteries of Heaven, and to mingle with the beauty it gleaned from thence, something of the grotesque deformity which it conceived to exist in the uttermost abyss. Ministering angels and mocking demons are mingled in one strange mystic whirl of action. In a word, it was the exponent not only of the theologic creed, but we may almost say of the scheme of mediæval thought and idea of existence. It was, at its best period, a style of art glowing with fervid faith; a style which evinces as firm a conviction in the existence of a future life, as it does clearness of apprehension of the inexhaustible variety and beauty manifested in the present one. What, compared with this, is Renaissance? Upon the face of it I fear that it looks very much like a relapse into paganism. Clearly, if Gothic was the art of faith, Renaissance was that of culture. Up to the 15th century the Bible and the Lives of the Saints were the sources whence art derived its inspiration, but at the revival of learning, and the discovery of the wonderful artistic relics of Greece and Rome, a fresh element, in Italy especially, superseded mediævalism. Charmed with the exquisite finish, and the luxuriant and graceful fancy displayed in the writing and sculpture of classic times, Italian poets and artists emulated these models, and created a new world, haunted as of old by nymph and faun,—not unvisited by the goddess of the silver bow or unirradiated by gleams from the golden-shafted Apollo. For angels now we have Oreads, but on the other hand Satan with horn and hoof subsides into the comparatively harmless satellite of old Silenus, the Satyr. And here one cannot but notice the powerful influence which the poets of that period must have exercised on their friends and associates, the sculptors and painters. Who can read Pulci, Berni, Ariosto, Tasso, without perceiving that the classic idea and imagery with which they teem—largely leavened, by the way, with the mediæval chivalric spirit—not then extinct—must have kin-

dled a correspondingly prolific effort of imagination in those who filled Italy with exquisite creations in imitative and plastic art. But the inspiration of this art, be it borne in mind, was derived wholly from sources acknowledged to be fabulous. The ancients really did believe in these deities—or, at any rate their poets wrote, and their artists worked for those who believed in them; but what faith could Renaissance poets and artists have in a "creed outworn"? None. But they did believe, and very fully and entirely too, in their own intellectual power, and in the inexhaustible beauty of the nature which supplied them, as it had supplied the artists of ancient Greece, with models. Beauty, then, is the end and aim of Renaissance art, and, within proper limits, a very legitimate aim too. Instruction is an excellent thing in its way, but amusement has its office also. It is quite right that we should be virtuous, but by all means let our virtue be rewarded with "cakes and ale." Only let the "cakes and ale" be of good wholesome quality, and Renaissance art, at its best, *is* of good wholesome quality. That it fell into decay is true, and "pity 'tis, 'tis true." But was classic art exempt from decay? and did not even Gothic art deteriorate? Is aught human free from the influence of that power concerning which Spencer sang so sweet and pathetically—"mutability." Renaissance art fell, then, not because it was false, but because its hour had come. It was not false art, but true. Not of such sustained splendour as classic art, nor of such sublime endeavour as Gothic, but equal to either in exuberance of imagery, in lavish profusion of fanciful device, and in that indispensable element of all artistic excellence—spontaneity. Renaissance art, then, was not "writ in water," but has left imperishable records, inexpressibly delightful to all who are free from sectarian obliquity of artistic vision. And now I come to certain phases of art which, very beautiful, nay, perfect in their kind, are nevertheless, in some respects, alien to our thoughts, feelings, and culture—I might almost say to our habits—I allude especially to the styles which are Oriental in origin, and known as Indian, Persian, Chinese, and Japanese. Be it understood that I yield to no one in admiration of the truly artistic qualities of a high decorative kind almost invariably found in these productions, but I devoutly believe that blind admiration of them among ourselves is an error, and is calculated to produce results of an unsatisfactory and hybrid character. That in certain important qualities, such as flatness of effect, subtly involved intricacy of line, symmetrical disposition of mass, harmonious arrangements of colour, they are akin to the fine decorative art of all periods I thoroughly concede. And I also admit, unconditionally, that the art of these nations is in perfect accord with their theology, literature, tastes, and customs. But this is the very reason why it does not harmonise in all respects with ours. To us it is, and always must be, to a great extent exotic. Style in art depends in a measure upon race. The Chinese idea of beauty in form is not ours. We cannot take kindly to copper complexions, nor to narrow oblique eyes, nor to squat broad noses—all prejudice doubtless—but prejudice that fire will not burn out of us; we must die in it at the stake. So with their mythology. Who, save perhaps a privileged few, can attempt or profess to understand its meaning? No, depend upon it, art, to satisfy the "supreme Caucasian mind," must have as a basis Caucasian beliefs, or such ideas as have at some former period been Caucasian beliefs. True "the Heathen Chinee *is* peculiar," but "the Caucasian is" not yet "played out."

But, to return to the Greek vases, these examples of decoration, then, by the union of variety with repose, and the harmonious combination of line with mass, express in perfection simplicity allied with beauty; and where these qualities, together with distinctness, are desirable, they must always be regarded as models, invaluable for suggestiveness, if not desirable for literal imitation. The decoration on Greek painted vases of the earlier or archaic period differs from those of the best period in effect and merit rather than in principle, inasmuch as the figures are usually darker than the ground of the vase, and are varied by the introduction of dark red and of white, whilst the forms are comparatively quaint and angular. In the vases of the latest period, from B.C. 336 to B.C. 100, a few colours, such as white and red, are also introduced, whilst the outlines of the figures are often eminently flowing and graceful. Still, in these vases, ornament tends, occasionally, to over-elaboration, and somewhat interferes with the feeling of repose. All those flat decorative effects are peculiarly adapted for flat surfaces of wood, and in marquetry and inlaying they have been largely used.

To define the distinction between decorative and imitative art, it may be said that the former is art which is essentially subservient to architecture, but subservient not in the sense of tame insipidity but of sympathetic helpfulness. In all cases decoration should heighten the effect of structure, not apparently weaken or conceal it, should add to it variety, and consequently increase its beauty, but not attract attention to itself, to the detriment of more important or nobler qualities of strength, symmetry, or grandeur. For the office of decoration, at least in our day, is pre-eminently to amuse. The cultivated eye delights in a composed intricacy of line, in a symmetrical variety of figure, in a subtle balance of apparently conflicting forms. The artistically wrought principle of repetition is as pleasant to the sense of sight as that of recurring poetical rhythm is to the ear. In a word, a decorative design, if not possessing the power of a full orchestral harmony, should at least resemble a simple, delightful, and refreshing melody. Decorative art and imitative or pictorial art, then, have two distinct functions; that of the former is to heighten the effect of structural features, and should, therefore, be adapted to the locality to which it is applied; whilst that of the latter is to attract and concentrate the spectator's attention on itself, and to make him entirely oblivious of everything surrounding it. In decorative art, form, light and shade, and colour are used merely to make fanciful or symbolical ideas intelligible, amusing, or beautiful; in pictorial art they demand the utmost subtlety of execution that the hand of the artist can express.

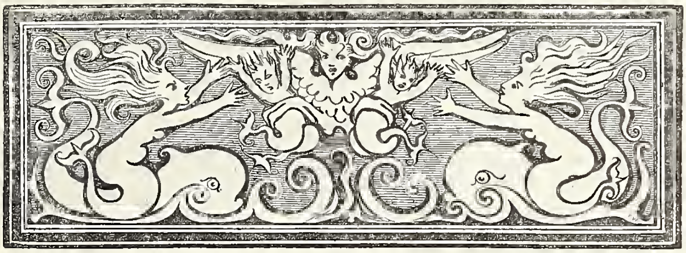
Nevertheless it is extremely difficult to construct a definition that will include all the aspects of which such a subject is susceptible. For instance, might

it not be asked—are not some pictures termed decorative pictures? and if so why are they decorative and not others? To this it may be answered that decoration is intrinsically an adjunct to architecture and structure. Decorative design may consist of mere outline, whether of pattern or figures, or of masses of light form relieved on dark, or *vice versa;* or it may consist of masses of harmoniously contrasted colours. Bearing this in mind, we must recollect also that pictures are not all equally imitative. Some express in perfection one quality, such as form; some another, such as light and shade; others again, are distinct from these, and illustrate colour. Now, let us consider what the qualities are which true ornamental art must possess. Accurately defined form is one; accurately defined masses of light and dark is another. Harmoniously contrasted masses of colour is a third. But delicate, or almost imperceptible gradations of light and shade which confuse form, and detract from the purity or richness of colour, are, in decorative art, fatal. Works, whether engravings or pictures, in which this quality is expressed, may be so far true to nature and exquisitely beautiful, but they are not decorative. Pictures, then, of a decorative kind are such as have figures strongly contrasting with the background, or in which the effect depends on broad, powerful masses of colour. For instance, pictures by Paul Veronese are certainly more decorative than those by Correggio. Compare the "Family of Darius," in the National Gallery, with the "Venus, Mercury, and Cupid," and the distinction will be at once apparent. So, again, Titian's "Bacchus and Ariadne," with its masses of powerful but harmonious orange, blue, green, purple, and white, is more decorative than Rembrandt's homely, but poetically conceived, "Adoration of the Shepherds," in which the colours are fused, as it were, into very low-toned light, and richest depths of "grateful gloom." The quality that is essentially non-decorative is imitative gradation of shade. All Oriental nations, supreme in certain phases of ornamental effect, without exception ignore it. And it is scarcely too much to say that, for a time at least, the introduction of this pictorial quality into decoration, confused form, vitiated colour, and did decorative art in Europe an injury from which it is only just beginning to recover. Again, in what category, it may be asked, should such a work as Michael Angelo's Sistine ceiling be placed? I reply, in a very small class—by itself. Its merit is so exceptional as to be far beyond classification, cavil, or criticism. We can but wonder and admire. But when we come to work of another kind, beautiful rather than sublime—Correggio's Cupola at Parma, we may feel justified in doubting whether a dome should be built in order that a painter, by a prodigious *tour de force,* should make it seem of no effect. There is this to be said, however, that Correggios are not so common as domes, and that even if one of the latter be architecturally spoiled by the transformation of it into the semblance of saints and angels, the world is decidedly a gainer thereby. To come nearer home, Sir James Thornhill's treatment of St. Paul's dome is not decorative, and unfortunately he was not by any means a Correggio.

Now in the Greek vases, as in all other true artistic work, we find that decoration is invariably governed by fitness. It meets with an essentially architectural treatment. It never disturbs or destroys the effect of constructive lines. It is always appropriate to the position it fills. Thus, on the body of the vase is depicted some incident of heroic times, or story of the gods, whilst the border is composed of fret or foliage, of design which modern artistic ingenuity has not been able to surpass. This decoration, be it observed, is always, in vases of the best period, perfectly flat. There is no attempt to deceive the eye by semblance of relief. The natural baked clay colour of the vase, a pale brown, stands for the figures, whilst distinctness is given them by means of a transparent black ground, on which they tell as masses of light. Upon the importance of this quality of distinctness in decoration, of which form is the characteristic, too much stress cannot possibly be laid; and some remarks by Mr. Ruskin on one of the mediæval uses of this quality are so pertinent, that perhaps you will bear with me if I quote his words concerning it:—"And this love of symmetry," he says, "was still further enhanced by the peculiar duties required of art at the time; for, in order to fit a flower or leaf for inlaying in armour, or showing clearly in glass, it was absolutely necessary to take away its complexity, and reduce it to the condition of a disciplined and orderly pattern; and this the more, because, for all military purposes, the device, whatever it was, had to be distinctly intelligible at extreme distance. That it should be a good imitation of nature when seen near was of no moment, but it was of the highest moment that when first the knight's banner flashed in the sun at the turn of the mountain road, or rose, torn and bloody, through the drift of the battle dust, it should still be discernible what the bearing was. * * * * Hence, to the one imperative end of intelligibility, every minor resemblance to nature was sacrificed, and, above all, the curved, which are chiefly the confusing, lines; so that the straight, elongated back, doubly elongated tail, projected and separate claws, and other rectilinear unnaturalnesses of form became the means whereby the leopard was, in midst of the mist and storm of battle, distinguished from the dog, or the lion from the wolf; the most admirable fierceness and vitality being, in spite of these necessary changes, obtained by the old designer."

The process for the mechanical production of designs on wood, for which I have obtained a patent, has not a pictorial, but a distinctly decorative intention. It is fitted to express on flat surfaces of wood either flat effects of light figures on a dark ground, or dark figures on a light ground, or figures light and dark in parts on a ground intermediate in shade; and these effects are produced on the wood by an adaptation of the processes of engraving and printing. Into the details of the various engraving processes for producing designs on paper, after the profound and exhaustive articles on these subjects, by a most competent authority, Mr. Davenport, the worthy Financial Officer of this Society, it is unnecessary for me to enter, especially as those who wish to study examples of all the stages and varieties of progress in this important branch of art may obtain access to one of the richest collections in the world—the print-room of the British Museum, now under

the able keepership of Mr. George W. Reid, F.S.A., whose courtesy on very many occasions I am happy to take this opportunity of acknowledging. I will confine myself therefore to the experiments which I have made for producing certain specimens which are here submitted to your judgment. These specimens are printed on wood, from engravings from my designs, executed on wood blocks by Mr. Edmund Evans, and Mr. Horace Harrall, and also from electrotypes from such wood blocks. The kinds of wood which are best adapted for receiving such impressions are those which are light in colour and soft in grain, such as pine, and lime trees, which I have here employed. The conditions under which the impressions are taken are precisely those essential to the production of prints on paper, namely, that the surfaces of the engraved block and of the substance taking the impression must be throughout in perfect contact. The specimens here shown were produced in an "Albion" hand printing press, with ordinary printer's ink, and were taken by Mr. Attfield, in the employ of Mr. Hooke, printer, Guildford. Such impressions, being polished or varnished, are necessarily as durable as the wood itself. As regards the colouring material for producing the impression, I may remark that the process is by no means limited to printers' ink. The object, then, of this process is to multiply designs of a decorative kind, at a cheap rate; and such designs may, I conceive,



be applied to all purposes and situations in which flat surfaces of wood are or may be used; and especially for friezes, dados, panels, and borders, either for walls, architectural adjuncts, or furniture. To show the application of this process to the decoration of furniture a cabinet has been designed by Mr. Cozens, and manufactured by Mr. F. Coote, of Tottenham-court-road, well known for the excellence and beauty of his deal suites. It is placed here for your inspection.

By some connoisseurs mechanical processes for multiplying copies of works of art have been gravely objected to. But I think it must be conceded that even mechanical processes are not without a certain utility. Making plaster casts is, for example, a mechanically reproductive process, and some years back the Arundel Society published exquisite reductions, likewise by a mechanical process, of those two famous statues which a clever American sculptor and writer now

proves, to his own satisfaction, in the current number of *Blackwood*, are not by Phidias—the Theseus and the Ilyssus. Would any lover of art object to possess these casts because they are the result of mechanical process? Again, we may not all be fortunate enough to possess a picture by Landseer, but there few, I fancy, who are unable to obtain, or object to possess, a mechanical reproduction, in light and shade, of the delineations of those animal instincts, passions, and emotions which he has so marvellously interpreted for us, and which may be said to have enlarged our sympathies with one class of created beings. The question really is not whether a process is mechanical, but whether the result is mechanical. Does the material or the method over-ride artistic qualities of imagination or execution? Do we get mere neatness in place of intelligent, if seemingly careless, finish? or, on the other hand, have we coarse or clumsy, in place of delicate and refined work? If the result be good, what matter though mechanism be employed; if bad, what advantage though it be shunned? Now engraving is a recognised mode of multiplying copies of works of design. Hitherto its function has been chiefly an imitative one. It has been used with this intention by great masters of thought, such as Albert Durer; or of outline and action, such as Mark Antonio; or of brilliant light and mysterious shade, as Rembrandt; but the use to which my adaptation purposes to put it is that of multipying for decorative purposes decorative ideas. The comparative cheapness of the process to some may be objectionable, but do we disapprove of those marvels of pictorial

journalism, the *Graphic* and the *Illustrated London News*, because they are cheap? Do we turn up our noses at *Punch* because his price is only threepence? Surely the love of decoration is a good thing. Would nature teem with decorative effects merely that we might shut our eyes to their influence? This Society was founded to encourage not only manufactures and commerce, but art. Its efforts, from its origin until now, have been persistently directed to sap the foundations of the false and absurd Puritanical theory that beauty is a snare in the path of the righteous, and decoration a device of the devil. That these wise efforts have been crowned with success is, fortunately, beyond a doubt. The establishment of schools of design in the manufacturing districts largely contributed to spread a taste for drawing among operatives; and now the Museum and Schools at South Kensington, for the prosperity of which the country is so largely indebted to Messrs. Henry Cole and Redgrave, has dealt, let us hope, a deathblow to insipid formality for evermore. This decorative experiment of mine, then, is not intended to compete with or expected to supersede the beautiful and delicate, but comparatively costly processes of hand-painting and inlaying, the skill displayed in which has made the cabinet work of our great firms renowned throughout Europe; but as printing on paper has brought imitative art within reach of even the poorest, so I conceive that printing on wood may eventually enable all who possess decorative taste to indulge it, and to adorn their houses with articles in which ornament will be a more important and at the same time common feature than it has hitherto been possible, for ordinary purposes, to employ.

DISCUSSION.

The **Chairman**, in inviting discussion, said the word "mechanical" must have a very wide meaning, and in one sense every form of art might be termed mechanical, inasmuch as it was the product of the human hand. The finest painting, even, was produced by the mechanical efforts of the artist; and even in those branches which seemed least connected with it, such as photography, it was found that the photographer might impart his own spirit and refinement of feeling to his work in the most wonderful manner.

Professor Gamgee asked for a little further information as to the process, especially with regard to the kind of blocks used.

Mr. Whitburn handed round the blocks used for producing the designs which were exhibited, saying they were the same as used in ordinary printing, and with common printer's ink.

Mr. Pitman thought, if the two surfaces were not exactly even, it would be impossible for very fine features in a design to be reproduced so exactly as when transferred to a yielding material, such as paper. The only speciality appeared to be printing on wood instead of paper, and it occurred to him that if printing ink were used with an unyielding surface, such as a piece of wood, it would either cause it to come up in lumps, which would have to be finished afterwards, or else it would squeeze out, and destroy all delicacy of outline.

Mr. Whitburn said he had not found these results.

The Chairman remarked that in the process of calico printing, with which in his younger days he was familiar, he cloth was stretched upon a yielding surface or blanket, and the block lifted the colour and impressed it readily upon the cloth so stretched out. Here there was a block printing upon a comparatively rigid surface, and care would have to be taken that in all cases the block should be so arranged that in giving it the necessary pressure, it should not be destroyed. He supposed there would be no difficulty in printing in several colours, as in block printing on calico.

Mr. Eldon asked if it had been attempted to apply the same process to curved surfaces, by transferring? It struck him that in this way a much wider application might be given to the method.

Mr. Whitburn said he had this under consideration, but had not yet tried the experiment.

Mr. Trollope thought it would be necessary, in order to ensure perfect printing, to make the two surfaces which had to come in contact so perfectly true, that it would be almost impossible to use it for ordinary purposes.

Mr. Whitburn said there was no difficulty in preparing the wood on which the impression was to be taken. It was only necessary to have it the same thickness all over.

The Secretary said he apprehended the material on which the printing took place was not to be regarded as a rigid surface, but was practically a soft, yielding material, at any rate as compared with the printing block process.

Mr. Whitburn said it might be considered as a combination of stamping and printing. The light parts came out slightly in relief, owing to the yielding of the wood. In answer to a further question, whether it was necessary to prepare the wood in any way to prevent the spreading of the ink, he said it might either receive a coating of size or be used in its ordinary state.

Mr. Trollope inquired what was the largest size that could be printed—could an ordinary door-panel be prepared in this way?

Mr. Whitburn said there was no difficulty at all. The printer who had produced the specimens on the table, said he could undertake to print from a block two feet with his ordinary press, and with a larger press a still larger slab could be produced.

Mr. Hay inquired the price at which ornamental blocks could be produced, say by square foot.

Mr. Whitburn replied that it would entirely depend on the demand and the number required of any given pattern. He had as yet made no calculation of that kind.

Dr. Dresser said he had been waiting for some time in the hope of seeing the specimens handed round, because up to that moment he had not had an opportunity of inspecting the results of the process which had been described, and of which he had expected to have heard considerably more. They had heard a dissertation about art, and many interesting remarks had been made; but he had come prepared rather to consider a new mode of decorating wood, or of applying decoration to wooden surfaces, and could have wished that the lecturer had given more information respecting the process. It struck him there was a great fear, when a mechanical process so simple as the present was introduced, of attempting to do too much in decorating wooden structures. A fault which he constantly found when an attempt was made to decorate furniture was that too great elaboration was given to it, and the general effect suffered. Those who had visited the late Exhibition at Vienna could not fail to have noticed that some of the most costly pieces of furniture, upon which labour must have been lavishly bestowed, and which manifested a great amount of art workmanship, were altogether ineffective; and were they placed in a room, he did not hesitate to say that one hundred people might enter the

room and yet not be struck with the beauty of the furniture. If furniture were decorated, it behoved them to have a true, just, and legitimate structure. He liked to see a perfect revelation of truth in all things. After having chosen a fit structure, it was necessary to determine on a just mode of working the material, and to choose such decoration as was necessary; but although an ornamentist himself, he was strongly opposed to too much ornamentation of furniture. It must be borne in mind that the general effect of a room had to be considered, and that they should have subjects that they could understand. When a man went anywhere to dine, it was not to be supposed that he would get up and minutely examine the chairs and every other piece of furniture in the room; and the same thing would apply to a drawing-room—the furniture must be useful. Any mechanical process which would enable them to beautify cheap furniture at a low cost was a thing to be desired, but they must not do too much in that way, and should be very careful in the application of ornament. He would not go into a discussion of the art part of the paper, that being really foreign to the subject; but none of the styles mentioned were altogether without merit. At the present time their houses were for the most part built as much in one style as another. Many houses were called Gothic with scarcely a Gothic feature in them, and the same might be said of the other styles. If the room was only a square box with a few holes, it was just as legitimate to decorate it in one style as another. If they considered what was wanted when producing any article, and tried to use the material of which it was going to be formed in the most fitting manner, and then sought to add to it such forms as would give beauty, not altogether considering that they were pure renaissance, or Greek, or Gothic, it would be better if they were beautiful, better if they were original and vigorous expressions of that which was new and peculiarly adapted to their present wants. He hoped the lecturer would keep to the utmost simplicity, so that the art of the country might be benefited and not injured by his invention.

The **Chairman**, in proposing a vote of thanks to Mr. Whitburn, said he had been especially pleased with the remarks of Dr. Dresser, and agreed with what he had said. He thought art should decorate and not smother the object, and he also thought that a considerable amount of decoration was practised now, of which he would say, as Dr. Johnson said of a piece of music, which he was told was very difficult. "Difficult! I wish to God it was impossible." With regard to Greek art, he thought in trying to imitate this an enormous amount of injury had been done. Architects had attempted, in this country, to reproduce that which was done in Greece, with the materials they had in hand; had tried to copy their forms and mouldings, and to reproduce them in coarse sandstone, and the result had been utter failure. He had been told by a German professor that the Greeks used marble solely or principally because it was good to paint upon; but there were others who denied that entirely, and who maintained that the Greeks never painted the lovely temples the remains of which could now be seen. He thought the time was gone by when they would do much in attempting to copy the temples of Greece. The Gothic style, he thought, was exceedingly beautiful when kept to its own purpose, but its time had gone by. The Houses of Parliament were built in a style which would not last, the stone being undercut in all directions, for this exposed the surface so that the weather got at it, and in a few years it would go to destruction. The Houses of Parliament before they were completed began to crumble; and canopies and pinnacles were falling down now by the cwt., nor could any of the processes which had been employed to stop the decay be considered as successful. In modern art, if they had decoration, they certainly wished to have comfort, and if the architect failed in giving comfort and the means of health, he failed in his building. With regard to the special art they were then considering, a means of decorating wood by block painting, it appeared that the wood must be carefully prepared, and the design such that the block should not be fractured by the pressure put upon it to give the impression on the wood to which it was to impart its pattern. In calico printing that was not necessary, the lines being of the most delicate character. In printing our pottery, the pattern was put on to a piece of fine paper, thinner than bank-note paper, of a very strong kind, and it was simply laid on the article to be printed, the colour being left on the article, and the paper removed by moisture. This art, no doubt, might be employed for cheap forms of decoration, and might supersede in some degree the old style of graining and varnishing, but he could not see any evidence in the patterns exhibited of the same durability as wood, because he thought the ornamentation would rub off.

Mr. Whitburn, in acknowledging the vote, said he desired to thank those gentlemen who had taken part in the discussion, and especially Dr. Dresser, who would find, on reading the paper, that he had laid especial stress on structure, to which he considered ornament entirely subordinate. This process was one of extraordinary simplicity, and professed merely to be an adaptation of printing to wood surfaces. The process itself might be considered with that of printing on paper, except that a piece of wood of equal thickness throughout was used to receive the impression. The block was placed in an ordinary printing press, covered with printers' ink, or any other which it might be desired to use, the piece of wood was laid upon it, and then the press brought down upon it. If the two surfaces were in perfect contact, the impression would be perfect in all its details. The durability, he thought, might be considered beyond all doubt, because the ink sank into the wood to a certain extent, and when protected by varnish might be considered imperishable. No doubt it could be extended to all wood surfaces, though his experiments had as yet only dealt with flat ones, and it was the cheapest mode of decoration possible, because any number of impressions might be taken from one block or series of electrotypes for a block; and it was necessarily more rapid than any other kind of decoration.

The specimens exhibited by Mr. Whitburn will remain on view, in the Society's Room, till the end of the month.

Some specimens of two new processes for ornamenting metal articles, such as goblets, tea-services, trays, &c., were exhibited during the evening, by Mr. J. A. Rhodes, of Sheffield. The first process was a method by which a similar effect to parcel gilding is obtained by saw-piercing the form desired in a different sort of metal, and then attaching the saw-pierced form to the surface by soldering. The other process was a method by which raised or embossed surfaces can be produced by hand, leaving the inside smooth, for drinking vessels, &c. &c. It is carried out by first saw-piercing the form of decoration in plates of outline, then raising up the parts wanted in relief, then melting solder into the embossed parts, to make the parts solid for chasing, and soldering the formed and embossed part upon the article, to be afterwards chased up in the usual way.

The average number of lives lost at sea on and near our coasts is 791 per annum, taking an average of five years, whilst the number of persons killed by railway accidents for the year 1872 is no less than 1,145, besides injury to 3,038 more; 632 of the lives lost were those of railway servants, and of the same class 1,385 suffered injuries.

In 1870 there was realised 1,400 cwt. of amber, to the value of £60,000, from dredging upon the shores of the Baltic. It is also found in a blueish clay, bed in Eastern Prussia and elsewhere, in limited quantities.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

The second meeting of the Committee for Architecture, Building Contrivances and Materials was held at Gore-lodge, on the 10th December, Colonel Gallwey, R.E., in the chair. There were also present Major Du Cane. C.B., R.E., Messrs. G. Dines, G. Godwin, J. Grant, H. Grissell, D. Kirkaldy, and T. Roger Smith, and Colonel Wray, R.E.

The following sketch of next year's Exhibition is taken from the *Engineer* of last week:—

Among the elegancies of manufacture in the Exhibition of 1874 will be lace, both hand and machine made. The class next to this on the list embraces civil engineering, architectural and building contrivances, sanitary apparatus and constructions, and cement and plaster work. Next we come to all devices for heating purposes, with any and every kind of fuel. Leather also comes this year, including saddlery and harness. Bookbinding is a kindred matter; and lastly in this division we have foreign wines, of which a great feature is to be made, the vaults of the Albert Hall being appropriated as cellars, with tasting counters close at hand. Freed from the trammels of the refreshment purveyors, the Commissioners will be able to grant the exhibitors the privilege of selling or giving away wines to those parties who wish to ascertain the quality of the vintage. Of course, proper regulations will have to be devised to prevent any abuse of the privilege. The permission is simply that the public shall be enabled to taste and carry away samples. It will be observed that this part of the Exhibition consists of "foreign" wines, though not to the exclusion of colonial. It is intended to group the specimens from abroad in geographical order. British firms will only appear as importers. Exhibitors of Australian wines are encouraged to come forward by the argument that the arrangements for 1874 afford a better opportunity of bringing their wines before the English and continental buyers than has ever yet been available. With regard to the character of the Australian wines, as reported upon by Dr. Thudichum this year, it is right to say that the test was scarcely fair, the wines having evidently suffered by standing cork upwards and dry in the Exhibition for some time before being examined. Dr. Thudichum speaks hopefully of the Australian wines—an industry quite in its infancy.

The devices for heating may be expected to form an interesting section. Manchester will have an exhibition of this kind in January and February. The Society of Arts has set on foot a competitive display of heating apparatus at South Kensington, on the premises of the Exhibition, which may be expected in some degree to prepare the way for what is to be seen next year. But the scheme thus arranged by the Society of Arts is limited to one kind of fuel—namely, coal—and relates solely to domestic appliances. It is a prize competition, but it may be expected that many of the objects will be shown in the ensuing Exhibition. We have already mentioned that civil engineering, together with architectural and building contrivances, enters into the programme of 1874. Diagrams of ancient and modern buildings of all kinds are invited, such diagrams to be of a bold scenic character, and executed on canvas. Proprietors of paintings or drawings represснting ancient or modern buildings of interest are invited to lend them for the occasion. The aid of photography is also to be invoked. Sanitary apparatus and constructions introduce us to a very wide field; but we do not suppose the Commissioners intend to have an exhibition of disinfecting processes, carried on, for instance, in the gardens of the Royal Horticultural Society, the ornamental waters being changed for the nonce into real sewage. We might also have irrigation carried out upon the turf beds and the gay parterres of flowers. Mr. William Hope, Mr. Bailey Denton, Mr. Rawlinson, the Native Guano Company, the Phosphate Sewage Company, and a host of others, might here fight their battles in the presence of spectators, who could view the scene in safety from the terraces over the arcades. Under the head of leather we may expect a good deal that will be interesting, and in the department of bookbinding we may look for elegance as well as utility.

The fine arts division is certain not to be neglected. On this we need not dwell. The annexes—Indian, colonial, and foreign may be expected to do their duty. France will be forthcoming, and cannot fail to attract, though in 1872 she was rather retrogressive as compared with 1871. Her best help is needed for the ensuing season. The present has been a dull year for the South Kensington Exhibition, and unless 1874 makes amends, the public will look coldly on the affair. But the prospect is hopeful. The Indian court is reckoned upon as likely to be far superior to what was seen of it this year. Russia will also do better. Austria will be able to come. Belgium is not likely to be absent, and is capable of great things. Japan—clever while odd—may be looked for again, though a little fickle perhaps in her purpose. The Australian colonies would do better if they would pull together a little more, and combine their forces for the purposes of the Exhibition. But they have made a grand show already, and will probably advance. Next to the French annexe, we suppose the ladies will find pleasure in the lace department. The machinery connected with lace-making will be a pretty illustration of mechanical skill, serving to attract both sexes. Lastly, we may advert to the division devoted to "scientific inventions and new discoveries." Here we may look for all sorts of things, and may expect to find some objects of special merit.

EXHIBITIONS.

Vienna Exhibition.—The artisans' reports upon the Vienna Exhibition have now been published by the Society for the Promotion of Scientific Industry, Manchester.

Agricultural Implement Exhibition.—The Agricultural Society of Brabant (Belgium) intends, under Government patronage, to open in June, 1874, a "Concours National d'Animaux Reproducteurs" and an "Exposition Universelle d'Instruments d'Agriculture." Agricultural machines and implements will be admitted to the Exhibition from all countries, and numerous and valuable premiums will be awarded exhibitors for their efforts in behalf of agriculture. The society will defray the cost of transporting the implements by the State railways and by those enjoying State grants in Belgium, and will endeavour to obtain a considerable reduction of the charges on foreign lines. Implements of foreign origin and re-exported will be free from duty. In addition to the premium proposed in the programme, a prize of honour, consisting of a gold medal, will be awarded to the exhibitor whose contribution of agricultural implements shall be considered most deserving of notice. On the other hand, it is contemplated in the regulations to organise a grand lottery, the entire proceeds of which will be devoted to the purchase of implements to be selected from those on view at the Exhibition.

The Royal Society for the Prevention of Cruelty to Animals offer premiums amounting to £400 for improved cattle trucks.

SIDA RETUSA.

The following copy of a letter from the Government analytical chemist at Brisbane, on the subject of the growth and preparation of *Sida retusa*, has been transmitted, by the Agent-General for Queensland, to the Secretary of the Society:—

[Copy.]

Old Post-office,
Brisbane, 5th August, 1873.

Sir,—I had the honour to receive from the office of the Honourable the Colonial Secretary, included documents, in which I am requested to answer certain questions of Mr. Daintree, as regards the plant *Sida retusa*.

I take the liberty to make the following suggestions.

The principal aim in making fibre would be to aim at the production of a branchless, or nearly branchless, plant; this would facilitate the operation, and allow the introduction of machinery.

Therefore a bed (say 100 × 100 feet) of best soil should be well prepared, and the *Sida retusa* sown thereon as thickly as possible. This would, to a great deal, hinder the plant from shooting out branches, and so make it most adapted for fibre making. The plants when ripe should be cut, the stumps let grow again, so that the actual yield of a good tilled acre of land per year, and not of one cutting alone, could be ascertained. One part of it should be made into fibre alone, and another part into half-stuff.

Various experiments should be tried in the preparation of the fibre, such as water, hot water, steam rotting, action of high pressure with different chemicals, &c.

For the successful preparation of the half-stuff, into whose composition the wood of the *Sida retusa* might enter to a more or less degree, a small moving power, either hand or steam, is wanted, for driving a machine, called on the Tecknic "the Devil."

Only by such searching experiments satisfactory results can be obtained, and the questions of Mr. Daintree exhaustively answered.

Such reliable information and data for commercial calculation would either at once create native industry, or would settle the matter altogether.

The apparatus and machinery would also be available for the trial of other indigenous plants.

The experiments should be carried out in a properly situated and built place.

The cost of labour, machinery, would not exceed £150, except a proper steam boiler and engine is bought.—I have, &c., (Signed)

Karl Theodore Staiger.
Government Analytical Chemist.

The Honourable the Minister for Public Works.

The international bridge across the Niagara, near Buffalo, which is to be used by several roads, among them the Canada Southern and the Great Western of Canada, is finished. It has nine spans, is 1,968 feet long, and cost over a million dols.

All the manufactures of Cincinnati have increased during the past year, the heaviest increase being in iron manufactures, which is eight-and-a-half million dollars.

The export of nitrate of soda from Chili has risen from 18,706 cwt. in 1830 to 3,605,966 cwt. in 1871. 6,500,000 pounds of borate of lime are exported annually for the manufacture of borax.

The discovery is reported of an immense copper ledge in the southern part of Utah Territory. It is said to crop out 3,000 feet in length.

Professor Ansted gives the following as the coal supply of the world:—British Islands, 12,800 square miles; France, 2,000 square miles; Belgium, 520 square miles; Spain, 4,000 square miles; Prussia, 12,000 square miles; Bohemia, 1,000 square miles; United States, 113,000 square miles; British North America, 18,000 square miles; total, 152,520 square miles.

CORRESPONDENCE.

IRRIGATION WITH STREET SEWAGE.

Sir,—I beg to submit an account of some important results obtained from one description of town sewage at Paris.

At the time of the first International Exhibition at Paris, I brought the question of the utilisation of town manures for agricultural production under the consideration of the Emperor, and, at my instance, he directed that some trials should be made systematically. These were made by M. Mille, the chief engineer of Paris, and by Professor Moll, an eminent professor of practical agriculture at the Ecole des Arts-et-Metiers. Paris was then, and is yet, without self-cleansing house-drains, and is a city of cesspools, all the human excreta (about three-quarters of a million of cubic metres) being retained beneath the habitations, mostly in fixed fosses, until they are emptied by a joint-stock company, usually about once a year. The trials were made with this manure, which is kept in a state of putridity, wasting by decomposition, and giving off noxious emanations into the houses. By this process the productive power of the manure is reduced, usually by about one-third, and its quality is deteriorated as compared with fresh manure. The trials were very ably conducted, and the results obtained were of much interest and general importance; but, I regret to say, they did not excite appropriate municipal action.

But the more recent and extensive trial works, made by M. Durand-Claye, of which I am enabled now to present an account, have been made chiefly with the surface-washing of the streets, with the addition of the waste water of kitchen sinks, which is allowed to run into the gutters from some of the houses—a species of town manure of the separate productive power of which, so far as I am informed, no distinct observation of any considerable extent has hitherto been made. In streets of considerable traffic, in Paris probably as in London, the manurial deposit is greater than that derivable from within the houses. It is stated that in the City of London proper about one hundred loads of mud are carted daily from the roadways before 17,000 houses. This mud, according to the analysis of Dr. Letheby, consists of about 57 per cent. of horse-dung, 17 per cent. of abraded iron, and the rest of abraded granite—a mixture which, when dispersed in dust and inhaled, might be presented as a local cause of diseases of the respiratory organs, of which 20,000 persons die annually in the metropolis.

In Paris this evil of street dirt and dust is reduced in the thoroughfares of the greatest traffic by the extensive use of impermeable asphalte pavement, which is the least adhesive to dung, and by the cleansing of the street by the jet, which sends the manurial matter into the sewers in a better condition, fresher and less decomposed, and consequently more nearly approaching in quality for agricultural use the manure from the horses. We have had distinct evidence as respects stable manure that, when applied fresh in the liquid form, it has more than double the productive power than when applied as top dressing in the solid form.

One objection made to the washing of the street surfaces by the jet is that the detritus swept into the sewers would tend to choke them up. The answer to this objection is, that the sewers are badly constructed when this is the case, and that it will pay to reconstruct them properly for the purpose. Where the sand and granite detritus is considerable, it will be a cheaper and more convenient arrangement to make a catchpit for it at the outfall, and remove it from thence, than to gather it up along the street surfaces, or from the river bottom. There is, however, extraordinarily little detritus from

hard asphalte surfaces, and the complete removal of the manure by the jet is far cheaper and more productive than the cleansing of the surfaces by the broom.—I am, &c.,

Edwin Chadwick.

Sewage and its Utilisation for Agricultural Purposes in France and Abroad, by M. A. Durand-Claye, Engineer of the Department of Ponts-et-Chaussées.

The "Annales des Ponts-et-Chaussées" have already directed attention to the question of the chemical treatment of sewage and its application to agricultural purposes. The object of this paper is to depict the present state of this important question of public health.

Readers will, no doubt, be acquainted with the principal features of the subject. In order to improve the internal sanitary condition of the towns, the public thoroughfares have all been drained, the result of which is a perfect network of subterranean passages, extending its ramifications under most of the streets and the adjoining houses. In this manner, the household and rain-water, the excreta of men, animals, the dust, mud, and refuse of all sorts are carried away by the stream of water supplied to the town. To quote the simile of M. Dumas, the network of sewers may be said to act as the venous system, and to carry away, when polluted, the water which has been introduced into the town in a state of purity by the arterial system of the water supply. Thus, the internal sanitary condition of the city is improved. But what becomes of all this waste water, laden with impurity? It is generally carried away by the sewers to some distance from the city, and discharged into the nearest river or water-course, there to become the source of unhealthiness and pestilence to the whole neighbourhood. Moreover, the solid matter which it carries with it gradually fills up the bed of the river, and necessitates continual dredging at a great expense (£4,400 in 1872 for Paris alone); and the organic matter held in solution produces a sort of fermentation, rendering the water of the river, which is public property, and to which as such, all have an equal right, unfit for domestic or even industrial purposes. Its very appearance is disgusting, and the suburban residents find their interests and rights considerably affected by the consequences of the sanitary improvements carried on in the heart of the town. Happily, the remedy exists side by side with the evil. The sewage which is so dangerous and pestilential when thoughtlessly discharged just outside the town, carries with it the elements of fertility and agricultural productiveness. When the putrefaction takes place on the soil, and the products of decomposition are absorbed by the surrounding vegetation, then the dungheaps and accumulation of organic and mineral matter which exercise so pernicious an influence on the atmosphere of a large town, are converted into a useful manure. In those cases where it is impossible, all at once, to revolutionise the method of cultivating the soil in the suburbs, and to compel the inhabitants to introduce the system of irrigation by liquid manure, the sewage water may be purified in a limited space and in municipal establishments, through a simple chemical process, by which a gelatinous precipitate is produced which sinks to the bottom, carrying with it nearly all the foreign particles held in solution by the water. This substance is akin to street mud, and when removed leaves the water clear, though perhaps still containing some extraneous matter, yet quite sufficiently pure to be discharged without danger into the rivers, or to be used if necessary for agricultural purposes.

Such are, briefly, the main features of the sewage question, the solution of which concerns not only public health, but the agricultural interest; the utilisation of the refuse matter being the only remedy for the evils arising from the compulsory crowding together of great masses of human beings. We will now see what development this question has received in France and abroad.

1. In France.

The notice inserted in the "Annales des Ponts-et-Chaussées," of 1869, of the experiments in purifying the sewage and applying it to agricultural purposes, shows how the city of Paris undertook in 1867 the trial works at Clichy.

Whilst a regular service was being organised for this purpose, and all the necessary preliminary facts ascertained, such as the daily supply (260,000 cubic yards per diem), the chemical ingredients, the temperature, &c., a trial was made in 1867 and 1868, of applying about 200,000 cubic yards of sewage to a small field about two or three acres in extent. Part of this quantity was applied direct to the soil, under the direction of the engineer, M. Mille, and about 100,000 cubic yards were received in tanks and purified by sulphate of aluminium, a reagent strongly recommended by M. le Châtelier and M. Leon Durand-Claye.

The results of both experiments were quite satisfactory. The various plants, especially the market garden produce, flourished admirably, and specimens were sent to the Exhibition of 1867.

The water in the tanks, when purified, at a cost for the reagent of 0·1d. per cubic metre, was quite clear, and the deposit could be used as soil for the gardens or other purposes.

The minute observations made during these first experiments, published in an official report, and verified by various scientific and agricultural societies, constitute the basis of all future operations.

At Clichy a bend of the Seine forms the peninsula of Gennevilliers, an extensive plain of sandy alluvial land, comprising more than 5,000 acres of almost perfectly level ground. The cultivation is in a very backward state, though the distance from the fortifications is only $2\frac{1}{2}$ miles, and from the market-place of the town about 4 miles—a fact which may be explained by the imperfect means of communication and the proverbial poverty of the soil. All these conditions are, however, extremely favourable to the experiment of applying the sewage.

As the mean level of the plain is not more than 6 or 7 yards higher than the spot where the sewers empty themselves into the Seine, from 200,000 to 300,000 cubic yards of sewage could be raised per diem. The ground is also so flat that there are no accidental obstacles to the distribution of the sewage over the surface of the peninsula, and consequently no expensive preliminary works are required. The soil, as well as the subsoil, is gravelly, and is capable of absorbing and filtering an immense quantity of water. The primitive vegetation is naturally scanty, but the poverty of the land serves to bring out more clearly the results of irrigation; and the vicinity to the town secures a market for the vegetables, which it is always the interest of the suburban farmer to grow, provided land, manure, and water are ready to his hand.

In order to profit by all these natural advantages, the system of utilising the sewage was to be inaugurated on the plain of Gennevilliers. Though it was ascertained that there was land in the direction of Houilles, Sartrouville, Herblay, and even as far as Pierrelaye, which might ultimately be brought under the system, yet it was thought advisable to draw all possible advantage from the adjacent ground before attacking more distant land, which it would require a greater outlay to reach.

In 1868 a project for commencing the experimental farming in the plain of Gennevilliers was laid before the municipal authorities. At this time the plan had met with great opposition in all these regions, and the city of Paris was placed in a singular position; for whilst petitions against the pollution of the water poured in from the dwellers on the banks of the Seine, whilst the municipal councils of Asnieres, Clichy, Saint Ouen, Argenteuil—the council of the district of St. Denis, the general council of Seine-et-Oise—all united to deprecate the discharge of the sewers into the rivers—the com-

munes of those localities in which the utilisation and purification of the sewage could best be carried out, all protested against the proposed enterprise. However, the Prefect of the Seine and the municipal council perceived that these objections could only be met with facts, and accordingly, on the 10th July, 1868, the first experiments were decided upon. We have not space to give here all the details which will be found in the official report published in 1870 by the municipality. We will only attempt to give a slight sketch of this undertaking.

The preliminary works were commenced at the end of 1868, and completed on the 1st May, 1869. From that time between 5,000 and 6,000 cubic yards of the sewage has been raised daily by engines of forty horse-power and centrifugal pumps, and of this volume of water (which is considerable, corresponding as it does to a population of 50,000 to 60,000 souls) two-thirds were received into tanks for purification, and the remaining third was applied to a piece of land about twelve or fifteen acres in extent, which had been purchased by the municipality, and divided amongst some thirty or forty persons who had so far overcome their prejudices as to undertake the cultivation of the soil with sewage water, and who brought their practical knowledge to the assistance of the engineers.

At the end of several months the results of this experiment upon a naturally poor soil were such as to induce the neighbouring farmers to ask to be included in the benefits derived from the sewage, so that at the end of 1869 the tanks for purification were quite superfluous, the whole volume of sewage raised daily being applied to 75 or 100 acres of land, chiefly owned by small farmers.

Such was the state of affairs at the commencement of the year 1870, and the experience of the first six months of that year confirmed all the facts collected since the beginning of 1869. The farmers soon learnt to prefer the direct application of the sewage to the land to the more expensive purifying process. Owing to the extreme permeability of the soil, 20,000 cubic yards of sewage could be annually absorbed per acre, and they obtained crops of 70,000 lbs. of cabbages, 60,000 lbs. of carrots, 150,000 lbs. of turnips; and in the case of the more elaborate mode of culture carried on by the market gardeners on the municipal land, the returns amounted to between £120 to £160 per acre.* All land suitable for the irrigation rose in value. No evil effects on the health of the inhabitants could be detected, and a village sprang up round the confines of the municipal property. A Parisian perfumer established his manufactory on the outskirts of the irrigated land, and obtained, either directly or through the neighbouring farmers, a supply of the sewage water for his gardens of aromatic herbs, more especially of peppermint.†

The opposition which these proceedings had excited died away gradually, and it became possible to think of making further extensions now that the foundations of the system had been laid, and a practical basis established as applicable to the plains. It has been proved that this arid and desolate peninsula could be transformed into productive land, and the holders of land and their tenants had demonstrated this fact on their 75 or 100 acres even more effectually than the municipality of Paris could have dared to hope. Plans having been made of a more advantageous system of sewers, it was proposed to extend that system which had proved so successful, when applied to 15 acres of land which had been abandoned for generations on account of its hopeless unproductiveness, to the whole plain, the area of which exactly tallied with the volume of sewage which the experience of the past year had shown to be neceesary, and which was procurable. 20,000 cubic yards, multiplied by 5,000, gives 100 million of cubic yards per annum, which was about the volume conveyed by the sewers in the course of twelve months. A more comprehensive plan of operations was accordingly drawn up. The municipality of Paris could not now draw back, for the central administration had stepped in to inquire what were its intentions with regard to the pollution of the Seine by the sewers. When this communication was received at the Prefecture, the new project had just been completed, and on the 21st July, 1870, it was submitted to, and approved by the General Council of Ponts-et-Chaussées, and on the 30th July received the ministerial sanction. According to this scheme, the water of the two main drains meeting in the great sewer along the right bank of the Seine was to be raised to a height of 10 yards by steam-engines of 1,200 horse-power, at a large establishment erected at Clichy. It was then to be carried across the Seine in a special aqueduct, to traverse the peninsula in a covered passage, and to be distributed to the land along the line of route, any surplus being received into tanks for purification at Argenteuil. The expense was estimated at about £400,000.

Such was the state of affairs when the fatal war of 1870 broke out, and the environs of Paris became the scene of horrors which need not be described here. Sufficient be it to say that amidst the universal destruction Clichy and Gennevilliers were not spared. Whilst the engineers and their assistants were enlisted for the defence of Paris, the irrigated land was deserted and laid waste, the buildings were used for military purposes, and the bridge and aqueduct at Clichy destroyed.

The utilisation of the sewage was not, however, entirely neglected even during the siege. Two societies—that of agriculture and another—which had always taken great interest in the question, courageously resumed their sittings, and endeavoured to take steps to secure the reorganisation of the system in time of peace. As great difficulties were foreseen in the sowing and bedding out of plants in the spring, the sewage deposits were utilised in a novel and interesting manner. More than 150 hotbeds were erected, and filled with the solid residuum of the purified sewage instead of earth, and in this manner great numbers of plants were reared, which enabled the market gardeners to resume work again immediately in the land formerly irrigated and in some of the neighbouring communes.

As soon as the armistice was signed, the engineers tried to re-establish the works, but no sooner had they taken possession of their offices and establishments than the civil war broke out, and for more than two months the country round Asnières and Clichy was the scene of bloodshed and confusion. It may be imagined in what a condition the engineers found these localities when they re-visited them in June. The plain of Gennevilliers was desolate, neglected, and overgrown with weeds. Their first care was to repair, as best they could, the damage which had been done, to restore the buildings and offices, and prepare to bring the land again into cultivation. The irrigation could not possibly recommence for several months, as the aqueduct at Clichy was destroyed. The municipal land was immediately put in order by the former cultivators. The deposits remaining in the tanks of purification were collected to the last handful, and used as manure. An engine of four horse-power pumped water from a cistern into the furrows of the 12 or 15 acres first brought into order. The crops, though not as large as in former times, were yet sufficiently satisfactory to keep on foot this stronghold of

* "As a proof of the results of the irrigation, we may state that in a field which had been in part irrigated, we brought from the irrigated portion two white beetroots, which together weighed 32½ lbs; whilst two of the largest roots in the part which had not been irrigated only weighed 9 lbs. In the case of the red beetroot the difference was still more remarkable. In the irrigated part, two roots weighed together 43 lbs., and in the part which had not had the beenfit of the sewage two roots only weighed 10 lbs."—Page 14 "Utilisation des eaux d'egout de la Ville de Paris, 3me Rapport."

† "In this piece of ground we see in part very fine mint growing, and in another part very inferior plants; the former the sewage has been applied abundantly, to the latter in very small quantities."—Page 10 "Utilisation des eaux d'egout de la Ville de Paris, 3me Rapport."—[The finest mignonette in Covent Garden Market has long been grown from sewage irrigated soil.—E.C.]

the new system. The other farmers of the plain, finding themselves deprived of the benefits of irrigation, applied for the solid sewage deposits, but in vain—the tanks and cisterns were all empty. Thereupon, the engineers conceived the idea of extending an operation carried on hitherto on a small scale. A regular service of dredgers was constantly employed, as has already been mentioned, in keeping the Seine clear of the deposits from the various sewers. The dredgings contained a large proportion of organic matter, and, in fact, very closely resembled the substance obtained from purifying the sewage with sulphate of aluminium. It was arranged that the dredgings should be deposited near the municipal land, and placed at the disposal of the cultivators, instead of the sewage manure. During the last few months of 1871, 3,525 cubic yards were used to manure about 200 acres of land. The farmers soon learned the necessary proportions of this manure which were considered as equivalent to the sewage, and it was applied in quantities of about 15 to 19 cubic yards per acre. Meantime, the engineers were preparing to resume the irrigation works. In order to secure a good flow and prevent stoppages, the furrows in the ground were lined with tiles, instead of being simply traced in the earth as formerly. At the same time plans were made to extend the system, which was placed under the superintendence of a special department in the new municipal constitution of Paris, under the direction of M. Belgrand. The project made in 1870, and sanctioned by the government, was reconsidered in detail. The disasters of the war had simplified matters in an unexpected manner. When the bridges of Clichy and St. Ouen came to be rebuilt, it was found that a passage for the sewage could be effected across the Seine, so as to obviate the expense of building a special aqueduct. The departmental sewage, or that of St. Denis, could be carried along the bridge of St. Ouen, and brought to the entrance of La Chapelle by its own weight, without the aid of engines. Various improvements might also, it was found, be introduced into the method of distribution. The working of the system being simplified, the expense was consequently reduced, and was estimated at £200,000. It was important first to carry out those works which would enable the municipality to extend their operations in proportion to their resources, on the one hand, and, on the other, to execute those which would hasten the cultivation of the plain. Designs were accordingly made for connections with the various sewers, for the conduits along the bridges, and the various pumping establishments, and for a centrifugal pumping engine of 150 horse-power. These works once executed, nothing was wanting for the thorough purification of the Seine but to finish the pumping establishment at Clichy by the addition of five or six similar engines, and to extend the works of distribution in the plain, for which purpose £40,000 was immediately voted by the Municipal Council.

At the present time (January, 1873), these works are almost completed. A sewer, about four miles in length, has been brought from the entrance of La Chapelle to the plain of Gennevilliers, crossing the Seine in an iron pipe. All the sewage from Charonne, Belleville, La Chapelle, Montmartre—a total volume of about 30,000 to 40,000 cubic yards—is brought down on to the land by its own weight alone.

The expense is estimated at about £16,000. At Clichy a large pipe of brickwork, 2 yards 4 inches in diameter, connects the great sewer with the pumping establishment which occupies the field on which the first experiment was tried. These works, as we have already said, are calculated for an engine of 150 horse-power, which can raise a volume of 100 gallons per second, or 44,000 cubic yards per diem.

Along the bridge of Clichy the sewage is carried in an iron pipe, 1 yard 4 inches in diameter, and for the rest of the way in the old pipes of about 2 feet. The old pumping apparatus is used occasionally to supplement the new machinery.

The cost of all the works recently carried out at Clichy is estimated at about £24,000.

Thus, the flood of filth which pollutes the Seine will shortly be diminished by 80,000 cubic yards daily, or about one-third of the total volume of sewage, which will, it is hoped, eventually be applied to the improvement of the soil. It will be seen that in no other country has this system been tried on so large a scale.

We must now return to the history of the operations at Gennevilliers, which were left for a moment to consider the technical details. The year 1871 came to an end without the possibility of resuming the application of the sewage to the land, consequently the municipal land had to be irrigated with pure water, and the soil manured with the dredgings from the river. It was not until the 1st May, 1872, that, thanks to the establishment of a provisional pipe along the bridge of Clichy, the pumping engines could be set in motion. The works had thus been unavoidably stopped from the 1st of September, 1870, to the 1st of May, 1872, a period of twenty months, and now the question arose, whether the proprietors and cultivators of the plain would be found in the same frame of mind as formerly. Would it be necessary to open again the tanks for purification, or would they be willing to return to the former system of irrigation? Of the 75 or 100 acres of irrigated land would any be now found ready?

The question was soon answered. After several days of regular work, in spite of the wetness of the season, twenty-five farmers had offered 112 acres of land for irrigation, exclusive of the fourteen acres of municipal property. They vied with one another for the water, and, to satisfy all demands, it was necessary to work the engines day and night to raise about 12,000 cubic yards per diem, whereas formerly only about 5,000 to 6,000 cubic yards had been required. Between the months of May and November, at which time the engines were temporarily stopped, owing to the rise in the Seine, only a very small quantity was received into the tanks to undergo the purifying process, and that was only done in order that some experiments might be made by various English companies (see "Systèmes du Native Guano et du Phosphate d'Alumine"). Besides the irrigation of these 112 acres, about 3,210 cubic yards of the dredging from the bed of the Seine were utilised in the same manner as in 1871, and might be said to have become almost an article of commerce.

As for the municipal land, it continued to keep its position as a worthy type and example of that species of culture, and was, indeed, always known as the "Model Garden."*

The engineers and their agents did not confine themselves to any one branch of agriculture. The municipal property was placed in the hands of competent florists, market gardeners, and arboriculturalists irrespectively. The time is long past when any doubt was felt as to the quality of the vegetables grown on the sewage farms, and in 1872, 450,000 cabbages were brought to the markets from the irrigated land. Thousands of lettuces, beans, carrots, &c., found their way to the markets of Asnieres, Montmorency, and other places. Some of the finest products were bought by the Grand Hotel, and some heads of artichokes have been sold for as much as 1s. 3d. a-piece. The free play of private industry soon enabled the farmers to discover the crops which might be cultivated with most advantage, and the best methods to be adopted with each. The 112 acres of private property are almost exclusively devoted to market gardening. In the open plain the husbandry is still very rude, and the furrows are traced with the plough.

The expenses of cultivation, inclusive of the ground-rent, amount to from £8 to £11 per acre. The crops have realised from about £32 to £64 per acre, from which must be deducted the general expenses of sale, &c. In the

* "Even melons have been cultivated with success." See "Utilisation des eaux d'égout de Paris," p. 12.

irrigated land the costs of cultivation amount to about £32 to £40 per acre, but the produce realises from £112 to £128 per acre.*

These facts, obtained by practical observation, quite unbiassed by the engineers (who consider that complete liberty of action in the matter of cultivation is the best policy), have decided those concerned in the undertaking to join in the further developement set on foot by tho municipal authorities.

Applications have now been made for the irrigation of 1,427 acres of land, an extent which could easily absorb 93,495 cubic yards of sewage daily, as against the 80,000 cubic yards to be brought on to the land next spring. Although favouring those farmers who have from the beginning borne the brunt of the enterprise, the administration has imposed on them a progressive tax of £1 per acre, reserving at the same time the right of imposing taxes on the sewage which may be brought on to the land at any future time. In short, 80,000 cubic yards are being taxed at the present moment as against 170,000 to 200,000 cubic yards available in the future.

Of the 1,427 acres above mentioned, 1,000 acres are owned by agriculturalists who have entered into the plan of a more advantageous system of sewers, and are now endeavouring to form a company to carry on the sewage farming on a large scale. These speculators have at various times tried to obtain a monopoly of all the sewage for this purpose.

The engineers have, however, steadily refused to sacrifice those farmers who had the courage to resume the undertaking in May, 1872; and even if it should be found desirable at some future time to appoint an agent or factor to regulate the rates of payment, &c., it is still felt that no concurrence ought to bo rejected, and no one arbitrarily excluded from the benefits of the system.

Such is the present state of the sewage question in Paris. The principles have been established by a series of experimental works, carried on without interruption except during the period of foreign invasion and civil war. The municipality has boldly faced the question, and may be now said to have solved the problem of the purification of the Seine. Eighty thousand cubic yards of sewage may now be daily brought on to the plain of Gennevilliers, and in order to extend the undertaking three-fold it is only necessary to erect pumping-engines similar to those now in use on the newly-purchased land. The 125 acres now under cultivation was as much as could be safely attempted in the first instance, but it has now been shown that the extent of irrigated land only depends on the volume of sewage which can be supplied, and private industry has stepped in to profit largely by an undertaking which was first set on foot by the municipality of Paris as a sanitary measure rather than as a financial speculation. In this matter the municipality may claim the credit of those indispensable conditions of success, steadiness and perseverance.

In the other parts of France the sewage question has received comparatively little attention, which is the more to be regretted as the agriculturists are complaining more and more of the high price and scarcity of manure, a consideration which has influenced powerfully the action of the metropolis in this matter.

Almost all our provincial towns, down to the smallest boroughs, are situated on somo stream or watercourse, which is the receptacle for all the sewage and refuse of the town. The waste is great, and the sanitary condition often flagrantly bad. In such cases there would be little difficulty in carrying out the above described system, as in many of these places the volume of sewage would be small, and additional facilities would often be offered by the character of the country, and the method of cultivation generally adopted in river valleys.

At Rheims trial works have been carried on for several years. The volume of sewage amounts to from 15,000 to 17,000 cubic yards per diem, and is charged with an immense quantity of refuse from the manufactures. The sewers pollute the river Vesle, and affect the sanitary condition of the suburbs. An attempt was made to treat the sewage chemically by a combination of lime with a lignite found in the neighbourhood, and composed of coal, sulphate of iron, and sulphate of aluminium, &c., by which means they were able to purify it at a cost of about one farthing per cubic yard for the reagent alone. The same chemists tried another method, in which the reagent consisted of pit coal, sulphate of iron and lime, the cost of which was somewhat higher. The residuum was used as manure or as fuel for the engines.

The direct application of the sewage to the soil was also proposed, by conveying it in a pipe more than a mile in length, as far as the district of Maretz, there to irrigate an extent of 667 acres of ground at a rate of about 10,000 cubic yards per acre per annum. Many persons felt doubtful of the success of this undertaking, owing to the peaty character of the soil; and it was therefore proposed instead to make the first attempt on about 500 acres of chalky land at the entrance to the town. Experiments have now been carried on ever since the conclusion of the war under a special commission, for the purpose of comparing the advantages of the system of purifications with that of irrigation.

At Versailles the drains flow into two large sewers, constructed by Louis XIV., which open into a tank of masonry, whence they issue forth again, constituting almost exclusively what is called the brook of Gailly. The dwellers on the banks of this stream have addressed numerous petitions to the municipality of Versailles, complaining of the unhealthiness of the water. Inquiries have been instituted by the municipal engineers of Paris, but no decision has yet been come to, although the surrounding country offers every facility for the system of irrigation.

At St. Germain (Seine-et-Oise), the sewers empty themselves into the Pecq, forming a filthy stream, which flows into the Seine above the bridge, passing through 50 acres of fine pasture land, the proprietor of which made an experiment of irrigating his land with the water of the Pecq in 1869. After three years of discussions and inquiries, the utilisation of the waters of this stream was at last authorised by a decree of the Prefect in 1872. The results have been remarkable. This meadow is covered with the most luxuriant vegetation by means of the water, whose only function had formerly been to spread disease and pestilence. A centrifugal steam pump has been erected by the farmer to spread the water over the whole surface of the property.

In the neighbourhood of Montpelier, an agriculturist, M. Marés, applies from 250 to 500 cubic yards of sewage per diem to a piece of land about 10 acres in extent, and obtains the finest crops of vegetables. He also makes use, to a great extent, of the deposits from the sewage received in simple tanks or trenches.

At Carcassone, Cambrai, Aix, Chambéry, St. Etienne, the question has never been considered from a sanitary point of view, and no agreement has been come to on the subject between the dwellers in the suburbs and those in the towns, but the individual proprietors, nevertheless, endeavour to utilise the streams and brooks which issue from the towns by connecting them with simple trenches, and thus bringing the water on to the fields and market gardens through which their courses lie.

Several sugar and other manufacturers in the north of France have also begun systematically to devote their refuse water to the improvement of the soil, instead of

* "Les recoltes ont donné des produits bruts de 2,000 à 4,000 par hectare; sur lesquels il reste à imputer les frais généraux, les frais de vente, &c.; dans les terrains devenus maraichers les depenses de culture peuvent monter à 2,000 et 2,500 francs; mais le produit brut atteint 7,000 à 8,000 francs." This amount will appear to many agriculturalists to be incredible, but in market garden culture near London, where the annual expenses are commonly £50 per annum (labour, manure, rent, and rates), £100 is the frequent return per acre; and common market garden produce has been greatly exceeded by the sewage farm produce.

allowing it to pollute the rivers. They follow in the steps of M. Dailly, who set an excellent example in his farm at Trappes (Seine-et-Oise). Persevering efforts have also been made in the same direction by M. Girardin, near St. Denis.*

[Mons. Claye then gives an account of the chief sewerage irrigations in England, which is omitted on account of their length and their being known here.]

Belgium.

At Brussels large sanitary works have been recently carried out, which make it necessary to take the question of the disposal of the sewage into consideration. The river Senne formerly received all the sewage and refuse of the town, and when flooded, as was frequently the case, was a constant source of unhealthiness to the poorer quarters of the town.

Throughout the whole length of the town the river has now been built over, and two sewers have been carried alongside of it, flowing into one main pipe, which carries the sewage to a spot about three miles from the town on the right bank of the Senne, a short distance above the village of Vilvorde.

All these works, together with a great boulevard all along the covered part of the Senne, and a new exchange, were to be carried out by an English company (the Belgian Public Works Company), but after two failures of this company the municipal authorities were obliged to take up and finish the work themselves.

It is now completed, but the question, what is to become of the sewage outside the town, has only just arisen. A settlement is urgently called for, as almost all the houses in Belgium are being gradually provided with water closets in connection with the sewers. According to the original agreement with the English company, a pumping establishment was to be erected at the mouth of the sewers, and the sewage was to be spread over 120 acres of meadow land, which the company was to maintain at their own cost, and from which they expected to derive large profits. Whilst examining the grounds for these sanguine expectations, it may be remarked, in passing, that as the volume of sewage amounted to from 30,000 to 75,000 yards per diem, the quantity brought on to each of the 120 acres would be at a rate of from 100,000 to 150,000 cubic yards per diem, and that on only moderately permeable alluvial soil, situated in a valley surrounded by natural meadow land, and in the foggy atmosphere of Belgium.

After the failure of the English company the Belgian engineers resumed the study of the question, and, after visiting the trial farms established at Gennevilliers by the municipality of Paris, they recommended the establishment of works on a similar footing at Brussels, to serve as a basis for more extended operations. This is now being done. The Belgian engineers, abandoning the scheme of permanent meadows in the valley of the Senne, have proposed to raise the sewage to the plateaux of Loo and Penthy, where several thousand acres of unproductive sandy absorbent soil may be made available for market garden culture by the action of liquid manure. The sewage will be raised to the necessary height, 22 to 36 yards, by steam-power centrifugal pumps, similar to those in use at Gennevilliers. Definite conclusions have not yet been arrived at, but as all the first illusions have not yet been dissipated, the question is in a fair way to be satisfactorily settled.

Germany.

The town of Dantzig has led the way in sanitary improvements in this country, including the application of the sewage to the soil. The plans of the works were drawn up by Mr. Latham, an English engineer, who has for a long time been employed in the sanitary works at Croydon. A steam-engine has been erected at the extremity of the sewers to carry the sewage over an area of 1,600 acres. The expense is estimated at about £7,560. A concession for thirty years has been granted to an Englishman, Mr. Aird. The *Official Journal*, of the 10th September, 1872, gives a very favourable account of the manner in which the system works. Sanitary science may be said to be in its infancy at Berlin. Sewers scarcely exist. All the refuse of the town putrify in the shallows of the Thier Garten. A branch of the "Phosphate Sewage Company" has been established in this town, in order to try and convert the sewage into a good manure by treating it with the phosphate; but, since the company has lost the concession of the mines in the island of Alto Vela, this undertaking has gradually sunk into insignificance.

At Vienna and at Pesth preliminary inquiries are being made by the municipalities with a view to improving the drainage of the town, and the engineers sent out for the purpose have visited the plain of Gennevilliers, and the various works of the same nature in England.

Italy.

The vast meadows of more than 2,000 acres in extent which surround the town of Milan are watered by the Vettalia, a stream which receives all the sewage of the city, and may supply a volume of 100,000 cubic yards per diem. This is often cited as an instance of the application of the sewage for agricultural purposes. This cannot, however, be said to be exactly the case. The waters of the Vettalia are almost entirely pure, and, according to a report made by M. Mille, in 1862, to the prefect of the Seine, could not be in any degree compared to the state of the Thames at London-bridge, or of the Seine at Asnières, near the mouth of the sewers. According to an analysis made by M. Hervé Mangon, the water of the Vettalia contains only one-tenth the amount of organic matter contained in the water at the mouth of the sewer at Asnières. Moreover, the land has become so impermeable that the water in its rapid course over the surface might be used forty times over before emptying itself into the Lambro. There is thus no resemblance between this case and those previously mentioned.

The municipality of Florence have also been instituting inquiries at Paris and elsewhere, as to the best means of utilising the sewage of the town.

Spain.

The splendid market gardens of the Huerta of Valencia are irrigated with the waters of the Rusafa canal, which receives the sewage of a town of 100,000 inhabitants. But there—as at Milan—the sewage is so much diluted that it is of little value as manure, and consequently also the sanitary question does not present itself so urgently as in many other places.

In conclusion, all this evidence may be summed up by saying that the practice of discharging the drains into the rivers and watercourses in the neighbourhood of the towns, besides spreading pestilence in the suburbs, is also a culpable waste of the fertilising matter contained in the sewage, which latter is, moreover, a necessary consequence of the internal sanitary improvement of the towns. The sewage may, by chemical manipulation, be clarified, and the water separated by precipitation from the substances held by it in solution.

The water being then harmless may be carried away to the river, and the residuum may be utilised as manure, or in any other way. But though the water is sufficiently pure to have no bad effects on the river water, yet it is never entirely free from organic matter, which is in this manner carried away and lost.

To meet this evil the purified water has been used for agriculture; a plan which is, however, found to be as

* M. Pepin has observed that there are certain ingredients in the sewage water which have an injurious effect on some species of vegetation. He gives, as an example, the waters of the Bievre, which flows by leather-dressing works, and, consequently, contains a large proportion of tannin and of acid; with this water nothing but cabbages will grow.—"Utilisation des caux d'egout de la Ville de Paris," chap. 12.

costly as that of applying the sewage direct to the soil, in which latter case it is brought on to the ground in its natural state and is absorbed, if the nature of the ground is in any degree favourable; oxidisation thereupon takes place, producing azote and other substances necessary for the growth of vegetation, whilst the solid particles remaining on the surface form an excellent top-dressing.

In Paris, the municipality has tried both methods for several years, and has considered the purification as only secondary and supplementary to that of direct irrigation. A provisional establishment at Gennevilliers brings daily from 6,000 to 12,000 cubic yards of sewage on to 112 acres of land, and arrangements are being made to increase the quantity to 80,000 cubic yards, or one-third of the entire sewage of Paris; and further increase of the facilities for working are all that is necessary to increase the undertaking three-fold, and to complete the purification of the Seine. The city of Paris does not cultivate the land solely on its own account, but in connection with numerous agriculturists, so that the operations may be extended in a rational and natural manner. The climate and the character of the ground allows of the sewage being applied in large quantities, 25,000 cubic yards per acre per annum.

In the other towns of France the question has met with much consideration, except at Rheims, where experiments have been carried on for some years on a considerable scale.

In England, the city of London discharges its sewage at the mouth of the Thames. Several companies have made attempts at utilisation, so far without much brilliant success. Several second-rate provincial towns have applied the sewage to the cultivation of the soil on land either bought or rented for the purpose.

There is a general tendency to limit the area to be irrigated by intermittent filtration, and to substitute market garden produce for grass crops.

There have been some attempts at chemical purification, but nearly all the companies formed for the purpose have already failed, or are in a most critical state.

In Belgium, the municipality of Brussels is endeavouring to complete the magnificent sanitary improvements recently made in the town by applying the sewage to the land. But their engineers are still gathering information on the subject, and nothing is yet settled.

At Dantzig the system of irrigation has been for some time successfully carried out.

In almost all other places the question is still in its infancy, for the meadows round Milan and the Huerta of Valencia are scarcely worth mentioning.

Much remains to be done in France and elsewhere to effect a settlement of this important sanitary and agricultural question. There is, however, no doubt that the right path has been struck out when the principle is enunciated that the earth alone can transform all the noxious sewage waters into a useful and harmless substance. And we have only ourselves to blame if we refuse to adopt so simple and obvious a remedy against the evils attendant on civilised life, or to recognise in this regeneration of refuse matter the working of the grand and beneficent laws of nature.

Note by E. Chadwick.—On this paper it is just to observe, that on examination of the minutes of information "On the Practical Application of Sewer Water and House Manures to Agricultural Production," published in 1852 by the first General Board of Health, for the information of Local Boards of Health, it will be found that this "right path" was then struck out—namely, the direct application of manure in solution in water to agricultural production, and that there has yet been no deviation from it in principle, and no material deviation from the instructions in detail, that have not been deviations in wasteful error. There remains also to be carried out in Paris, and in all the continental cities, the system of the immediate removal of all human excreta, by water, through self-cleansing channels, house-draining and sewers, on the principles propounded in the minutes of information for the removal of soil water or drainage of dwelling-houses and public edifices, and for the sewerage of the sites of towns, July, 1852, "and presented to both Houses of Parliament by command of her Majesty." At present Berlin promises to be in the fore in its drainage, as well as its irrigation works.

GENERAL NOTES.

Society for the Protection of Scientific Industry.—The opening of the Exhibition of Appliances for the Economical Construction of Fuel has been deferred to January 30th, 1874. Applications will be received in all classes till December 20th.

Preservation of Meat by Cold.—Two importations of frozen meat have been reported during the past week. An entire ox was received in Liverpool from Canada on Monday, and on Wednesday the Allan steamer Scandinavian brought over some specimens of beef and mutton and three turkeys, all of which had been killed two days before the steamer left Quebec, frozen in ice, and stored on board in a cool and dry place.

American Iron Imports.—The imports of iron and steel into the United States are still decreasing, both in quantity and value. The *Iron Age*, of the 16th ult., gives the following summary of the total values for the third quarters of 1871, 1872, and 1873:—

——	1871.	1872.	1873.
	dols.	dols.	dols.
Pig-iron	373,122	1,115,074	625,904
Bar iron	1,294,567	1,635,148	431,411
Railroad iron	3,666,747	3,298,885	2,421,311
Sheet iron	63,254	118,980	161,611
Steel	696,568	696,262	575,947

Trade in Ceramic Manufactures in Belgium.—The following shows the trade in ceramic manufactures of Belgium with other countries:—

Imports.

Countries.	Common Earthenware.	Majolica.	Porcelain.
	weight in kils.	value in frs.	value in frs.
Zollverein	534,628	50,645	102,712
Netherlands	247,810	211,297	18,508
England	164,906	49,901	66,273
France	657,789	22,290	152,771
Other countries	..	557	240
Total ..	1,599,133	334,690	340,504

Exports.

Russia	237,697	..	..
Sweden and Norway	58	..	425
Zollverein	282,451	9,295	2,069
Hanse Towns	150,765	..	2,720
Netherlands	780,482	36,207	48,001
England	77,023	10,597	24,909
France	677,928	447,677	2,250
Spain	447	..	..
United States	..	..	633
Brazil	..	42	..
Rio de la Plata	..	..	14,747
Other countries	27,662	2,926	6,150
Total ..	2,234,513	506,744	101,904

Sericiculture.—An American gentleman, Mr. J. L. A. Warren, the author of a valuable treatise on "Silk Culture," has lately arrived in Europe, and intends visiting the different departments of silk culture and manufactures of France and Italy, to collect all the necessary information for his new work on "Silk Culture in Europe and America," now in course of preparation.

Trans-Continental Railway in Australia.—The Government of South Australia have introduced a Bill authorising the construction of a railway across the continent of Australia, from Adelaide to Port Darwin. Capitalists who undertake to construct the line will get alternate blocks of land. One hundred miles are to be constructed every twelve months, and the whole work is to be complete within fourteen years.

Education in Chili.—From a recent report to the congress by the inspector-general of public instruction in Chili, some idea of the educational condition of that republic may be formed. There are 1,190 schools in Chili, of which 726 are public and 464 private. It appears from the latest census, that the population of the towns is 520,668, being at the rate of one school for every 1,769 inhabitants; and in the country, with a population of 1,298,560, there would be one school for every 3,020 inhabitants. In 1872 these schools were attended by 82,162 children and young persons of both sexes, and the amount expended by the government for educational purposes amounted to 414,127 piastres. The number of teachers in the primary schools was 1,544, of which 896 were male and 657 female teachers.

Production of Coal in Sweden.—The production of coal in Sweden has not increased very rapidly. In 1870 the quantity raised exceeded only by five per cent. the yield of the previous year. There is a prospect, however, at present that the production will be greatly increased by the discovery of large fields in the province of Skara, lying in the south of the kingdom, and through which the railway from Goteberg to Stockholm runs. Trial borings have been made, and in one case, at a depth of 560 feet, twelve different seams have been found, varying from eight to twelve feet in thickness. Several companies have been organised to work the new mines. This discovery is of the greatest importance to Sweden, as the export of timber from that country has reached its maximum, and the demand for charcoal for smelting purposes has made wood very scarce and dear. At present, Sweden imports coal from Great Britain, but it is anticipated that she will soon export this fuel to other countries. These coal-fields, according to the opinion of eminent geologists, are widely extended.

NOTICES.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

ORDINARY MEETINGS.

For the remaining Meeting previous to Christmas, the following arrangement has been made:—

December 17.—"Whitby Jet and its Manufacture," by John A. Bower, F.C.S., Science Master, Whitby School. On this evening Thomas Chapman, Esq., F.R.S., will preside.

CANTOR LECTURES.

The second course is on the "Chemistry of Brewing," by Dr. Charles Graham (University College, London), and consists of seven Lectures, the second of which will be given on Monday, the 15th December, and the remaining five after Christmas, as follows:—

Lecture II.—December 15th, 1873.

On Malting.—The germination of seeds. Chemical changes produced. Examination of the processes of steeping, germination, and kiln-drying. English and Bavarian methods contrasted. Chemical examination of malts, with some analytical methods adopted for the use of the master brewer (Braumeister).

Lecture III.—February 2nd, 1874.

On mashing.

Lecture IV.—February 9th, 1874.

On Boiling. Hops, their properties and uses.

Lecture V.—February 16th, 1874.

On fermentation. (Primary.)

Lecture VI.—February 23rd, 1874.

On fermentation. (Secondary.)

Lecture VII.—March 2nd, 1874.

The beer of the future.

These lectures will include a chemical examination of the chief features of the methods of brewing adopted in England, Scotland, Germany, Belgium, and Norway, with proposals for the prevention of acidification and other destructive changes which occur in beer. The lectures on fermentation will include an account of the nature and chemical functions of the various yeast plants. During the course, chemical tests will be described for the guidance of the brewer in the mashing, boiling, and fermenting processes, and for testing the purity of the water and utensils used.

Other courses will also be given during the Session, one by Professor Barff, M.A., having been already arranged. These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture.

MEETINGS FOR THE ENSUING WEEK.

Mon.....**SOCIETY OF ARTS, 8.** Cantor Lectures. Dr. Graham, "On the Chemistry of Brewing."
British Architects, 8.
Medical, 8.
Asiatic, 3.

Tues....Civil Engineers, 8. Discussion upon Mr. Joseph Prestwich's Paper "On the Geological Conditions affecting the Construction of a Tunnel between France and England."
Social Science Association, 11 a.m. Conference of Chairmen and Vice-Chairmen of Boards of Guardians.
Statistical, 7¾. Sir Rowland Hill, "High Price of Coal: Suggestions for Neutralizing its Evils."
Pathological, 8.

Wed....**SOCIETY OF ARTS, 8.** Mr. John A. Bower, "On Whitby Jet and its Manufacture."
London Institution, 7.
Geological, 8. 1. Mr. A. B. Wynne, "Observations on some Features in the Physical Geology of the Outer Himalayan Region of the Upper Punjab, India." 2. Mr. E. J. Dunn, "On the Mode of Occurrence of Diamonds in South Africa." Communicated by Prof. Ramsay. 3. Mr. D. Mackintosh, "On the Traces of a Great Ice-sheet in the Southern part of the Lake-district, and in North Wales."
Royal Society of Literature, 4½.

Thur....**SOCIETY OF ARTS, 8.** Conversazione at the Royal Albert Hall.
East India Association, 8. (At the House of The Society of Arts.) Mr. W. Taylor, "Famines in India: their Remedy and Prevention."
Linnæan, 8. Sir John Lubbock, "Observations on Bees and Wasps."
Chemical, 8. 1. Mr. W. C. Roberts, "On the Preparation of Standard Trial Plates, to be used in Verifying the Composition of the Coinage." 2. Mr. R. Schenk, "On a New Compound of Nickel and Phosphorus." 3. Dr. Gladstone and Mr. A. Tribe, "Researches on the Action of the Copper Zinc Couple on Organic Bodies. No. IV. On Allyle Iodide."
Numismatic, 7.

Fri......Philological, 8.

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FRIDAY, DECEMBER 19, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

NATIONAL TRAINING SCHOOL FOR MUSIC.

The ceremony of laying the first stone of the new building took place yesterday, December 18th. The Council of the Society of Arts, Her Majesty's Commissioners for the Exhibition of 1851, the Council of the Royal Albert Hall, and other visitors, assembled at 12.30, at the foot of the staircase by the west portico of the Royal Albert Hall. On the arrival of His Royal Highness the Duke of Edinburgh the company proceeded by a covered passage to the platform. Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman of the Council, then formally requested His Royal Highness to lay the first stone, and presented him with the trowel for the purpose, expressing, as he did so, the satisfaction which must be felt by all promoters of the institution at having the aid of one so thoroughly able, from his musical knowledge, to appreciate its objects as His Royal Highness. Lieutenant H. H. Cole, R.E., then showed the model and plans of the building to His Royal Highness. A Bible, coins, *The Times* newspaper of the day, &c., were next deposited under the stone, and His Royal Highness proceeded to lay the stone in the usual manner, Mr. James Waller, the builder, assisting. The stone having been announced as "well and truly laid," a prayer was offered by the Rev. Canon Brookfield, Her Majesty's Chaplain in Ordinary.

The Duke of Edinburgh was attended by the Hon. Elliot Yorke. The following were among those present:—

Members of Council.—Major-General F. Eardley-Wilmot, R.A., F.R.S., Sir Daniel Cooper, Bart., Capt. Douglas Galton, C.B., F.R.S., Mr. Seymour Teulon, Mr. E. Carleton Tufnell, Mr. G. C. T. Bartley, Mr. Andrew Cassels, Colonel A. A. Croll, Lord Alfred Churchill, Mr. Hyde Clarke, Mr. James Heywood, F.R.S., Vice-Admiral Ommanney, C.B., F.R.S., Mr. Robert Rawlinson, C.B., Lieut.-Colonel A. Strange, F.R.S., with Mr. P. Le Neve Foster, Secretary; also the Right Hon. Hugh Childers, M.P., the Right Hon. Lyon Playfair, M.P., Mr. John Fowler, M.P., Mr. Frank Morrison, M.P., Mr. T. Hawksley, President of the Institution of Civil Engineers, General Scott, R.A., Mr. Henry Cole, C.B., Lieutenant Cole, R.E., Sir Thomas Gladstone, Bart., Sir Michael Costa, Sir Julius Benedict, Sir J. Goss, Dr. Stainer, Mr. Warren Delarue, Mr. W. L. Cole, Mr. Arthur Sullivan, Mr. J. Ella, Mr. Randegger, Mr. Best, Mr. J. L. Hatton, Mr. G. Cooper, Mr. G. Mount, Mr. Manns, Mr. J. Hullah, Mr. Brinley Richards, Mr. Cusins, Mr. H. Calcott, Mr. J. Barnby, Mr. A. H. Littleton, Mr. Jos. Bennett, Mr. C. L. Gruneisen, and Dr. Mouat. Mr. Freake was prevented by illness from attending.

In the evening, a Conversazione was held at the Royal Albert Hall. The proceedings were arranged to commence at half-past 8, and shortly after that time His Royal Highness the Duke of Edinburgh, with the Council of the Society, and the Council of the Royal Albert Hall, proceeded across the arena to the front of the organ. The National Anthem was then sung, and His Royal Highness the Duke of Edinburgh called upon the Rev. Canon Brookfield, Her Majesty's Chaplain in Ordinary, to read a statement, which the Rev. Canon did as follows:—

1. Under the most encouraging and hopeful auspices, the first stone has been laid this day, by his Royal Highness the Duke of Edinburgh, of an Institution of which it would be difficult to exaggerate the domestic, the social, or the national importance. It can hardly be necessary at this time and place, and in this presence, to discuss the universal, or scarcely short of universal instinct, which renders Music one of the most irresistible agents upon the mind of man, or the co-ordinate necessity of providing such an influence with the most careful and judicious means of cultivation.

2. A National Training School for Music has long been felt to be a necessity in this country, and has occupied the attention of the Society of Arts for many years. As far back as 1866 the Society of Arts, through an influential committee, conducted inquiries into the working of all the principal schools of Music throughout Europe. The Society published, both in its *Journal* and separately, the evidence it took as well as two reports.

3. Soon after the issue of these reports it was hoped that the establishment of a school on a sound basis might have been undertaken on the responsibility of the Government in connexion with National Education. It appears from the reports of the Science and Art Department that the question of a Training School for Music was actually at one time under the consideration of the Lords of the Committee of Council on Education—Earl Granville being then Lord President. The Department of Science and Art not having, up to this time, taken any active steps towards its establishment, it was decided by the Society of Arts to take the initiative, and establish a training school by voluntary support, with the full intention that it should, and under the confident hope that it will, eventually be transferred to the responsible management of the State.

4. The fundamental principle and primary object of the school will be the cultivation of the highest musical aptitude in whatever station of society it may be found. In order to carry out this principle to the fullest extent, admission to the school will be obtained by competitive examination. The mere payment of fees without competency will not give admission to the school.

5. As the gift of musical ability is found in all grades of society, and frequently among persons of very limited means, it is evident that in a large number of cases the student must not only receive gratuitous instruction, but also be supported during the period of his or her training. To provide for this it is intended to establish about 300 free scholarships. The proposed scholarships will be

of two kinds, the one to afford free instruction by paying the students' fees, the other to give such free instruction, with a maintenance allowance in addition. Should there be more accommodation in the school than is requisite for the instruction of these scholars, students paying their own fees will be admitted by competition to fill the vacancies, care being taken that they show sufficient aptitude.

6. The school fee, without maintenance, it is estimated, will be between £35 and £40 a year. The maintenance allowance for the support of the scholar will be in addition to this fee, and independent of the school. It is thought that the average time necessary for giving a complete course of instruction will probably be five years.

7. The Society of Arts, by means of private inquiries only, has ascertained the probability that the counties in the United Kingdom will be willing to establish one or more free scholarships each county for itself, to be awarded by competition. Thus, influential persons have expressed their willingness to do this. They represent the counties of Bedford, Berks, Cambridge, Cheshire, Derby, Devon, Dorset, Gloucester, Hampshire, Hereford, Herts, Huntingdon, Kent, Lancashire, Leicester, Lincoln, Middlesex, Norfolk, Northampton, Northumberland, Nottingham, Oxford, Shropshire, Stafford, Surrey, Sussex, Warwick, Wilts, Worcester, and York. In Ireland—Kildare, Monaghan, and Tipperary. In Scotland—Argyll, Ayr, Fife, Haddington, Inverness, Perth, Renfrew, Ross, and Sutherland. In Wales—Anglesea, Carnarvon, Denbigh, and Glamorgan. In the British Colonies—New South Wales and South Australia.

8. The Archbishops of Canterbury and York have expressed their willingness to support the school in their respective dioceses. Several of the City Companies of London have the subject under consideration; the Mercer's Company having established a full scholarship of £50 a-year, and the Fishmonger's two scholarships of £25. There will be a scholarship to be competed for, by the musical talent of the Cinque Ports, promoted by the Lord Warden, the Earl Granville, and by Lady Granville. Sir Titus Salt has promised £1,000 for a Saltaire scholarship; and two public spirited individuals have guaranteed that the town of Nottingham shall find out and send its musical genius to the school. It may be confidently hoped that other counties will follow this example.

9. Such a training school as now commenced, on the basis of free instruction given by public competition, occupies a field of action wholly distinct from that of any existing institution.

10. The site of the school is on the west side of the Royal Albert Hall, and only about 50 feet distant from the western portico of the hall. Her Majesty's Commissioners for the Exhibition of 1851 have granted a lease of the ground necessary for the school for a period of 99 years. The Royal Albert Hall supplies unrivalled accommodation for any large audiences in connection with the training school. It will also provide a small theatre and some large rooms for library, &c. It is therefore contemplated to connect the building with the Albert Hall, by means of a bridge, and to have an arcade from the Kensington-road, giving a passage under cover to the school. The new building, devoted to 20 class-rooms, professors'-rooms, and offices, has been designed by Lieut. H. H. Cole, R.E., expressly to meet the requirements of the school. The style is an English style of the 17th century, as may be seen at Longleat and Wollerton, with panels decorated with sgrafito work, designed by Mr. F. W. Moody. Mr. C. J. Freake will liberally cause the building to be erected at his own risk, by Mr. J. Waller, and he has offered the free use of the building to the school for five years.

11. When all the local arrangements of the school are completed, it will have premises positively unrivalled by those of any school in Europe. It will have the use of the great amphitheatre and of an adjacent moderate sized theatre; it will have libraries and professors' rooms, and a multitude of small rooms for instruction.

12. During the construction of the building, which will probably take eighteen months in completion, the Society of Arts will continue its movement throughout the United Kingdom to enlist public support for scholarships. The success which has hitherto attended the efforts of the Society gives promise that the nation will support the Society in this movement.

13. The Society will be prepared to send a deputation to explain the whole subject to any large town or corporation which expresses its readiness to form a local committee to aid in finding out the musical talent of the district.

14. When the school is built, it will be under a committee of management consisting of two members appointed by the Royal Commissioners for the Exhibition of 1851; two members appointed by the Council of the Royal Albert Hall; and three members appointed by the Council of theSociety of Arts. The committee thus formed consists of H.R.H. the Duke of Edinburgh, K.G., chairman; H.R.H. the Prince Christian, K.G.; Admiral the Lord Clarence Paget, K.C.B.; Sir William Anderson, K.C.B.; Major-General Eardley-Wilmot, R.A., F.R.S., or the chairman of Council of the Society of Arts for the time being; Henry Cole, Esq., C.B., and Major Donnelly, R.E.

15. The Council propose to establish the school which has been thus explained for a period of five years, and to obtain the public support for that period. At its expiration the Society of Arts hopes that the British Empire will so recognise the utility of the institution, that it may be engrafted upon the system of National Education, and be made part and parcel of Science and Art instruction, directed by a Minister of Public Education.

The reading of the address having been concluded,

Major-Gen. Eardley-Wilmot then called upon the Right Hon. Lyon Playfair to move a vote of thanks to His Royal Highness.

The Right Hon. Lyon Playfair had great pleasure, as a Vice-President of the Council of the Hall, in proposing the vote of thanks. His Royal Highness had better opportunities than most men of appreciating the value of such an institution as that now founded. This hall was intended not only for musical performances, but for musical education. He alluded, in conclusion, to the great event in which His Royal Highness was soon to take part, and expressed the feeling, which must be shared by all, of gratitude that at such a time His Royal Highness should devote so much time to this project, and undertake even more than his due share of work.

The Rev. Wm. Rogers seconded the motion, and expressed the general feeling of satisfaction at the very happy occasion on which they were met.

His Royal Highness the Duke of Edinburgh, in reply, expressed his pleasure at being connected with so great a work. He referred to the Royal Academy as a body which it was hoped might have taken a prominent part in the movement. It was not until after considerable time spent in negotiation that the idea was given up: but it was found that the whole system of the Academy was at variance with that of the new institution. The main object of the National Training School was to provide scholarships, by which all ranks might profit. He had much pleasure in announcing three new scholarships of £50 each, to be given by Her Majesty the Queen, by the Prince of Wales, and by himself. He concluded by moving a vote of thanks to the Society of Arts, which for over one hundred years had done so much to promote the arts, including that which might be termed the greatest of all arts—Music.

Major Gen. **Eardley-Wilmot**, in responding, said that it was a happy thing, after so many years of labour and exertion, to see the result so nearly attained. The foundation stone, so auspiciously laid that day, might be taken to symbolise the foundation of another house soon to be raised by His Royal Highness with the best wishes of the whole people. He would conclude by proposing that a cordial vote of thanks should be passed to that kind and liberal friend, Mr. Freake, who had so munificently guaranteed the funds for the foundation of the school. He was indeed absent from illness, but the vote would, he was sure, be none the less cordially passed in his absence.

His Royal Highness then returned to his box, and a series of musical pieces, under the direction of Mr. Barnby, was then performed. The programme was as follows:—

1. Chorus—"In these delightful pleasant groves" —*Purcell.*
2. French Song—Madame Lemmens-Sherrington.
3. Cantata—"Athalie"—*Mendelssohn.*

Overture.
Chorus with Soli—"Heaven and the Earth display"—Madame Lemmens-Sherrington, Miss Catherine Poyntz, and Miss Antoinette Sterling.
Chorus—"O Sinai."
Soli and Chorus—"Holy, holy"—Madame Lemmens-Sherrington, Miss Catherine Poyntz, and Miss Antoinette Sterling.
Choral Recitative—"What star in its glory."
Duet and Chorus—"Ever, blessed child, rejoice"—Madame Lemmens-Sherrington and Miss Catherine Poyntz.
Solo—"Alas, that all by virtue sainted"—Miss Antoinette Sterling.
Recitative—"O David's regal home"—Madame Lemmens-Sherrington.
Solo and Chorus—"Behold, Zion, behold"—Miss Antoinette Sterling.
Solo and Chorus—"How long, O Lord"—Madame Lemmens-Sherrington.
Solo and Chorus—"Rejoice, exclaims the frantic throng"—Miss Antoinette Sterling.
Solo and Chorus—"The sinner's joys decay"—Madame Lemmens-Sherrington.
Chorus (Eight parts)—"Lord, let us hear Thy Voice."
Chorus with Solo—"Promised joys"—Madame Lemmens-Sherrington.
Trio and Chorus—"Hearts feel that love Thee"—Madame Lemmens-Sherrington, Miss Catherine Poyntz, and Miss Antoinette Sterling.
War March of Priests.
Chorus—"Depart, depart."
Soli and Chorus—"Where are the shafts thou employest"—Madame Lemmens-Sherrington, Miss Catherine Poyntz, and Miss Antoinette Sterling.
Chorus—"Heaven and the Earth display."

4. English Song—Miss Antoinette Sterling.
5. Overture—"Il Barbière"—*Rossini.*

It should be mentioned that the Society is indebted to the ladies above mentioned for their gratuitous services.

The following were amongst those present on the platform:—The Hon. E. Yorke, in attendance on His Royal Highness, Major-Gen. F. Eardley-Wilmot, R.A., F.R.S., The Right Hon. Hugh Childers, M.P., The Right Hon. Lyon Playfair, M.P., Mr. J. Fowler, M.P., Mr. Hyde Clarke, Mr. Seymour Teulon, Mr. A. Cassels, Vice-Admiral Ommanney, C.B., F.R.S., Col. Strange, F.R.S., Mr. R. Rawlinson, C.B., Mr. Abel, F.R.S., Mr. E. C. Tufnell, Mr. T. R. Tufnell, Sir Daniel Cooper, Bart., Mr. J. Heywood, F.R.S., Capt. D. Galton, C.B., F.R.S., Mr. G. C. T. Bartley, Colonel A. A. Croll, Mr. H. Hunt, Dr. Mouat, Rev. W. Rogers, Mr. H. Vaughan, Mr. H. Cole, C.B., and Mr. Napier-Brown.

NATIONAL MUSEUMS AND GALLERIES, AND PUBLIC EDUCATION.

The Executive Committee met on Wednesday, the 10th December, at three o'clock.

The minute of Council appointing this Committee was read, as follows:—

1. That the undermentioned persons be invited to serve on a Standing Committee for the purpose of bringing under Parliamentary responsibility the National Museums and Galleries, so as to extend their benefits to Local Museums, and to make them bear on public education. The following are the several objects in view for effecting this purpose:—

2. All Museums and Galleries supported or subsidised by Parliament to be made conducive to the advancement of Education and Technical Instruction to the fullest extent, and to be made to extend their advantages to the promotion of original investigations and works in Science and Art.

3. To extend the benefits of National Museums and Galleries to Local Museums of Science and Art which may desire to be in connection, and to assist them with loans of objects.

4. To induce Parliament to grant sufficient funds to enable such objects to be systematically collected, especially in view of making such loans.

5. For carrying out these objects most efficiently, to cause all National Museums and Galleries to be placed under the authority of a Minister of the Crown, being a member of the Cabinet, with direct responsibility to Parliament; thereby rendering unnecessary, for the purpose of executive administration, all unpaid and irresponsible trustees, except those who are trustees under bequests or deeds, who might continue to have the full powers of their trusts, but should not be charged with the expenditure of Parliamentary votes.

6. To enter into correspondence with all existing Local Museums and the numerous schools of Science and Art, including Music, now formed throughout the United Kingdom, and to publish suggestions for the establishment of Local Museums.

7. Also, to cause the Public Libraries and Museums Act (18 and 19 Vic. c. lxx.) to be enlarged, in order to give local authorities increased powers of acting.

The Secretary reported that, the above resolutions having been submitted to the following Peers, Members of the House of Commons, Chairmen of Schools of Science and Art, &c., they have consented to serve on the Standing Committee. Those marked * form the Executive Committee:—

Bath and Wells, Bishop of	Longford, Earl of
Carlisle, Bishop of	Lyttelton, Lord
Carnarvon, Earl of	Portland, Duke of
Clinton, Lord	*Powerscourt, Viscount

Darnley, Earl of	St. David's, Bishop of
De Tabley, Lord	*Sandhurst, Lord
Ebury, Lord	Sutherland, Duke of
Hardinge, Viscount	Talbot de Malahide, Lord
Houghton, Lord	Vernon, Lord
*Kinnaird, Lord	Westminster, Marquis of
*Lichfield, Earl of	York, Archbishop of

Akroyd, Col. Edward, M. P. ..	Halifax.
Backhouse, Edmund, M.P. ..	Darlington.
Barclay, James, W., M.P... ..	Forfarshire.
Beaumont, Somerset A., M.P. ..	Wakefield.
*Bourne, Col. J., M.P.	Evesham.
Bowring, Edgar A., C.B., M.P.	Exeter.
*Charley, Wm. T., D.C.L., M.P.	Salford.
*Cochrane, A.D.W.R.B., M.P...	Isle of Wight.
Cowper-Temple, Right Hon. Wm., M.P., *Vice-Pres.*	Hants (S).
Dickinson, Sebastian S., M.P. ..	Stroud.
Dilke, Sir Charles W., Bart., M.P.	Chelsea.
Dixon, George, M.P...	Birmingham.
Dodds, Joseph, M.P.	Stockton.
*Elcho, Lord, M.P.	Haddingtonshire.
Finnie, William, M.P.	Ayrshire (N.)
Fitz-Gerald, Right Hon. Lord O. A., M.P.	Kildare County.
*Goldney, Gabriel, M.P.	Chippenham.
*Gower, Lord Ronald Leveson, M.P.	Sutherlandshire.
Gray, Lieut.-Col. W., M.P. ..	Bolton
Grosvenor, Right Hon. Lord Richard, M.P...	Flintshire.
Guest, Arthur E., M.P.	Poole.
*Hambro, Charles J. T., M.P. ..	Weymouth.
*Henry, J. Snowden, M.P. ..	Lancashire (S.E.)
Hick, John, M.P.	Bolton.
*Holland, Samuel, M.P.	Merionethshire.
*Kay-Shuttleworth, U. J., M.P.	Hastings.
Laird, John, M.P.	Birkenhead.
McArthur, William, M.P... ..	Lambeth.
*McLagan, Peter, M.P.	Linlithgow.
Mitchell, Thomas A., M.P. ..	Bridport.
*Morley, Samuel, M.P.	Bristol.
*Mundella, Anthony J., M.P. ..	Sheffield.
Northcote, Right Hon. Sir Stafford, Bart., C.B., M.P.	Devon (N.)
Pakington, Rt. Hon. Sir J. S., Bart., M.P., *Vice-Pres.*	Droitwich.
*Palmer, John H., Q.C., M.P. ..	Lincoln City.
*Parry, Love Jones-, M.P. ..	Carnarvonshire.
Pease, J. W., M.P.	Durham (S.)
Playfair, Right Hon. Lyon, C.B., M.P.	Edinburgh University.
Read, Clare S., M.P.	Norfolk (S.)
*Reed, Charles, M.P...	Hackney.
*Rothschild, Nathaniel M. de, M.P.	Aylesbury.
*Samuelson. B., M.P.	Banbury.
Smith, W. H., M.P.	Westminster.
*Straight, Douglas, M.P.	Shrewsbury.
*Verney, Sir Harry, Bart, M.P.	Buckingham.
Wedderburn, Sir D., Bart., M.P.	Ayrshire (S.
Wells, Edward, M.P.	Wallingford.
*Whitwell, John, M.P.	Kendal.
Yeaman, J., M.P.	Dundee.

*Abel, F. A., F.R.S., *Vice-Pres.*
*Brady, Sir Antonio.
*Brock, E. Loftus.
*Cassels, Andrew, *Member of Council.*
Cheetham, John, *Member of Council.*
*Clarke, Hyde, *Member of Council.*
*Cole, Henry, C.B.
*Croll, Colonel Angus A., *Member of Council.*
*De la Rue, W., F.R.S.
*Eardley-Wilmot, Major-General F., R.A., F.R.S., *Chairman of Council.*
*Gerstenberg, I., *Auditor.*
Greenwood, Professor (Owens College, Manchester).
Heywood, J., F.R.S., *Member of Council.*
Mouat, Dr.
Ommanney, Vice-Admiral Erasmus, C.B., F.R.S., *Member of Council* (for time being).
*Paget, Admiral, the Right Hon. Lord Clarence, K.C.B., *Vice-Pres.*
Piggot, John, F.S.A.
Roscoe, Prof., F.R.S. (of Owens College, Manchester).
*Sclater, Dr. P. L., F.R.S.
*Strange, Lieut.-Col. A., F.R.S., *Member of Council.*
*Thomas, E., F.R.S. (Athenæum Club).
Thomson, Sir William, F.R.S.
*Tufnell, E. Carleton, *Vice-Pres.*
Twining, Thomas, *Vice-Pres.*
*Ward, W. G., Chairman of School of Art Commitee, Nottingham.
Also the Prime Warden for the time being of the Worshipful Company of Fishmongers.
The Master for the time being of the Worshipful Company of Clothworkers.

Also the following Chairmen of Art and Science Schools:—

Allen, Richard	Art Sch., Preston.
Armstrong, Joseph	Sci. & Art Classes, Swindon.
Barclay, James W., M.P...	Mechanics' Inst., Aberdeen.
Barham, Charles, M.D. ..	Art Sch., Truro.
Barran, John	Sci. and Art Sch., Y.M.C. Assoc., Leeds.
Barrow, Benjamin, J.P. ..	Sch. of Art, Ryde.
Bate, C. Spence, F.R.S. ..	Sci. & Art Sch., Plymouth.
Baynes, Rev. Canon	Sci. Sch., Coventry.
Beale, James	Art Sch., Cork.
Berguer, Rev. H. J... ..	Sci. and Art Sch., Essex-road, Islington.
Black, Rev. Robert	Sci. & Art Sch., Dundalk.
Blenkin, Rev. Canon.. ..	Sch. of Art, Boston, Lincolnshire.
Bousfield, Rev. H. B. ..	Sch. of Art, Andover.
Brigg, John	Sci. & Art Sch., Keighley.
Brown, W...	Sci. & Art Sch., Galashiels.
Brinton, John	Sch. of Art, Kidderminster.
Bore, Richard	Sci. and Art Classes, Wolverton.
Burnet, Rev. W. R., M.A.	Sch. of Art, Sunderland.
Butler, Rev. George	Sch. of Art, Liverpool.
Campion, Rev. J.	Sci. Sch., Doncaster.
Carpenter, Alfred, M.D. ..	Sch. of Sci. & Art, Croydon.
Cholmondeley, Reginald ..	Sch. of Art, Shrewsbury.
Clark, Thos.	Sch. of Art, Trowbridge.
Coe, Rev. C. C.	Sci. Sch., Leicester.
Cole, Rev. Alfred A... ..	Sci. and Art Inst., Walsall.
Coombs, James, M.D. ..	Sci. Classes, Bedford.
Cope, C. R...	Sch. of Design, Birmingham.
Corderoy, John	Sci. Sch., Borough-road, Southwark.
Cosens, Rev. Dr.	Sch. of Art, Dudley.
Coward, Ralph J.	Sci. Classes, Worcester.
Cust, Rev. A. P...	Sci. and Art Sch., Reading.
David, Charles W. (Alderman)..	Sci. Sch., Cardiff.
Davies, T., J.P. (Alderman)	Museum Library, Salford.
Dawson, Thomas	Sci. and Art Sch., Leeds.
Dickie, J.	Sci. and Art Sch., Kilmarnock.
Dickinson, H.	Lit. and Sci. Inst., Coalbrookdale.
Dodd, Rev. J.	Sci. and Art Sch., Newry.
Falconar, John B.	Sci. and Art Sch., Newcastle-upon-Tyne.
Fitzgerald, Gerald	Sch. of Art, Clonmel.
Follett, Charles John . ..	Sch. of Art, Exeter.
Gaye, Rev. Charles H. ..	Sch. of Art, Ipswich.
Gibson, J. H., M.D... ..	Sch. of Art, Hull.

Girdlestone, Rev. Canon	Sci. Sch., Bristol.
Godlee, Burwood, J.P.	Sch. of Sci. and Art, Lewes.
Graham, Peter	West-London Sch. of Art, Marylebone.
Grant, Rev. Edward P.	Sch. of Sci. and Art, Portsmouth.
Greatorex, Rev. D.	Sci. and Art Class, Wellclose-square, E.
Gregson, Henry	Sch. of Sci. and Art, Lancaster.
Griffin, J.	Sci. & Art Sch., Banbury.
Gripper, E.	Sci. Classes, Nottingham.
Hallewell, J. W., J.P.	Sch. of Art, Stroud.
Hamilton, Rev. H. P. (Dean of Salisbury)	School of Sci. and Art, Salisbury.
Hansard, Rev. Septimus	Sci. and Art Classes, Bethnal-green.
Hickman, Rev. E. B.	Sci. Sch., Plymouth.
Hickman, W.	Hartley Inst., Southampton.
Holt, P. H.	South District Sch. of Art, Liverpool.
Hunter, J., jun.	Sci. & Art Sch., Holywood.
Hyde, John	Peter-street Sci. Schs., Manchester.
James, Charles H.	Abermorlais Sch. Sci. Class, Merthyr Tydfil.
Jex-Blake, Rev., T. W.	Sch. of Art, Cheltenham.
Lightburne, H.	Sci. Sch., Trim.
Lightfoot, Dr. J. B.	Sch. of Art, Cambridge.
Loveridge, H.	Sch. of Art, Wolverhampton.
Lowenthal, J.	Mech. Inst., Huddersfield.
Lyttelton, Lord	Sch. of Art, Stourbridge.
McCrea, Henry C.	Sch. of Art, Halifax.
McGavin, Rev. J. R.	Sci. Sch., Dundee.
Maughan, Rev. William	Elswick Mech. Inst., Newcastle-on-Tyne.
May, J.	Sci. & Art Sch., Devonport.
Merrifield, Frederic	Sch. of Art, Brighton.
Miles, Philip W. S.	Sch. of Art, Bristol.
Montagu, J. M. P., J.P.	Sch. of Art and Sci., Bridport, Dorset.
Moon, Rev. George	St. James the Less Sci. Sch., Bethnal-green.
Moore, Hugh	Sci. Classes, Newtonwards.
Murray, David	Sch. of Art, Paisley.
Nance, J.	Sci. and Art Sch., Burnley.
Nash, William Joseph	Sci. Sch., Bedford.
O'Callaghan, P., LL.D.	Sch. of Art, Leamington.
O'Gorman, N. S.	Sci. Sch., Corraclare.
Powell, Rev. Canon	Sci. and Art Sch., Bolton.
Radcliffe, Rev. W. T.	Sci. Sch., North-st., Bristol.
Reichardt, Rev. L. C.	Sci. Sch., King's Hospital, Dublin.
Richardson, William	Lyceum Inst., Oldham.
Ridding, Dr.	Winchester Coll. Sch. of Art, Winchester.
Semon, Charles	Art Sch., Bradford.
Simpson, Alexander	Sch. of Sci. and Art, Inverness.
Skillicorne, W. N., J.P., D.L.	Sch. of Sci., Cheltenham.
Smith, Basil Woodd	Sci. Sch., Haverstock-hill, N.W.
Spencer, J.	Sch. of Art, York.
Spillane, William, J.P.	Sch. of Art, Limerick.
Sumner, Rev. J. M.	Art Sch., Farnham.
Tabrum, Edward J.	Youths' Inst. Sci. Classes, Islington, N.
Talbot de Malahide, Lord	Art Sch., Queen's Inst., Dublin.
Taylor, William T., M.D.	Art Schs., Cardiff.
Teal, Francis	Sci. Class, Langton-street, Bristol.
Tennant, Rev. W.	St. Stephen's Sci. Class, Westminster, S.W.
Thompson, Rev. W. M.	Presbyterian Church District Sch., Woolwich.
Thornton, Rev. S.	Sci. and Art Sch., St. George's, Birmingham.
Tyler, Rev. William	Sci. and Art Sch., Church-street, Mile-end New-town, E.
Vaughan, Rev. Canon	Sci. Sch., Leicester.
Vivian, Edward	Sch. of Sci. & Art, Torquay.
Walsh, Rev. E.	Sci. Sch., Rathmore.
Wamsley, Rev. J. M.	Sci. Sch., Oswaldtwistle.
Ward, W. G.	Art Sch., Nottingham.
Watson, Joseph	Sch. of Art, Newcastle-on-Tyne.
White, Rev. James	Arsenal Sci. Classes, Woolwich.
Whitwell, John, M.P.	Sch. of Sci. & Art, Kendal.
Williamson, John	Sch. of Art, Birkenhead.
Winkworth, S.	Mech. Inst., Bolton.
Yeaman, J., M.P.	Sci. Sch., Dundee.
Young, J., F.R.S.	Anderson Univ., Glasgow.

The following, though unable to join the Committee, have expressed their sympathy with its objects:—

Earl Fortescue—"I must content myself with expressing my active concurrence in the object mentioned in your letter, and wishing the Council all success in their efforts for its promotion."

Earl Russell—"Quite agrees with the resolutions passed by the Council."

Viscount Sidmouth—"It appears to me that in the event of the direction of museums being assumed by the State, or indeed in any case, a thoroughly qualified staff ought to be available for the use of the public, whose duty it should be to give, when required, full explanations respecting the different objects exhibited. With such means at hand, the value of good collections is incalculable, but I am always struck with the great disproportion existing between the numbers of vague and unsatisfied visitors and those who leave a museum with a fresh supply of real, solid information. You can get this information in most museums, ruins, &c., abroad, by paying for it, but in London, where you must not pay, nine out of ten are afraid to make enquiry."

Thomas Ashton, J.P.—"The object has my full sympathy."

Dr. Hooker—"I entirely sympathise."

Professor Huxley—"I am unfeignedly rejoiced to see the movement set on foot by the Society of Arts."

J. D. Lewis, M.P.—"Sympathises with the object, &c."

J. G. Talbot, M.P.—"I beg to express my satisfaction that you are pressing this matter upon the Government."

The Council of the Hartley Institution, Southampton, has passed the following resolution:—"That the action of the Society of Arts, for the purpose of bringing under Parliamentary responsibility the National Museums and Galleries, so as to extend their benefits to Local Museums, is a movement deserving of the approval and support of the Hartley Council."

The Secretary reported that the Council had referred to this Committee, for special consideration, the condition of the Museum of Patents, and the accumulated and accumulating fund derivable from the fees taken for letters patent for inventions.

It was moved by Major-General F. Eardley-

Wilmot, seconded by Mr. U. J. Kay-Shuttleworth, M.P., and resolved:—

That the committee are of opinion that a committee of the House of Commons is necessary to cause practical effect to be given to the resolutions of the Council, and that Mr. Mundella, M.P., be requested to move the appointment of such a committee as soon as Parliament meets.

Moved by Mr. Cole, seconded by Mr. Cassels, and resolved:—

That the Executive meet after Christmas, at South Kensington, to inspect both the Patent Museum, under the Commissioners of Patents, and the collection of mechanical inventions, under the Lord President of the Council; and that after such visit the Lord Chancellor be requested to receive a deputation on the Patent Museum when convenient.

Proposed by Mr. Mundella, seconded by Mr. U. J. Kay-Shuttleworth, M.P., and resolved:—

That letters be written to Lord Aberdare, the Right Hon. W. E. Forster, and the Treasury, informing them of the formation of this Committee—transmitting list of the Committee—expressing the satisfaction of the Committee that the South Kensington Museum is not to be put under the Trustees of the British Museum, without the consent of Parliament, as announced by the Prime Minister, and requesting that the vacancy of Trustee of the National Gallery, occasioned by the death of Mr. Baring, may not be filled up pending the consideration of the whole question.

That the proceedings of this Committee be reported in the *Journal* from time to time, and sent to the press.

Resolved, that the following be invited to join this Committee:

Thomas Hughes, M.P.
C. W. Siemens, F.R.S.
Professor Max Müller, F.R.S.
Professor A. W. Williamson, F.R.S.
Thos. Webster, Q.C., F.R.S.,
And the Presidents of the principal learned Societies.

PROCEEDINGS OF THE SOCIETY.

FIFTH ORDINARY MEETING.

Wednesday, December 17th, 1873; Thomas Chapman, Esq., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Barker, Robert Wilkinson, 7, Warnford-court, E.C.
Bramwell, Frederick J., 37, Great George-street, S.W.
Burwash, Thomas Seabrook, Woodlands, Streatham, S.W.
Carfrae, John, F.R.G.S., 31, St. Swithin's-lane, E.C.
Fallon, James Thomas, 114, Collins-street West, Melbourne, Australia.
Graham, Dr., University College, W.C.
Hughes, Walter Watson, 48, Porchester-terrace, Bayswater, W.
Humphrys, Robert H., Deptford-pier, S.E.
Jackson, E. P., 14, Orsett-terrace, Hyde-park, W.
Millar, R., Milerevan Works, Lambeth, S.E.
Pagden, J. C., Little Heath, Potter's Bar.
Robinson, Robert, C.E., Darlington.
Shillington, D. F., 2, Great Tower-street, E.C.
Spencer, George, Tressillian-villa, Upper Lewisham-road, New-cross, S.E., and 77, Cannon-street, E.C.
Thompson, Henry, Summerhill, Colchester.
Tucker, Charles, Mayor of Bridport.

The following candidates were balloted for and duly elected members of the Society:—

Brown, Ralph, Brunswick-terrace, Wednesbury, Staffordshire.
Cleaver, Edward Lawrance, 20, Ladbroke-road, Notting-hill, W.
Darlow, William, 435, West Strand, W.C.
Giles, Benjamin, 2, Royal-parade, Blackheath, S.E.
Gilles, Malcolm, 4, Waddington-terrace, Windmill-street, Stratford, E.
Hart, Edward, 57, Moorgate-street, E.C.
Heath, Robert, J.P., the Grange, North Staffordshire.
Junkison, James, 229, Grange-road, Bermondsey, S.E.
Lloyd, Edward J., Hatton-hill, Warwick.
Murdoch, William Buchan, 115, Cannon-street, E.C.
Richards, W. Phelps, Messrs. W. and R. Richards, brewers, Kensington, W., and The Poplars, Shepherd's-bush, W.
Slate, Archibald, the Brewery, Chiswell-street, E.C.

The paper read was—

WHITBY JET AND ITS MANUFACTURE.

By John A. Bower, F.C.S.

Like very many industries of this country, little was done to develop that which is to occupy our attention this evening, previous to the Exhibition of 1851. At this exhibition jet was represented chiefly through the management of a Mr. Varley, who, it appears, in 1849 or 1850, in prospect of this first International Exhibition, wrote—for information as to designs, and the kind of articles to be displayed—to the editor of the *Art Journal.* The necessary information, with a series of original designs, were at once forwarded to Whitby, and a case of Messrs. Slater and Wright represented this town's staple manufacture at the world's great fair. Since then its progress as an ornamental art has been great, but not so great as it might have been under different auspices. Jet has been worked a very long time in this district, even long before the history of the famous Abbey St. Hilda forms a part of her records, but how long history does not decide for us. I find the following mention of it in "Charlton's History of Whitby:"—"I myself," says this learned author, "have lately viewed the ear-ring of a lady who had most certainly been buried in one of these houses long before the time of the Danes' arrival in Britain; it is of jet, more than two inches over and about a quarter of an inch thick, made in form of a heart, with a hole to its upper end, by which it has been suspended to the ear. It lay when found in contact with the jaw-bone; and if any credit be due to antiquity, must assuredly have belonged to some British lady who lived at or before the time the Romans were in Britain, when ornaments of this sort were universally worn." The term houes here used refers to tumuli, which are found in considerable numbers on the neighbouring moors, and were probably repositories for the dead, as in all cases, when dug into and examined, human bones are found. In recording the "finds" of Canon digging Greenwell, of Durham—who has been on the Goodmanham Wolds lately—it was stated in the *Whitby Gazette*, about a month since, that "a jet pendant ornament, associated with a good knife and some capital skulls," were found.

The Saxon poet, Cædmon, who died and was buried at Whitby Abbey, in his "Translation on Jewels," refers to jet in the following lines:—

> "Jeat stone, almost a gemm, the Lybians find,
> But fruitful Britain sends as wondrous kind;
> 'Tis black and shiny, smooth and ever light;
> 'Twill draw up straws, if rubb'd till hot and bright;
> Oyl makes it cold, but water gives it heat."

The electrical phenomenon referred to by Thales in regard to amber would apply equally well to jet, for we find that on being rubbed or excited in the same way it has the tendency to draw particles of straw or any light substance towards it with quite as much energy. From this circumstance it has probably acquired the name of "black amber." In the abbey records the reference to jet is rare. In the year 1350 it appears that a charge for repairing a jet ornament was made, and there is no doubt but that during the time Whitby Abbey was flourishing as a seat of learning, and the resort of pious pilgrims, beads and rosaries of jet were in common use, and that it was probably worked by the priests, as one of the handicrafts in which it was necessary for them to excel. Passing over some centuries, we find, in 1598, the name of John Carhill, jet worker, in the list of Whitby's principal citizens; there must therefore have been some trade in this article carried on at that time.

We apparently hear no more of it as a local trade till the beginning of the present century, when John Carter and Robert Jefferson (the latter was a painter by trade) are said to have made beads and crosses, with knives and files. A necklace thus roughly made was given to Thomas Simpson, Esq., who gave Jefferson a guinea, as a reward for his painstaking work; this incited him to work on and gradually improve in the making of such articles. Another incident then steps in which helps Jefferson forward considerably; a naval pensioner, who was staying at Whitby, saw him, in company with Carter, working at their jet, and suggested that, as he had just had some amber beads turned up by the lathe, he did not see why they could not do the same with jet, as by this means the work could be better done, and with much greater ease. This led them to a turner, named Matthew Hill, who turned out some beads in a far more satisfactory manner than Carter or Jefferson could do by hand. We find, however, that Hill had no confidence whatever in the art being made one of profit, but he was engaged to turn jet beads, and these were for some time disposed of very quietly, for by keeping the business to themselves they could realise greater profits. Thus it appears the first jet workshop was set up at Carter's house in Haggersgate, 1808 or 1810. We soon afterwards find a Mr. Thomas Yeoman, silversmith and druggist, entering on the business, and giving full employment to two hands, named Ward and Forster. Others soon entered the ranks, and in two or three years as many as ten or a dozen shops were engaged in the manufacture of jet beads, snuff boxes, and crosses, but they had as yet no means of polishing, no rouge board, or even grindstone, which is now used to give the first form to the rough piece. I find the following among the most prominent promoters of the trade, Bingent, a Frenchman, who came over about 1814, engaged at jet necklace making; Walmer, who still further developed the trade, and added to the number of articles made in jet from 1815 to about 1835; Mr. Charles Bryan, who made rings as well as beads, from 1819 to about 1847; he also had the good fortune to bring up the largest seam of jet ever discovered from what was called the North Bats, about the year 1847; it weighed 370 stones, and was worth about £250.

To the jet workers last named, several who are still living at Whitby were apprenticed, and we find among them those who had been cabinet-makers, joiners, bakers, and other businesses that did not pay them so well. Many instances of the manner of disposing of the jet goods are given in the early history of the trade, which are not only amusing, but show how one who wished to considerably outdo his neighbours tried by all sorts of plans to dispose of his goods at the best markets. The wife of one of the earliest among the jet workers always transacted this business, by making journeys to London with parcels whenever an opportunity offered, which only occurred at that time at intervals of three or four months; for of all places in England, probably none were more isolated from the rest of the country, before the days of railways, than Whitby. Then the journey was generally done by sea, for if by land the moor which surrounds Whitby on three sides had to be crossed, though pleasant enough in the summer, too hazardous in winter to make it desirable. From these small beginnings the trade has gradually increased and developed, so that in 1850 there were about fifty workshops, but now, in 1873, they exceed two hundred, and jet articles are sent to the Continent and to most of our colonies; and a very large and increasing trade is now done with the United States. As an illustration of how events influence the trade in a fancy and ornamental article of this kind, I might name that the death of the Duke of Wellington gave a wonderful impetus to it, and articles of a better class were then in demand. Again, the lamented death of the Prince Consort gave it another impulse, but it is now steadily on the increase, and employs about 1,500 hands, or gives support to nearly one-third of the population of Whitby. Before leaving this historical portion of our subject, allow me to give a few statistics, dating from the year 1860, which show the increase in the value of the trade. In 1860, it realised about £45,000; in 1861, £50,000; in 1862, £53,000; in 1863, £55,000; in 1864, £57,000; in the year 1870 it had reached £84,000; in 1871 it had risen to £86,000; in 1872, to £88,000; in 1873, it will probably exceed £90,000. There is no doubt whatever that, as the taste of the workmen improves, and the ornaments are more widely distributed, even this growth, which has been rapid, will be still more so, and especially as the merits of jet as an article that "will wear" become more widely known. But all persons of taste do not like jet as an ornament. In proof I quote the following paragraph from the *Spectator*—one of the numbers for September last. This gives an article on Whitby, which was reproduced in the *Scarborough Gazette*, of September 4th, with all the good feeling this fashionable watering place always accords to Whitby. It runs thus:—"All towns have their peculiar industries, and jet is well known to be the industry of Whitby. Jet meets you at every turn, and in every shape; even the large, black Newfoundland dogs (Whitby is certainly famed for dogs, if numbers are to be considered), glossy from their bath, sit as if carved out of jet. Surely no modern manufacture of trumpery ever

rivalled this in ugliness. With a refinement of cruelty some workers embed sections of ammonites in it; others, and this is the *ne plus ultra* of richness, surround it with a fretwork of alabaster; anl you may have a card tray of this glittering, inconclusive material with the classic features of Victor Emannuel staring at you in jet from the bottom. One wonders who can buy such things; but there are some people who must have the speciality of the place they are in, however base and trivial it may be, and those who acquire mosaics at Rome, beads at Venice, inlaid wood at Sorrento, carved paper knives in Switzerland, iron brooches at Berlin, marble paper weights in Derbyshire, and 'all the fun of the fair' wherever they go, will surely not fail to carry away some dark memorials of Whitby." I cannot agree with the taste of the writer of this article.

Having said thus much on the rise of the manufacture, we will pass on to consider the substance itself.

What is jet? This is a question often put, but never satisfactorily answered. Nearly all the jet workers have an opinion on its origin, and most of them, in common with the greater part of the inhabitants of Whitby and its neighbourhood, believe it to be of ligneous origin. Some, however, believe it to be of mineral origin, and others think it combines the two. Taking the opinion of Mr. Martin Simpson, the curator of the Whitby Museum, who has studied the geology of this district exceedingly well, and with whom I have talked on this subject, he put his theory as follows:—"Jet is generally considered to have been wood, and in many cases it has undoubtedly been so; for the woody structure often remains, and it is not unlikely that comminuted vegetable matter may have been changed into jet. But it is evident that vegetable matter is not an essential part of jet, for we frequently find that bone and the scales of fishes have also been changed into jet. In the Whitby Museum there is a large mass of bone, which has the exterior converted into jet for about a quarter of an inch in thickness. The jetty matter appears to have entered first into the pores of the bone, and then to have hardened, and during the mineralising process, the whole bony matter has been gradually displaced and its place occupied by jet, so as to preserve its original form."

To this latter opinion I am inclined to agree, for it has the appearance of a substance that has distilled from the rock, and in some cases has impregnated vegetable, and in other cases animal substances, while in others it has simply filled up a fissure in the rock, and solidified. In some specimens I have seen the grain, apparently of wood, distinctly, in others, scales and bones of fishes, and in one of the best specimens that has been found here, the mass in form and structure was that of a tree, with bark, knots, and roots, and in the curled portions of the roots, stones and soil conglomerated were imbedded.

That it has been formed from a distillate from what is called the jet rock is supported by these facts. Experiments tried on portions have been successful, and proved that at least ten gallons of oil could be extracted from one ton of the shale, and that this pure oil gave out a clear and brilliant light when burnt. A piece of jet on fire gives out a similar brilliant, clear light. Again, the substance is always found in seams, detached, and in a horizontal position, and spreads itself out in shallow layers, as water or fluid substances always do. The two kinds with which we are acquainted are the hard and soft; these are evidently of distinct species. The jet rock occurs in the lias formation. This formation, commencing at the peak about eight miles south of Whitby, traverses the whole coast to about fifteen miles north of Whitby, and from the bold and precipitous cliffs that skirt the sea to Tees' mouth. The rock divides into the upper and lower lias, with a marlstone series intervening, in the upper part of which we have the Cleveland ironstone. Then comes the dogger, or jet rock, and it is here where our "hard jet" is found in compressed masses or layers of various lengths and thicknesses, some having been found of an inch or two long and one-eighth thick to masses thirty inches wide, six feet long, and four inches thick. It appears that the largest piece ever found was six feet four inches in length, four and a-half to five and a-half inches wide, and one and a-half thick, weighing eleven pounds and a-half. The nett price was ten guineas; for this sum it was offered to the Curator of the British Museum; he declined to purchase it, and the specimen was afterwards sold for fifteen guineas, and cut into four-inch crosses.

Whatever may be the actual formation of jet, that known as the hard jet is most worked, it not being thought worth while working the soft species, since the importation of the Spanish article. The hard jet has a specific gravity of about 1·238, has a conchoidal fracture, a resinous lustre, it gives off a bituminous odour when burnt, is an electric, and a bad conductor of heat. It was formerly obtained in the largest quantity by working in the cliffs, by a process called "dessing" (very dangerous work), that is, by clearing away and hewing down the cliff-sides till jet ends protruded; the seams were then followed till exhausted. Some seams have realised as much as £1,000, and have been discovered in a short time. At other times, however, men have been employed for weeks, occasionally months, and have found nothing, in fact have been on the point of giving up, when they have unexpectedly come upon a seam that has fully repaid all their labour. In recording those who were among the earliest workers in the cliffs, I may mention the names of Barwick, Crosby, Banks, and Ebbington, the last of whom, unfortunately, fell over the cliffs and was killed.

The cliff workings are now, however, nearly abandoned for those along the hill-sides of Cleveland district, about twenty miles inland, the most extensively worked being that of Bilsdale, near the village of Broughton. The process of obtaining jet here is simple; the faces of the hills are turned down bodily, and by then tunnelling for some distance, and after carrying several passages parallel from the face of the hill, transverse drifts are cut. When the rock becomes too hard, the miners retire, pulling down the roofs on their return; in these falls the bulk of jet is found. The plant required for jet mining is small —a few hundred yards of rails, a few tram-waggons, forming the bulk of all that is needed. The railway is laid as the drifting proceeds, which is generally a passage of from six to seven feet high, and about five feet wide. The progress made per

day depends on the hardness of the rock, and varies from two to five feet per day. A visitor to such a working says that, "entering the narrow door-way, one splashes and wades through numerous little puddles that have accumulated, one knocks one's head against the low roof here, or scrapes one's ribs and elbows against the narrow wallings there. Now escaping breathlessly, now waiting in the painful darkness till the little waggons pass by, one manages to see a man pulling down a roof on one side, or quarrying his way into the earth on the other. At last a seam of jet is pointed out—lying always horizontally—which a third is following up. As soon as the 'black diamond' is found, it is taken up in pieces as large as possible, and placed in a bag, kept conveniently near, and removed each evening to the jet master's house." There are somewhat more than twenty mines at work at present; about 200 miners, whose weekly wages vary from 24s. to 26s. Owing to these low wages, many men, who might otherwise be at jet-mining, go to the iron-works in the district where they get paid much better. A short time since there were more than four hundred miners, but they have gradually lessened to the number before mentioned. Again, jet mining seems to be a sort of hazardous undertaking, as far as profits are concerned, for often large areas have been tunnelled and nothing found; and others have sometimes taken up mines that former workers have given up in disgust, and reaped a fine harvest. Both the jet cliffs and mines are rented by the workers. By far the largest jet miners are W. Thompson and J. Turner, both of Whitby. The former has carried his business on most successfully since the year 1860. Rough hard jet varies in value from 4s. to 21s. per pound, according to its closeness of texture, direction of grain, freedom from flaws and breadth for working. The soft jet varies from 5s. 6d. to 30s. per stone; the price of the Spanish is about the same as that of the English soft jet. The Whitby hard jet is the best in the world—not only for working, but it will take a fine polish, which it retains for years—and it can be worked up into finer designs on account of a greater tenacity and elasticity that it has over other qualities. These properties seem not only to be widely known but fully appreciated, for wherever jet ornaments are sold, without any consideration as to quality, they are always recommended and "warranted" as Whitby jet. We find this in France, Spain, Italy, Venice, and wherever the tourist finds himself; nobody who buys jet ornaments buys anything but Whitby jet. The Spanish jet varies very much in quality; some of the best works up very well indeed, and will admit of some fine work, and thus got up and well finished, it sometimes puzzles the best judge at first sight to distinguish it from real Whitby; but the action of the weather soon tells upon it; sudden heat and cold break it up, and, in fact, it has no wear compared with its finer rival. The chemical composition is the secret, for while Whitby jet appears to be mainly composed of hydrogen and carbon, the Spanish contains sulphur, and no doubt this fact explains the reason of its breaking up under the influence of sudden changes of temperature, owing to unequal expansion due to the presence of sulphur. On being burnt, Whitby jet leaves but a very little ash—Spanish jet much more. All the samples of rough Spanish and Whitby jet I have for illustrating this paper are furnished by the kindness of the Whitby jet manufacturers. They will help us to see the truth of the various statements I have mentioned in regard to its origin, especially the peculiar formation of each seam round a sort of "dogger" or core. The beautiful collection of worked jet is also the result of some of the best and most refined labour in this department that Whitby can supply. We will therefore next consider the various processes through which it passes before it becomes "an object of beauty." Rough jet, as seen in these specimens, is covered with a skin, and many of these bear the impressions of ammonites and other fossils. This skin is blue on the jet obtained from the cliffs, and brown on that obtained from the inland mines. Some very fine specimens of washed jet, *i.e.*, jet which has been washed out of the cliffs by the sea action, sometimes find their way to the workshop.

This skin has first to be removed, which is done by the workmen chipping the surface with a large iron chisel; the stripped portions are then taken to the sawing bench, where the jet is sawn up, with the keenest eye to economy, into the various shapes and thicknesses, according to the articles for which they are required. The pieces are then given out to the carvers or turners, as the case may be. In the case of the former, if he requires to make it into a brooch, locket, or chain-link, he takes it to a grindstone, which he works by a treadle, and brings the edge, which he keeps turning round, on to the face of the stone; it soon then becomes oval, round, square, or any geometrical shape required. The surfaces are next both ground smooth; it is then fit for carving. Very often—I might say rarely is it otherwise—the artist in jet who undertakes this is no draughtsman whatever, yet he can cut the most beautiful and truthful faces in high relief—the most delightful floral designs, the latter often without any pattern at all, the most tasteful monograms, and other designs equally good, without being able to sketch the simplest object on paper, and often not being able to write his own name. It was only last week a striking instance of this kind came under my own notice. I saw a workman, one of the best hands in a large shop in Whitby, able to cut the most elaborate monograms, the most accurate portraits, the most elaborate foliage, but quite unable to sign his name. Is it not important, then, when we have many such instances, that we in Whitby should have not only elementary classes, but also a School of Art? I remarked on the economy with which the jet was cut up. I am informed that some masters by care get one-fifth more work out of the same amount of material by strictly observing this. The smaller and detached pieces are made up into beads and smaller ornaments. In the general bead manufacture, however, the Spanish jet is mostly made up, for in ornamental work there would be too much waste. In using this material I have seen large lumps cut up which, owing to flaws, grit, and coarseness of grain, more than two-thirds has been useless; as a rule one-half is waste. Occasionally good and closely grained pieces are found which work up remarkably well, and at first sight even puzzle a jet worker to distinguish them from the best Whitby jet articles.

The cutting mill is often used in jet ornaments, in making grooved and serrated edges to brooches, bracelets, &c. This mill is simply a wheel about eight inches in diameter, made of a mixed soft metal, so that it can easily be ground. It has a thickness of from half to three-quarters of an inch, and gradually comes off to a knife edge at the circumference. After the object is thus far complete, it goes through a process of polishing. For all broad surfaces this is accomplished by holding them to a rouge board, which is kept in a rapid rotary motion, its surface being covered with walrus hide, or bull neck, besmeared with copperas—as it is called—and oil: but I believe the substance to be ferrous oxide. Edges, scroll-work, coils and twists, are first polished on a similar wheel, but having ordinary list nailed on edgewise, and finally by means of a rotary brush. This rougeing gives Whitby jet a beautiful velvety black appearance—the Spanish being somewhat more blue. After the polishing, the necklaces are ready for stringing; this is generally accomplished by young women, who have the beads placed in grooved boards according to size; they are then threaded on elastic or very strong twisted thread. The portions of bracelets are also fitted together by young women in a similar manner. In regard to link chains and all similar articles, every alternate link is carefully split, and, after being linked in with two complete ones, is cemented, in addition to having small pieces of wire drilled into it, so that if fitted properly and carefully, these links are quite as strong as the uncut ones. The cement is a mixture of shellac and resin. Pendants, ear-drops, and all attached portions are joined in this same manner. The same process of working as here described is adopted by all shops alike, from the largest, which is that of Mr. Charles Bryan, who has on the premises about 120 hands, down to the smallest garret workshop.

The most complete workshops we have in the town are those of Mr. Bryan, who has lately gone to considerable expense in rearing not only a large structure, but has added every possible convenience conducive to the health and comfort of the men.

One great advantage in the jet trade is, that all those who are now members have either been regularly apprenticed to the trade or have worked at it some years, so as to be thoroughly acquainted with it. The series of specimens I have here illustrative of the stages of progress in the jet manufacture are from Mr. C. Bryan's, as are also most of these elaborate works of art here exhibited. Some of the samples of rough jet are from the houses of Messrs. Chapman and Maule, and Mr. Wakefield, who are also representatives of this trade in the Old Town. The ease with which the art is learnt by lads is in many instances astonishing. As in every other art, skill varies very much; but I have heard Mr. C. Bryan, whom I named just now, say that he was willing to take fifty little London street Arabs as apprentices, and able, too, to guarantee that more than half should turn out first-rate jet workers; and from frequently visiting these workshops I have every reason to believe this is no exaggeration. The visit to a jet workshop is one of interest; we hear a busy hum of treadles, mingled with the whistling and singing of popular airs, often given with great precision and harmony; many part songs, creditably done; and all this without the least detriment to the work that is going on—some at the treadle, others at the cementing bench, others poring closely over some piece of carving, while the sawing out of material is left to older and thoroughly trustworthy hands. During last year the Premier and Mrs. Gladstone visited Mr. Bryan's workshop, and while Mr. Gladstone was becoming acquainted with the mysteries of the art, his lady was acquainting herself, by conversation, with the characters and condition of the workmen themselves.

According to the classes of work so do the wages of the workmen vary; some idle and careless hands getting from sixteen shillings to a guinea per week; others earning from thirty to fifty shillings weekly, and the average wages for boys, from twelve to fourteen years, being eight to ten shillings. In the present state of the trade, lads generally are apprenticed from three to five years, but without being required to pay a premium, and during the last year, and sometimes the two last, they receive wages. The packing, arranging, ticketing, and selecting goods, form a good opening for employment to young women; one establishment now employs from twenty to thirty, and it is as remunerative as most occupations for this class of labour. I have thus glanced briefly at the jet trade as it is; allow me to draw especial attention to some means by which it might really become not only a still more flourishing trade, but a high class work of art.

Jet is a material in which much better work can be done, and we have workmen who can do it. A glance at some of these beautiful specimens proves that. Some of our jet manufacturers are men who thoroughly appreciate a good design, and are glad to turn out something new, and also, of any suggestion for improvement. It is true that many patterns still made in jet are those that existed from the commencement of the trade, but as long as persons buy them so long will they be reproduced.

In conversations with the masters on an improvement in the patterns, or the introduction of something new, I am told that if customers improved in taste, and there were any demand for articles of a better design, they would be ready to do them; but when they made a fresh effort by bringing out a good and new design, it frequently was on their hands for a long time, or, to use their own expression, "it would not sell;" so that much improvement in this class of goods depends on the public taste. I have heard many remarks upon the unsuitableness of several designs in the jet carving, condemning them as only fit for metal work, because of their brittleness. I must say that a very exaggerated notion exists relative to this property in jet, for in a good piece of the Whitby material there is much tenacity.

I think, also, that there is nothing more suitable for jet work than floral patterns, and it is in designs of this class that the men mostly excel; some of the foliage in the examples I have here are admirable, not only, I think, as works of art, but as specimens of nature copying.

The designs would be greatly improved if we had a good art school at Whitby; this is very much required, and many of the artisans have expressed a strong desire that efforts should be made

to get them one. The only school we have in connection with drawing is one under the auspices of the Mechanics' Institute, but although it is doing much good to the few who attend, many more would avail themselves of it did it afford more advantages; the want of a larger selection of good copies, designs, and models is greatly felt.

A good museum of works of art, occasionally localised in the town, would do very much to help the men and improve the art, and repetition of such inducements as have lately been given by the Turners' Company would most assuredly bring out the taste and skill of the workman. In regard to the remarks made by Professor Tennant on the articles that were sent up from Whitby for that competition, the workmen generally do not endorse them. In reference to the designs, they think the designs most suitable, and would be glad if the public gave them sufficient encouragement to work at such objects more frequently. The thinness of the jet seam generally prevents large objects from being made, but with a good cement they are sometimes attempted, as in the case of the vase which gained for its turner (Matthew Greenbury) the honour of the freedom of the City of London, the first prize in the competition just mentioned. I may add that it is now a matter of great regret among many of the workmen that they did not compete. The vase is now at Brighton, having been purchased by Mr. Greenbury, one of the Whitby manufacturers and uncle to the maker, who has, like many of our best manufacturers, a branch establishment at that delightful watering place. The inkstand, made by the foreman of Mr. C. Bryan, I have here, and it is a fine specimen of jet carving, and a very good design. Jonathan Short, the maker, has also furnished these beautiful penholders, which present all the elasticity of the ordinary quill. The bust of the Prince Consort, the beautiful paper-knife, card-case, medallions in high relief, necklets, and bracelets are also of the finest that have ever been wrought. In regard to these, however, I must say it is a matter of regret that they have to be done and brought to a great state of perfection at a loss to the employer of labour. Two portraits or bunches of flowers, fruit, or any other design, may be wrought, so that at first sight they may look equally well, but on closer examination one specimen will be found to be far more elaborate and truthfully carved. The purchaser in making his choice does not consider the amount of painstaking in the one, but takes the imperfectly finished, because of its costing less. There is then not the encouragement for first-class painstaking work that there should be. Regardless of this, several of the masters do, however, make most praiseworthy sacrifices of capital to secure this, but, of course, many will not, and this makes it fall the heavier on those who do.

From the specimens here it is seen that the jet may be made into all objects that can be suitably made of, and have hitherto been almost confined to, ivory. It is worth a remark also that the general appearance of Dieppe, where the ivory-carving is the staple manufacture, very much resembles that of Whitby, both in its situation, the quaintness of the houses, and the irregularity of its streets.

The business of disposing of the jet goods is generally done by means of travellers, and the foreign trade through brokers. I think it would be much increased and extended if some enterprising men would open houses in various Continental and American towns, and even at home undoubtedly more would be done if our provincial fancy warehousemen went in for a better class of articles than we see generally displayed in the windows of the shops in our smaller towns.

Since visitors have increased in number, and railway facilities have been more favourable, the trade, as the returns show, has been much assisted, and the amount of business done in the retail department has within the last four or five years been more than quadrupled, and will no doubt continue to increase in a greater ratio, as Whitby more and more fits herself for a fashionable watering place. The beauties of nature in the neighbourhood of Whitby can hardly be excelled in England, and as these become more famous, they will not only be more appreciated, but the jet trade correspondingly helped. Another jet exhibition is contemplated for the coming year, to be held in Whitby during the month of August; and most liberally has a gentleman, whose interests have lately become connected with Whitby, held forth encouragement to the competitors. This liberality is not to cease with next year's exhibition, but he offers £20 for five years, to be awarded to the best workmanship, combined with originality of design. The jet manufacturers themselves have also offered liberal prizes. The gentleman to whose liberality I refer is George Elliott, Esq., M.P. for North Durham, who has also made a liberal offer towards a new building for the Mechanics' Institute, which is only exceeded by another, which is £500, from C. M. Palmer, Esq., towards the same purpose.

I consider these promising features, and I doubt not but that this great and noble Society, before whom I have the honour of giving this paper, will repeat the generous aid they have before given, and we shall find the jet trade advanced in the current ten years more than double, or even treble, that of any former similar period. We shall also be very glad of any aid that the Society of Arts can give towards getting a school of art, and occasionally a portion of that rich store of art which has its home at South Kensington. In awarding the prizes for jet carving or turning, it has been, I think very properly suggested that the gentlemen who are excellent art judges, should at the same time have the aid of a good carver in stone or marble; he would have the opportunity of calling the attention of the judges to the intricacies and difficulties of the work, which, from a practical point of view, he could more thoroughly appreciate and value. This would secure the consideration of the entire merits of the work, and, I am sure, increase the confidence of the artisans, and encourage more of them to send in their work for competition. The exhibitions of jet held in this town, and the cases that have been sent away to larger and more important gatherings of works of art, have undoubtedly done much good; and I am sure that the more this competition is brought to bear on the trade the more will it flourish, and I hope soon entirely put down the spirit of jealousy that still lurks in the minds of some masters respecting the designs, for the only way to get better designs still, is to improve upon the best that can be

obtained, and the more freedom and confidence with which the masters treat each other in this, as in every other business matter, will only result in a benefit to the jet trade as a whole. In putting together the few facts that I have had the privilege of giving in this short paper, I must acknowledge the great help and facilities shown me by the jet manufacturers of Whitby, especially Mr. C. Bryan, who has done probably more than any of the manufacturers to advance the interests of this increasing trade. They are glad to have a matter of so much interest to them brought before this Society. They, as a rule, are very considerate to their workmen, and their workmen in return are as a whole also considerate, so that the feeling between employer and employed is a very happy one—more so, I think, than in most businesses employing so large a proportion of the labour in the same town.

I wish to call special attention to the beautiful medallion, which is the work of E. H. Greenbury, who obtained the freedom of the city. It is a portrait of Sir Walter Scott, in high relief, and is beautiful for its softness and delicacy of work.

Many points of interest I have, in all probability, omitted to mention, but those brought before you I have endeavoured to give in the simplest and plainest form, and if I have raised the least interest in the minds of any gentlemen present, or aided in the least degree the jet manufacturers of Whitby, I shall feel that my humble efforts have not been in vain.

DISCUSSION.

Mr. C. Mast quite agreed that more ought to be done towards encouraging drawing, not only in Whitby, but everywhere throughout the country. But he feared one statement in the paper might be used by the enemies of art education, viz., that which referred to the fact that many of the jet workers, though very skilful in their trade, were utterly ignorant of art knowledge, and even unable to write their own names. The argument would be that men did not need to learn drawing if they could manage so well without. Now, against this false idea he wished to utter a caution, because, although it was true that by early training men might be capable of great mechanical excellence, either in turning or other handicrafts, still such workmen would never do anything to promote art; they might be able to do a given pattern, but nothing further. But something far beyond all this was required—the improvement and extension of artistic designs, and this required sound elementary art teaching from an early age. Boys and girls, too, therefore, ought to be taught drawing in all schools, and taught in a rational manner, not making them mechanical imitators, but leading them to become inventors, to appreciate beautiful forms, and to become tasteful designers. And not only so, but the public also required art education, because it appeared that one great difficulty in the way of manufacturers introducing improved designs was that purchasers did not appreciate them.

Mr. Botley thought the subject a most interesting one, and advised all who had the opportunity to pay a visit to Whitby and inspect the jet manufactories. It was quite true that the trade in jet ornaments was very little developed prior to 1851, and whenever jet was seen it was looked upon quite as a curiosity. It did not seem quite certain whether this particular kind of jet was peculiar to Whitby, but certainly that found there was of excellent quality, and he feared it was very often imitated in inferior material. Mr. Bower had plainly shown the necessity of fostering museums and schools of art, not only in Whitby, but in all other towns, and he really felt that this was a question of national importance. He felt sure, moreover, that any effort of this kind would receive every possible assistance from the Council of the Society of Arts.

Mr. Lockhart asked whether the lecturer did not consider jet to be absolutely bituminous in its nature. He apprehended that was so, and that in the specimens which had been spoken of as being in the form of wood or leaves, or animal bones, these substances had been infiltrated by the molten bitumen, and, under the tremendous pressure of the superincumbent lias, so driven into the pores of these materials as to assume their very form. He should also like to know what was done with the refuse of the jet works, and at what temperature—it would probably be a very high one—the jet would melt, so as to admit of being cast or moulded by pressure.

Mr. J. Jones said that the Turners' Company of the City of London some time ago offered rewards for the best productions in two or three materials, and rather unexpectedly they had some very excellent products from Whitby jet submitted for prizes at the Mansion-house. He was surprised to hear the lecturer on sculpture at South Kensington speak of one of the specimens as possessing great originality and elegance of taste, and considering from whence it came he was rather astonished to hear such commendation bestowed upon it. The result was that they awarded the silver medal of the Turners' Company to one of the workmen of Whitby, who exhibited an ink-stand. He had since heard, however, that it had made the men so proud that they had become rather disorderly.

Mr. Dipnall said the lecturer had dealt with jet almost exclusively as an article of ornament, and had altogether omitted to consider its application as an article of furniture. Being an article which would preserve a lustrous polish, he thought it might be used with great advantage in inlaying wood, and eventually, perhaps, to some extent take the place of ebony. He had visited Whitby several times, and always felt that it presented a rather sombre look from the appearance of mourning in every shop window. He thought it was a trade which must have its limits, but ventured to suggest that there might be further fields into which it might push itself instead of being confined to personal ornaments.

The **Chairman**, in proposing a vote of thanks to Mr. Bower, said that he could not but think that the event would prove a really momentous one for the manufacturers of jet, because not only the paper which had been read, but the discussion also, would be circulated far and wide, and this would tend to strengthen the hands of manufacturers, and do an enormous deal of good. The paper mainly treated of jet historically and statistically, but there was a good deal of other matter which was interesting. It was very true that Whitby had only within the last seventy years become a manufactory of jet, but it was known there long before that time. In the "Polyolbion," of Drayton, part II., page 146, they found it mentioned; and in "Young's History of Whitby" occurred the following quotation from that work:—

> "Let me but see the man
> That in one tract can show the wonders that I can.
> Like Whitby's self I think there's none can show but I
> O'er whose attractive earth there may us wild geese flye.
> The rocks by Moultgrave, too, my glories forth to set
> Out of their crannied cleeves can give you perfect jet."

Amongst the earlier notices of Whitby there would be found letters addressed to Guelph, in "Gent's History of Ripon and Hull," 1734, where reference was made to snake-stones, but no allusion to jet. In the year 1816, when "Young's History of Whitby" was published, the author enumerated the trades of the district, as follows:—Alum works, lime-works, coal-pits, freestone quarries, Roman cement, Prussian blue, paper mills, and oil mills,

but no reference to jet. Few, probably, could carry their recollections further back than himself with reference to articles of jet; and he had brought a specimen of washed jet, which Mr. Bower informed him was one of great rarity; and he had also a small box, turned fifty or sixty years ago, perhaps more than that, of a kind which he was informed was not executed now. In his young days jet ornaments were confined to little bracelets and to necklaces of common beads, the usual appendage being a heart, and to jet rings, or seals to hang on chains. Jet at that time was entirely in its infancy, but since then it had taken rapid strides. The reader of the paper, however, had not quite correctly stated the proportion engaged in the manufacture at Whitby when he said that there were one-third of the population employed in the trade; it would have been more correct to say one-sixth. It was a most important trade, and he trusted it would receive an impetus from that meeting. Some twenty-five years ago Mr. Lough, the eminent sculptor, was at Whitby, and in conversation with him (the Chairman) stated he would try and give the workmen a little instruction in the matter, and for this purpose drew a design of a candlestick, representing a dolphin, but the cost of making the article was so great, being 30s. or 40s., that the workmen said it would be impossible for them to sell articles of the kind, and therefore they could not carry on such works of art. He believed the Whitby jet manufacturers were largely indebted to the Dowager Marchioness of Normanby for her introduction of jet to the Court and higher circles of society. Persons passing along Regent-street would no doubt have their attention struck by seeing "Real Whitby jet;" how much of it was real he could not say, but he feared, like champagne and claret, much was adulterated. Allusion had been made to the desirability of encouragement being given to the workmen; and to further the suggestion he was ready to follow the excellent example of the Turners' Company, and to give, through the medium of the Council of the Society, three prizes, one of £5, one of £3, and one of £2 for the best specimens of art produced by the Whitby workmen. He had much pleasure in proposing that the best thanks of the meeting be given to Mr. Bower.

The resolution was passed unanimously.

Mr. Bower, in reply, said the first question put was with regard to the art part of the subject. It certainly was an important matter that they should teach art rationally and intelligently, especially when they found there were many men and boys able to imitate nature so closely, but still not able to draw or write, for he thought they would have still more beautiful specimens of imitation if they studied nature a little more. With regard to the public taste, he had heard remarks made by some of the workers, that if they made things too like nature they would not sell; therefore he thought much depended on the public taste for the development of the trade. To develop the trade the men must be taught the elements of art, and in the simplest form. If they took the specimens exhibited, and criticised them as works of art, they were all deficient; but as works of mechanical skill they were exceedingly good. With regard to the geological part of the subject, which had been referred to, he might mention that, in one instance, a portion of the root of a tree was converted into jet, the other portion retaining its original structure. Again, in the Whitby Museum there was a specimen, where the outer coating of a bone, to the depth of a quarter of an inch, was converted into jet, the other portion not being so converted. It seemed as if the substance had really exuded from the lias rocks, settled down into crevices, and hardened into jet. Many seams had a sort of core or centre, around which the bituminous stuff had conglomerated. With regard to the waste in the production of jet, he could assure them there was very little waste, the jet being cut up with the greatest economy, nothing being left but a small dust, which was swept up and burnt. It had been suggested that the powder should be mixed with some glutinous substance, and made up again to be worked, but it had never succeeded. With reference to the remark that the manufacture was confined to small ornaments, he could only say that it was found in small pieces, and they could not get a cement to put them together with sufficient closeness to get a large body. When he said Whitby jet was not so brittle a substance as people imagined, he meant it could be got to a fine edge and would retain its sharpness for a considerable time, but this was not the case with Spanish jet, for when it was exposed to the weather the sharp edges would give way at once. The easiest way to tell the difference between the two was to scratch it with a knife, Spanish jet giving a very irregular scratch, whilst Whitby jet would give a nice fine groove. With regard to melting jet, they had never yet succeeded in that; it burnt with a beautiful flame, but did not seem to exist in any intermediate condition.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

The rules for the reception of Foreign and Colonial Goods are as follows:—

1. All Foreign Goods (with the exception of those specified in Rule 2) must be delivered at the East Goods Entrance, in Exhibition - road, on the appointed days, viz:—

Monday,	16th February,	Class 10. Heating by all methods.
Monday,	23rd "	Paintings in oil and water colours.
Tuesday,	24th "	" " "
Wednesday,	25th "	Sculpture.
Thursday,	26th "	"
Friday,	27th "	Fine art furniture; decorative works; stained glass—Reproductions.
Saturday,	28th "	Fine art furniture—Decorative works—architectural designs.
Monday,	2nd March,	Engravings, photographs, tapestries.
Tuesday,	3rd "	Designs for decorative manufactures.
Wednesday,	4th "	Machinery of all classes.
Thursday,	5th "	Class 9.—Civil engineering, architectural, and building contrivances.
Friday,	6th "	Class 11.—Leather, saddlery, and harness.
Saturday,	7th "	Class 12.—Bookbinding.
Wednesday,	11th "	Class 14.—Recent scientific inventions and new discoveries.
Tuesday,	17th "	Class 8.—Machine-made and modern lace.

Foreign wines (class 13) must be delivered punctually on the days which will be announced hereafter.

2. Foreign and colonial commissioners, having annexes, may deliver the goods of their respective countries at their own doors.

3. No packages can be opened except in the presence of the Customs' House officials, unless special permission is obtained.

4. Foreign and colonial commissioners or exhibitors who wish to have an agent of their own present during

the unpacking of their goods must cause him to attend at such hours as may be appointed from time to time by the officers of the Exhibition.

5. To every object sent for exhibition a label, in proper form, must be securely attached. All particulars on the label must be in English, and the number on the label must correspond with the number in first column of delivery order (see rule 6).

For pictures and works of art—Label form No. 19*b*.

For industrial objects and scientific inventions—Label form No. 19.

6. Delivery orders, on form No. 31, containing a complete list in duplicate of all objects sent, must be sent by each commissioner or exhibitor. All particulars must be entered in English, and the numbers in the first column must correspond with the numbers on the labels (see Rule 5). These delivery orders should be sent by post to the Secretary before the 16th February.

During the two weeks ending 6th inst. the following meetings of Committees have been held:—Saturday, 29th Nov., 1873, Sub-Committee for Civil and Mechanical Engineering, Sir John Coode in the chair. Monday, 1st Dec., 1873, Sub-Committee for Architecture and Building Contrivances and Materials, Colonel Wray, R.E., in the chair. Tuesday, 2nd Dec., 1873, Sub-Committee for Sanitary Apparatus and Construction, Dr. W. Hardwick, M.D., in the chair. Thursday, 4th Dec., 1873, Committee for Foreign Wines, Sir D. Cooper, Bart., in the chair.

The *Builder* remarks:—"We wish specially to direct our readers' attention to an advertisement from her Majesty's Commissioners as to the department of architecture, building contrivances, and materials, including cements, concretes, and plaster, in order that they may be induced to assist in forming an adequate representation of the section. A meeting of the sub-committee to whom it is intrusted was held on Wednesday, the 10th inst., at Gore Lodge, Colonel Gallwey, R.E., in the chair, when Colonel Wray, Major Du Cane, Mr. Grissell, Mr. George Dines, Mr. T. Roger Smith, Mr. Grant, Mr. Kirkaldy, Mr. Godwin, and others, also attended. It was determined, amongst other things, that facilities should be afforded exhibitors for testing new materials and processes. It was much desired that foreign materials and modes of construction should be well represented, and it was hoped that the foreign commissioners, through whom everything from abroad must necessarily come, would take steps to make this desire known. From France much that is valuable might be sent. If M. César Daly, M. Adolphe Lance, or M. Charles Lucas, for example, would move in it, most interesting means of comparing the building appliances and modes used in the two countries would doubtless be obtained. Intending exhibitors at home should send notice at once.

A new adaptation of a kiln to glass-staining, perfected by Mr. Small, of Edinburgh, is said to enable the art to be performed on very large surfaces of the ornamented material, which, at the same time, retains its original polish, all previous attempts having destroyed the rough surface of the glass. Very pleasing delicate shades are, it is stated, produced on the glass, one portion only of which need be coloured; but the deep, rich colouring of church windows obtained by the common mode of leading, cannot yet be effected by the new process.

A new method of utilising slag has been announced from Osnabruck. It is reduced into grains by being made to fall while hot into water from a height, as small shot are made, and is then used as railway ballast, or to mix with concrete; when, however, it contains sufficient alumina, it is manufactured into alum.

Actual experiments show that water which remains overnight in lead pipes in New York contains 1·10 of a grain of lead to the gallon.

THE EARLY HISTORY OF THE SEWING-MACHINE.

The sewing-machine is now so common an appendage to most houses that it seems almost difficult to believe that practically its employment only dates back some twenty years. In the 1851 Exhibition there was not a single machine of the sort now used. Yet, recent as the invention is, there is a great deal of uncertainty as to the person to whom the credit for it is due. Naturally enough, in such a matter, the possessors of rival systems are anxious to claim priority each for his own method; and the question, "Who invented sewing-machines?" has been argued with considerable bitterness both here and in America. Quite recently the matter has—for the present, at least—been decided, so far as relates to the first maker of a sewing-machine. A member of a firm of American sewing-machine manufacturers lighted on an English patent, granted to one Thomas Saint, in 1790, in the specification of which a sewing-machine was described. The patent was granted for a method of making boots and shoes, and the machine was intended for use in that manufacture. So far as can be judged from a rather meagre description and drawing, the machine worked the chain-stitch with a single thread. An awl and a needle were mounted parallel to one another, in a position similar to that now occupied by the needle in modern sewing-machines, and the needle was apparently notched at the end, to receive the thread and push it through a hole formed by the awl at the stitch preceding. There was a catch under the fabric, which held the loop of the thread when driven down by the needle, until the needle made a second stitch through the loop. There was also a feed-motion for carrying the article to be sewn through the machine on a slide to which it was attached; and it may be remarked that such a device would be better suited for stitching small articles, like boots and shoes, than for producing a seam of any length. It was worked by a winch-handle on a spindle on which were tappets that engaged with pieces on the sliding-arm carrying the needle. Such appears to have been the machine, which there is every reason to suppose may have worked practically enough. That its existence should never have been discovered before is decidedly very strange, considering the numerous and extensive searches that have been made through the records of the Patent-office in connection with this subject. Had the index referring to the "old-law" specifications (before the Patent-law Amendment Act, 1852) been prepared on the system now applied to the current indexes, of course such an invention could not remain hidden; and the incident offers another argument in favour of the speedy preparation of a new index. Such a work has, it is believed, been long under consideration, and the sooner it is actively taken up the better.

To say that such an invention as this could invalidate any of the patents for the sewing-machines now in use is certainly preposterous; but it is very curious that this Thomas Saint should have gone so near the mark, and that his invention should have fallen still-born at the time, to be revived, in many of its principal features, nearly a century later.

But Saint's is not the only old sewing machine that has escaped the notice of most writers on the subject. There exists an early French patent, taken out apparently by two Englishmen—for the names Stone and Henderson are certainly not French. In the "Description des Machines et procédés spécifiés dans les Brevets d'Invention," is given a specification bearing date February 14, 1804, and headed by the above names. The patent was "For a new mechanical principle, intended to replace hand-work in joining the edges of pieces of all descriptions of flexible matters, and specially applicable to the making of wearing apparel." This machine was intended to imitate hand-sewing, and in it an ordinary needle with an eye at the end was used, and this was worked

by two pair of jaws, one on each side of the fabric, which passed the needle from one to the other, turning it over every time to bring the point against the fabric. Only a needleful of thread at a time was employed, and the needle was drawn to a constantly diminishing distance every stitch, to allow for the decreased length of the thread. When the thread was used up, the machine had to be stopped and a freshly-filled needle introduced. If required, more than one needle could be employed at the same time. It seems as if the fabric was to be automatically fed through the machine, but whether this is so or not does not very clearly appear. In fact, spite of the fulness of the description, it is not very easy to understand the exact construction of the apparatus, though the above may serve as a brief sketch of it. The specification concludes with a description of a circular building in which a number of these machines could be arranged so as to be worked from a central vertical shaft.

Next to these, in chronological order, comes an American invention, by Adams and Dodge, of Monkton, Vermont, who produced a sewing-machine of some sort in 1818, but little is generally known of it. In the same country it appears that Walter Hunt, in 1834, made a true sewing-machine, but as the history of his invention is mixed up with that of Howe's machine, it may be left for the present, after the fact is mentioned that such a machine was really made, for of this there seems no doubt. In England we do not find that any true sewing-machines were made in the early part of the century. There are, indeed, several patents for embroidering machines, which, with a little alteration, might certainly have been made to sew. However, such an idea does not seem to have occurred to any of the inventors, and none of the machines were developed in this direction. Of them Duncan's machine (1804) is the oldest. It worked the chain-stitch on the surface of the fabric, and might, of course, easily have been adopted to sew together two pieces of stuff, in the same way precisely as the single thread machines now work. There were also a good many inventions, both in this country and America, in which a "basting stitch" for running fabrics together was made. Some of these were largely used for manufacturing purposes, until the introduction of the present sewing-machine. But we may leave these abortive attempts—few of which, as far as it is known, ever got beyond the Patent-offices of the various countries—and turn to the originals of the machines now in daily use.

It appears certain that the first man to construct and bring into actual use the machine was Barthlemy Thimonnier, a poor French tailor. Of this man not very much is known for certain. He was born in 1793, at Abreste, and was the son of a journeyman tailor of Lyons. In his trade he probably found hand-work expensive and slow, and was thereby induced to try and contrive some mechanical means for replacing it. In the end he certainly produced a wooden machine which sewed the crotchet or chain-stitch, and worked freely. This was in 1839, at St. Etienne, where Thimonnier was then living. Of his previous life next to nothing is known, but from that time forward his history is pretty clear. At St. Etienne the machine was seen by an engineer named Beaunier, and he persuaded Thimonnier to bring his machine to Paris. Spite of his mechanical ingenuity, the tailor seems to have been but a feeble-minded individual, and Beaunier apparently took up the matter, and did for Thimonnier and his machine far more than the latter could ever have done for himself. A firm was soon established, under the title of "Ferraud, Thimonnier, Germain, Petit, and Cie.," and a factory set up in the Rue de Sèvres, and here, in 1841, eighty wooden machines were at work on a contract for army clothing. At last the sewing-machine was completed and at work. But in the same year the machines were attacked and destroyed by a mob of workpeople, and the inventor himself was obliged to leave the capital. For some years Thimonnier does not seem to have had much success with his machine, but in 1847 or 1848 he got M. Magnin, of Villefranche, to take it up. An English patent was taken out in Magnin's name in 1848, and this was eventually sold to a Manchester company. Strangely enough, the machine attracted but little notice in this country. It was exhibited at the Royal Institution, where it formed the subject of a lecture, but very little practical good seems to have resulted. In the same year (1848) another workshop was set up in Paris, but the same fate befell this attempt as the former. In the troubles of that year the machines were again destroyed. In 1851 a machine was sent to the Great Exhibition, but it arrived too late to be catalogued, and so almost entirely escaped notice. After this we do not hear of any further attempt to bring forward the machine, and the unfortunate inventor died a pauper, in 1857, at Amplepuis.*

His machine worked the chain-stitch with a hooked needle; the thread was below the fabric, and the needle above it. The needle passed through the fabric, and drew a loop through from below, then passed again through the fabric, and drew a second loop through the fabric and the first loop, thus making a crotchet-stitch on the top of the seam. The fabric had to be moved by hand. The machine is said to have attained a speed of two hundred stitches a minute. It is noticeable that this principle has never been further improved on for sewing machines. All existing chain-stitch machines resemble rather the old one of Saint, in having a thread carried by a needle above, and a catch below for holding the loop until the needle descends again to pass a second loop through the first, and so secure it. The ingenious rotating hook of the Willcox and Gibbs' machine is the latest and by far the most beautiful development of this idea. This, it may be mentioned in passing, was the invention of a Virginian farmer, named Gibbs, who was led by curiosity to speculate on the subject, and hit upon the device.†

But we have not yet got to the real sewing-machine of our own days. Thimonnier had practically brought out a machine, but his invention had not taken real hold on the public, and had his efforts not been supplemented by those of a superior mechanical genius, the sewing machine might yet be unknown.

It was in America, after all, that the machine, as we now know it, was first made. Elias Howe is the man with whose name the origin of the sewing machine must ever be connected. The exact amount of credit due to him it is now impossible to decide, nor, indeed, can it ever be precisely known. There are two stories about his invention, one upheld by the present possessors of the Howe machine, and the other by the rival owners of the "Singer." Naturally enough each side is prejudiced in favour of its own version, and we may safely conclude that the truth lies somewhere between the two. All that the historian can do is to try and collect the facts so far as they are not disputed. The case for each side has been stated in two able and well-written articles —one in the *Atlantic Monthly* for May, 1867, and the other in the *New York Galaxy* for August in the same year. The former gave the Howe version, and the latter that maintained by their rivals.

Elias Howe was a native of Spencer, in Massachusetts, and was born in 1819. It is stated that the idea of a sewing machine was first suggested to him in 1839, by a conversation in a Boston instrument maker's shop. For five years he worked at his invention, till at last, after trying and rejecting many plans, he hit on the double thread, one above the fabric and one below it, the lower one to be carried through the loop of the upper thread

* A very full description of Thimonnier's machine will be found in Newton's *London Journal* for 1852, vol. 39, p. 317, where an interesting account of the "labour-saving machines" in the 1851 Exhibition is given.

† Full description of this and other machines will be found in a paper read before the Society in 1863, by Mr. E. P. Alexander, *Journal*, vol. xi., p. 358.

by a vibrating shuttle. In 1845 a working model of the machine was finished. In the following year an improved machine was finished and patented. Still Howe was very poor, and it was only by the help of a friend, George Fisher, who joined in partnership with him, that even this step was gained. He had no means of bringing his invention forward, and nobody seemed inclined to take it up. This induced him to bring his invention over to England, where he sold it to Mr. Thomas, a staymaker, in Cheapside. An English patent was taken out in Thomas's name, in 1846, but it was found that considerable alterations were required before the machine could be considered a practical success. One of the principal of these was the feed motion, invented by Johnstone.

Such is a brief outline of the history of Howe's invention. Now comes the great question as to the originality of that invention. It seems proved beyond any reasonable doubt that, in 1834, an inventor named Walter Hunt had constructed a machine on precisely the same principles as Howe's. There was a curved needle with an eye in the point and a shuttle; in fact, the machines were in their main points identical, but whether Hunt's was a practical working machine cannot now be said. Hunt sold his machine, and with it his patent-rights, to one George Arrowsmith, who, however, neglected to patent it, and so nothing came of it; nor did Hunt himself attempt to develope his invention. He was one of those eccentric geniuses who are always striking out new ideas and never following them up. His sewing-machine was only one of a host of ingenious but undeveloped inventions, so that there is nothing strange in the fact that he should thus have forgotten what might have been a source of wealth and credit. When Howe was first bringing forwad his invention, an account of this abandoned machine came into the hands of Isaac M. Singer. He looked into the matter, got hold of one of the original machines possessed by Arrowsmith, and caused Hunt to reconstruct one on the same model. The natural issue of there being thus two rivals in the field was that there was considerable litigation, into the details of which there is no need to enter here. The end of it was that Singer agreed to pay a royalty to Howe, and thus the dispute ended.

That Howe had ever heard of Hunt's machine there is no evidence whatever to show, and it may be considered certain that the similarity of the two machines was purely accidental; indeed, the original Hunt machine is said to be in some respects superior to Howe's first apparatus, and this alone disproves any allegation of plagiarism. Looking at the matter with the fairest impartiality, it may be said that Howe was not the first man to conceive of a lockstitch machine, but he certainly was the first to bring it really before the public. After all, it is not the man who first developes an idea, but he who first turns an idea into practical use and benefit, that is the real benefactor of his race. This Howe did, and in that sense he must be held the real father of the sewing-machine.

One other curious fact remains, which it may be worth while to mention, and that is, that in 1844 a machine, which was really a sewing-machine, was made and patented in England.

In December, 1844, Messrs. Fisher and Gibbons, of Nottingham (of whom the former was the inventor), took out a patent for "working ornamental designs on lace or net and other fabrics by machinery, in such manner that two threads are caused to loop together, one thread passing through the fabric and the other looping therewith on the surface, without passing through the fabric."

It is not necessary to describe the machinery by which this was done. Suffice it to say there were two needles, one on each side of the fabric, and one curved and the other straight. After giving a description of this machinery, the specification of the patent goes on to describe other machinery for "sewing thread, yarn, gimp, cord, or fabrics in pattern on the surface of fabrics." This machinery is "similar to the preceding, except that the upper needle and loop-guide are removed, and instead thereof a shuttle is used, carrying a thread, gimp, or cord. A reciprocating motion is imparted to the shuttle, so that at each ascent of the needle it will pass between the thread and the bent part of the needle, leaving its own thread, which is sewed or fastened down by the thread of the needle, on the latter descending. When the needle again rises, the shuttle will pass between the thread and needle in the opposite direction, leaving its own thread as before, and so on until the pattern is completed. If desired, a second fabric may be placed on the fabric to be ornamented, and, when sewed together, the former may be cut away between the figures or patterns."

If this was not a true sewing machine, what is? After Howe's invention became known in England, Fisher altered his machine, and made a sewing-machine of it, while, even as it was, it was sufficient to invalidate Howe's (or Thomas's) patent, parts of which were accordingly disclaimed.

We have now reached the time when the attention of mechanicians began to be turned to the sewing-machine, and numerous inventions were in consequence brought forward. One of these is noticed in the following, which appeared in the *Journal* of July 1, 1852:—"Sewing by Machinery.—A machine, of American invention, has been introduced into this country by Mr. Darling, of Glasgow (at whose manufactory numerous examples of it are now in operation), which carries the mechanical principle into a fresh department of human labour, namely, that of common hand-sewing. The machine is extremely simple in construction. Its framework is of cast-metal, and it occupies little more space than two cubic feet. The right hand of the worker turns a small wheel, which puts in operation two needles—one an upright needle, the other a sort of semicircular one; and on a strong tabular surface, at the left-hand extremity of which these two needles work—the upright above and the circular under—the cloth is laid with the left hand, and propelled between the needles as the machine proceeds with its stitching. It is said that the machinery is not liable to become deranged, and that any breakage of the thread can be rectified with very little loss of time. The machine can be driven by the foot, after the manner of a turning-lathe, and in this way the rate of work by hand, which is 500 stitches per minute, would be doubled." Many such appeared about the same time, but as the object of this article is merely to sketch the early history of this remarkable invention, a period has been reached at which it may fairly conclude.

The total length of all the Russian railways at work on the 1st of July last was 13,911 versts, or Russian miles, or 9,159 English miles. At the date of the last official return, 1,244 kilometres of railway were being worked in Turkey. In both countries great progress is now being made in the making and opening of new roads.

The production of coal in Germany is steadily extending. Advices recently received from Brussels state that the extraction effected at the Saarbruck mines in October was the largest ever realised in any single month, having amounted to 404,604 tons. The consumption of German coal is extending in France, Belgium, and Holland.

It is stated that a gentleman of San Francisco will soon establish a technical school for the instruction of boys in the use of tools for working both wood and metal. The course of instruction is to combine theory and practice.

The total number of net tons of iron and steel rails made in the United States in 1872 was 941,992, or 841,064 gross tons. This aggregate was produced in sixteen States.

The Inspectors of Mines report that they compute the quantity of coal raised in Great Britain in the year 1872 at 123,393,853 tons, an increase of 5,954,602 tons over the quantity in the preceding year.

CORRESPONDENCE.

PROPOSED TRANSFER OF SOUTH KENSINGTON MUSEUM.

Sir,—The decision of a matter of the highest national importance is now pending. I refer to the transfer of the South Kensington Museum to the control of the British Museum trustees.

The South Kensington Museum was instituted to meet a want which the British Museum never supplied. The latter concerns itself only with the world's history, the former considers the history of art. I know that many objects which are found in the British Museum collections are of the highest art value, and I am also aware that many objects which have found their way into the Kensington Museum are of more interest as antiquarian specimens than as art objects.

National feeling is, to a large extent, due to the publicity which attaches to the manifestation of an idea. Pageantry has in all ages been employed to impress the idea of sovereign nobleness, and in many countries, and in various ages, pageantry has played a conspicuous part in expressing the grandeur of religion. If we want art to shine in our midst it must have its shows,—a National Gallery; a Royal Academy Exhibition; a South Kensington Museum.

In one sense pictures are simply antiquarian objects, yet they are not associated with the antiquities of the British Museum. Art has special ends to serve, it must therefore have its special shows.

The South Kensington Museum I regard as simply one of the means whereby we seek to give art education to the people; but as an outgrowth of the School of Designs, it should especially minister to the progress of art as applied to industries. First, persons (perhaps every member of the community) should be taught to draw; this work of teaching tho department of art (which has had its centre at South Kensington Museum) has been entrusted with. Persons having learned to draw will now divide into three sections. One section will become pictorial artists; these will pass from Kensington, or the branch drawing-schools, to the Royal Academy of Arts. Another section will become ornamentists, but of these I will speak in detail; and another, and much the larger section, will return to the world which lies outside of art—to professions, commerce, &c.

Ours is a commercial country. Were we deprived of our commerce we should be reduced to beggary. Our commerce consists largely of goods of home manufacture, and to a great extent of fabrics or objects to which art is applied. Fabrics, and indeed objects of all kinds, if without pattern, have a fixed approximate market value. Art has no fixed value. Pattern, if the work of a great ornamentist, or if of peculiar merit, may lend to a fabric a value quite independent of the cost of production, and altogether beyond what it would have either if plain or of inferior design. The same clay can be formed as a common flower-pot, or as a tazza or vase worth many pounds; but, in order to its value the clay must become the instrument by which art is expressed. The wise legislator is he who affords every opportunity for the exaltation or ennoblement of matter, so that wealth can be brought to a country with the smallest possible expenditure of native material.

I have never thought that the South Kensington Schools do what they might do, nor what they should do, to render service to the manufacturer. They are drawing schools, and not great national *ateliers* of ornament and applied art. The worthy "art superintendent" is a pictorial and not a decorative artist, and every master in the central schools is a painter in greater or lesser degree, and not an ornamentist. I am not making derogatory remarks, for pictorial art is as great as ornamental art, and, if rightly understood, ornamental art is as great as pictorial art, for both require the entire and undivided energy of a life in order to their high development; and both forms of art afford an equal outlet for scholarship and knowledge. Decorative art is that which associates itself with our vast manufactures; and to decorative art we must look for the continued realisation of national wealth, rather than to pictorial art, and, as matters now stand, the wise legislator will use every means of strengthening, rather than to weaken or destroy, the means whereby ornamentists are to be raised in our midst.

I urge strongly that a high school be formed for the training of ornamentists, in which knowledge of the higher branches of ornamentation be taught; where, indeed, art such as is capable of application to our manufactures be pursued as a "high art"—in fact, a Royal Academy of decorative and applied art.

This becomes a necessity. America almost ceased to procure carpets from us two years since, while it was a large consumer of such goods, and now America is asking for "reports on design" in relation to the recent Vienna Exhibition, and is holding out inducements to English ornamentists to work for her, and teach her. Germany has taken much of our "rep" and "damask" trade, and bids fair to take more. Unless our patterns are better than those of foreign countries we have nothing to expect but the ultimate decline of our manufacturing industries. Machinery is now no English monopoly; labour is dear, rather than cheap, with us, so how can we hopo that other nations will continue to patronise our markets and to pay the cost of transit, and, perhaps, import duty, unless we excel in art.

The English, I unhesitatingly say, are an art people. The Puritans washed out our art, but between the times of the International Exhibition of 1851 in London, and that of 1867 in Paris, we made great strides in our knowledge of art, but this was due to the exertions of only a few men; but since 1867, judging from the various national exhibits made in Vienna this year, we have been utterly beaten in art as applied to certain manufactures. Austrian carpets were before ours, and in silversmiths' wares and enamels we were lamentably behind.

With these facts before us, can it possibly be expedient to transfer the conduct of an institution which should minister to the most vital wants of the nation, and which needs progressive re-organisation with the view of meeting further wants and fulfilling a higher mission than that which it has yet fulfilled, to a stationary and inactive body such as constitutes the government of the British Museum. To me it appears that a greater folly could not be committed. Our wealth is derived especially from our manufactures: if these do not progress national poverty must be the result. Let us have by all means individual responsibility, and, so far as we can, the right man as the head, not merely of the entire institution, but of each of its important departments, and then, by a liberal but judicious expenditure upon art education, national progress and national wealth may be long continued.

I have trespassed unreasonably on your space, but the matter on which I write is of the greatest national importance. I have also knowledge of English and French manufactures, and of the wants of British manufacturers, as you are aware. In this letter I have endeavoured to embody not only my own feelings, but also what I believe to be the unanimous opinion of the manufacturers of England.—I am, &c.,

Ch. Dresser, Ph.D., &c.

Tower Cressy, Notting-hill.

PRESERVATION OF MEAT.

Sir,—Your *Journal* of November 28th contains an interesting account of the alleged causes of the failure of Mr. Harrison's experiments in the great question of meat-preserving.

The discussion that ensued upon the reading of Mr. Harrison's paper brought out most vividly the defects of his system.

Surely Professor Gamgee's remarks on the unnatural process of freezing the meat are sufficiently to the point in discovering the real source of error. What does he say but, "This leads every meat preserver to look upon the freezing of meat as the very thing he ought to avoid."

Mr. Harrison's reply to this observation appears to acknowledge the correctness of the Professor's views, and consequently to throw over the freezing theory.

Now what is wanted is the means of keeping the temperature very low and the atmosphere very dry. These two things being accomplished, Nature herself will do the rest.

For some time past experiments have been made of the "Dry Cold Air" system, by which it has been proved that it is possible to preserve meat for any reasonable time in better condition than that of fresh-killed meat. By this system it is not possible for any moisture to accumulate, and thus the meat, with all its natural juices, is preserved thoroughly fresh and good. The vital importance to all classes of this question is my excuse for troubling you with this letter.—I am, &c.,

Edward Hart.

December 9th, 1873.

ON MECHANICAL PROCESSES FOR PRODUCING DECORATIVE DESIGNS ON WOOD SURFACES.

Sir,—Will you permit me to supplement my paper "On Mechanical Processes for producing Decorative Designs on Wood Surfaces" with a few observations. Some misapprehension seemed to exist respecting the designs which the Council have kindly permitted me to exhibit on the walls. These are not by my new mechanical process, but are partly intended to show certain effects which this process might produce if extensively carried out; and also to illustrate the artistic use of deal, both as a ground for designs and by a harmonious contrast to colours. They were not invented for the situation which they temporarily occupy, and therefore are not intended to illustrate my observations on the vital importance of decorative fitness. With Dr. Dresser's remarks upon the absurdity of excess in ornamentation I cordially agree; and I think that my reiterated recommendation of the Greek painted vases of the best period as perfect objects for study, but not for slavish imitation, will exonerate me from ignorance on that branch of the subject at least. Nor, in connection with these vases, were my remarks on the distinction between pictorial and decorative art irrelevant. My dissertation on Gothic and Renaissance art tended to show that those styles were natural styles; that is, they were characteristic of the races producing them, and the circumstances calling them forth. An unstrained inference is that, in our altered circumstances, some modification, instead of mere reproduction, of these styles might, artistically and nationally, be beneficial. I am aware, too, that in the present day a work produced for the sake of art, and a work produced to sell, stand often upon very different bases. The latter should proceed from, and seek to draw forth, emotions of the highest intelligence; the latter may sink level with the lowest. The mechanical process, to which the Society of Arts has enabled me to give publicity, is extremely simple, but it produces results entirely new to decorative art. It is a combination of stamping, printing, and staining. Let the colouring matter be, as in the specimens shown, chemically durable, and the design will neither fade nor wash off. The hieroglyphics on the Egyptian wooden mummy cases (British Museum) are as fresh as when painted four thousand years ago. Designs produced on wood now with the same simple pigments may, protected from damp and worm, last as long.—I am, &c.,

Thomas Whitburn.

GENERAL NOTES.

National Training School for Cookery.—The Marquis and Marchioness of Westminster have subscribed a hundred guineas in aid of the establishment of the National Training School for Cookery. Subscriptions may be paid at the London and Westminster Bank, 1, St. James's-square.

Preservation of Meat by Cold.—A series of experiments is now being conducted in Paris, under the direction of a committee of the Academy, with regard to this mode of preserving meat. The experiments are being made on the premises of M. Tellier, at Auteuil.

Coal Cutting Machines.—The Midland Institute of Mining Engineers have held a meeting at Barnsley, at which the question of coal-cutting machinery was discussed. It was resolved that the Council of the Institute and a committee of twelve members should be appointed to inquire into and report upon the merits of various coal-cutting machines. The sum of £50 was voted from the funds for expenses, and it was intimated that in the event of any deficiency of funds the district coal-owners would doubtless make it good.

Conflagrations in Cities.—A curious circumstance was noted by an observer, Mr. N. M. Lowe, during the great fire at Boston last year. He found that at places where a small street entered, but did not cross, a larger one, it frequently happened that a current of air was generated which carried the flames across the wide street at the point of junction, and fired the opposite buildings, even though that whole side of the street except at that point was not affected by the fire. Owing to this a wide street did not always offer as certain a check to the progress of the conflagration as might have been expected.

New Use of Gas.—Mr. Baker, Inspector of Factories, notices in his report, recently issued, that gas-engines are coming into use in various trades, particularly for small letter-press printers and riband weavers. It is a cheap and easily applied motive power, whenever a solid foundation for the engine can be obtained. In the neighbourhood of Coventry, he observes, steam-power forming a considerable element of expense in the weaving of ribands, the gas-engine has been applied to do the work of boys of 13 or 14 years of age, who used to turn the machinery, and the invention is acceptable, as relieving labour of some part of its fatigue.

NOTICES.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

INDIA COMMITTEE.

The Conferences on the threatened famine in Bengal, and the means of preventing or alleviating famines in India, adjourned on Friday last, will be renewed this evening (Friday, 19th inst.), at eight p.m. Lord Napier and Ettrick, K.T., will preside.

Members are entitled to attend these conferences and to admit two friends to them.

The report of last week's meeting will be published in the next number of the *Journal*.

MEETINGS FOR THE ENSUING WEEK.

Mon.....Medical, 8.

Tues....Civil Engineers, 8. Annual General Meeting.

Fri......Quekett Club, 8.

Sat......Royal Institution, 3. Prof. Tyndall, "On the Motion and Sensation of Sound." (Juvenile Lectures.)

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FRIDAY, DECEMBER 26, 1873.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

NATIONAL TRAINING SCHOOL FOR MUSIC.

It was not possible, under the exigencies of time and space, to publish in last week's *Journal* as complete a report of the speech of the Duke of Edinburgh on the occasion of the foundation of a National Training School for Music, as the importance of that speech demanded. The full text, which shows His Royal Highness's comprehensive views of the scope of the school, is consequently now given. His Royal Highness said :—

Ladies and Gentlemen—Convinced as I am of the national importance of the work which has been this day commenced, and interested as I am in its success, I feel very much gratified at having had the opportunity of being associated with the proceedings of this day. You have heard the report read by the Rev. Canon Brookfield, which sets forth the history and condition of this undertaking at the present time; but there are a few words which I should like to add. Very naturally many will raise the question, "Why should we establish a National Training School when there already exists the Royal Academy of Music?" This Royal Academy of Music, which has existed for half a century, has done much service, and the benefits arising from it none can doubt, for many of our most distinguished composers and musicians have been its members. There was a pause in the labours of the Society of Arts, and those labours have now extended over about fifteen years, but there was a pause which occurred at my own suggestion on account of a thought on my part that the two institutions might have been united into one. I myself undertook a negotiation with the Royal Academy of Music with that view, but after some considerable time had been spent in them, we found that the principles on which the two institutions were founded were so far apart, that it was not advisable that they should be united into one. The Royal Academy has but very few free scholarships for those who have displayed a knowledge and aptitude but have not means; the fundamental principle of the school we are assembled this evening to celebrate the foundation of is the free scholarships for all ranks of society. As Mr. Brookfield has read, nearly every county in England, and many in Scotland, Ireland, and Wales, as well as many places in the colonies, have given us the prospect of scholarships, and I have now the pleasure of announcing some others. Her Majesty the Queen proposes to found a scholarship of £50 a-year. The Prince of Wales proposes to found another also of £50 a-year; and I hope to be permitted, as chairman of the committee, to do the same also. Those scholarships having been established, and bearing in mind the best of the rules in force in the continental conservatoires, I think we shall be able to afford to the students of the new school a really excellent musical education, and not only that, but also an education in history, languages, elocution, and deportment, which are absolutely necessary for all musical education. I beg to return my sincere thanks to the proposer and seconder of the vote of thanks, which, ladies and gentlemen, you have so kindly awarded me, and I beg to propose a vote of thanks to the Society of Arts, which has laboured these so many years to bring this matter to the commencement we have made this day. It is a society which for 100 years has laboured to promote the arts, and I think music may be placed among the foremost of the arts.

It should also be added, that not only—as stated last week—was the assistance of the ladies who sang at the concert on the 18th inst. gratuitously given, but the gratuitous services of Mr. Barnby (who conducted), of Dr. Stainer (who presided at the organ), and of the Royal Albert Hall Choral Society, have also to be acknowledged.

FOOD COMMITTEE.

A meeting of this Committee was held on December 17th. Present—Mr. Benjamin Shaw (in the chair), Mr. F. A. Abel, F.R.S., Sir Antonio Brady, Lord Alfred Churchill, Major-General F. Eardley-Wilmot, R.A. F.R.S., Mr. Seymour Teulon, and Mr. James A. Youl. The Committee had before them specimens of meat sent by Mr. David Urquhart, preserved by a process of desiccation, at a low temperature, by means of a vacuum; also specimens of meat from Australia, preserved by Fryer's patented process; also specimens of meat from South America, sent by the Meat-Preserving Company.

ECONOMICAL USE OF FUEL.

The testing of stoves sent in for competition for the Society of Arts' prizes will commence shortly after Christmas, half of the testing rooms being nearly completed. Due notice will be sent to each exhibitor of the time when his stove will be tested. A large number of stoves have been received, the number of competitors being 104.

PROCEEDINGS OF THE SOCIETY.

INDIA CONFERENCE.

A Conference on "The Threatened Famine in Bengal, and the means of preventing or alleviating famines in India," was held on Friday, December 12th, Lord Napier and Ettrick, K.T., in the chair.

The Chairman, in opening the proceedings, said the subject for discussion that evening was one of very deep interest, and of the greatest possible difficulty. The features and bearing of an Indian famine could only be grappled with and apprehended by persons who had either been in India, or had made the affairs of that country their special study, and its features were so much affected and modified by local incidents and circumstances, that a person who might be competent to deal with these phenomena in one part of the country might be quite

unable to do so in another. It was very satisfactory, therefore, to him to find himself surrounded, as he was that evening, not only by persons who had spent years in India, and who were familiar with its interests and concerns, but by those who had distinguished themselves in its administration—who had had experience of different parts of the country, and of the wants and peculiarities of the various presidencies and provinces. He might take upon himself to say, in approaching the discussion of this subject, that gentlemen who were about to address the meeting were certainly not in any degree disposed to incriminate or criticise the course pursued by the Indian Government, nor even to address themselves to the duty of instructing those who were now practically concerned in Indian administration in any spirit of confidence or presumption. The meeting was summoned simply to discuss this question, in order to exhibit to the English public its various lights and bearings, to manifest their deep interest in the welfare of the people, with whom many present had been intimately connected, and to stimulate the interest which already existed in the great calamity with which India was threatened. At the same time, he trusted that out of the conflict of opinions and views which might be expressed, something of value might be elicited to those who were actually engaged in the duty of endeavouring to grapple with this great evil, or who might be similarly engaged hereafter. It was with great satisfaction that he reflected, in looking at the present state of affairs in Bengal, that there were on the spot two such men as Sir George Campbell and Lord Northbrook. Sir George Campbell was remarkable both for the originality and activity of his mind and for his sympathy with the masses of the people amongst whom he had lived, and whose habits and customs he had studied; in fact, he had had as great experience of the affairs of Bengal as any man now living. At the same time, in the Viceroy England possessed a statesman, firm, discriminating, and calm, and one who would deal in an eminently judicious and statesmanlike manner with the social problem placed before him. He now begged to call on Sir Bartle Frere to open the discussion.

Sir Bartle Frere, G.C.S.I., K.C.B.—My Lord, Ladies, and Gentlemen,—The first thing that strikes one in dealing with a subject of this kind is the great difficulty of taking hold of any salient point which shall not disturb the proportions of other parts of a subject so vast and complicated. I would rather try and begin by specifying what I do *not* intend to attempt. This evening I shall not attempt anything like a historical discussion of famines. There are some points of very great importance which might be derived from a historical retrospect of what we know of former famines; but there are only one or two features—or perhaps four altogether—to which I would beg your attention, and which you may verify by reference to the accounts you will find of any previous famine. The first is that years of scarcity and famine in India, as I believe is the case elsewhere throughout the world, never come singly. There is something connected with the variation of the seasons which is apt to make these years of scarcity which end in famine always come in cycles, and it is important to notice this, because you cannot really tell whether you are at the beginning, or in the middle, or towards the end of a series of years or seasons of scarcity, any one of which may end in actual famine. Then there is the second point, which it will be well to notice, and it is that the famines have become more rare and less severe in late years in India, but they are by no means uncommon there or in any other parts of Asia. I believe I may say that, during the time I have known India, and been interested particularly in Asia, there has been no time when you might not have said that a famine was either scourging a country, or impending, or departing, either from some part of India itself, or from some country in very close connection with it. Then there is a third fact to be noticed, and that is, though famines are less frequent in Bengal, owing to the very fine soil, and to the very abundant and regular rains, yet when they do occur there they appear to be more severe than in any other part of India. Some of the greatest famines of which we have any record appear to have invaded Bengal, and, if time admitted, it would not be difficult to show, from the character of the people and the country, that it must necessarily be the case, that, if less frequent, they are, when they occur there, more severe. Lastly, there is a fourth historic fact which should be noted, that the mortality from starvation continues long after the actual want of food has been supplied, so that you must not conclude that when you have supplied food to the starving multitude the results of starvation will have ceased to operate. Not only every form of disease, but a gradual shortening of life from starvation occurs there and in other parts of the world whenever the usual quantity of food necessary for healthy existence has been seriously curtailed. But the point to which I would wish to direct your particular attention is, what are the reasons why death from the want of food is much more frequent in India than in our own country. We all know that here in populous, wealthy London death from starvation is not unknown. Why is it that it occurs only singly and in occasional cases in London, and why does it occur by thousands and occasionally millions in India? I think if you will allow me to notice the particular causes which appear to give England its immunity from famine, and to contrast the condition of India with England in those particulars, you will arrive at some conclusions of considerable practical value. But in the first place let me remind you that for this, as for all very great phenomena, political or social, no single cause can be ascertained. We are all of us very apt to pitch upon some single cause for every evil which exists; but we shall find in this, as in all other cases, the causes are numerous and very complicated. Among the first causes in the immunity of England from famine of course we are struck by its superior agriculture, the greatly improved agriculture of every part of these islands, which has in various ways made the farmer and the cultivator so much less dependent than in less advanced countries upon the seasons and upon the natural fertility of the soil. We have everywhere not only an improved but a very varied agriculture, and this it is necessary to note, because it is in this respect you will find it is very different from a great part of India. We know that in England if grain is a short crop, roots make up for it, or, perhaps, hay pays the farmer's rent, and very often the shortest crop gives in the long run the best results, owing to the increased prices. This is one of the causes of the comparative immunity of our farmers from the severe sufferings which the Oriental has to endure when the seasons fail him. Then there is another point you may notice in England, that is that improved agriculture is very generally diffused throughout the whole of the country. The agriculture of the very remote parts of the British islands is in many respects quite equal, if not superior, to that in any part near the capital, and there is no part where you will find you are very far from either pastural or other forms of agriculture which are in their way nearly perfect. In this respect you will notice a very great difference in India. I think I could show you in almost every part of every province of India fields quite as skilfully cultivated as anything you could see in England; in every way they are models of good agriculture, but you also find that this good agriculture is confined in its area, and you are often quite close to very large tracts of extensive deserts and forests, where there is either no agriculture at all, or it is in its most simple and rude stage. I could show you some most beautiful specimens of agriculture, say in Guzerat, and almost within sight of it you may find forests where there are tribes living almost in a state of nature. All this, of course, is very different from what we see any-

where in England. Then there is another point on which you will find an immense difference in the condition of the English agriculturists. Whenever his own crops fail him he can import foreign grain. This peculiarity is closely connected with those we have been before considering. One way or another an English farmer has comparatively immense resources, and he can always get grain grown in other countries, which will be brought to him and sold to him for the money he may be able to raise by drawing upon his capital or his credit. In all these respects you will find that every part of the East, with the exception perhaps of some parts of China, is very far behind this country. With regard to the supply of foreign food, for instance, I do not recollect any case of a famine in the East where it was not quite clear that within a very short distance from the suffering districts — within what we should call a most practicable distance for transport — there were very fine crops, waiting to be sold and sent, and that when the cultivator was starving in one province, very often he was within what we should call easy reach of large crops in other parts of the country. But perhaps the greatest difference of all will be found in the great advantage that nearly all Europe possesses in the well-organised social and administrative organisations which exist there. Institutions of all kinds, municipal and parochial, which connect the central government with every family in the country, exist in England. This is a point on which I do not think it is easy to over-estimate the advantage which we possess here, as compared with Bengal. You know that in Bengal, so far from the social and administrative organisation being a complete one—such as we have here—there is now, and was formerly to a much greater extent, an almost impassable gulf between the governor and the governed. The governors in my memory were literally a few score of Englishmen, or of persons trained by Englishmen, dispersed at immense intervals over a very large area, and confined partly by law, and partly by usage and prejudiee, almost as potent as law, to the colleetion of the revenue from the great landlords, and to the administration of criminal and civil justice, and even for this latter purpose the numbers were so small in comparison to the work to be done that it was impossible for the judicial officers in my memory to do their duty thoroughly. When I first went to India, the government of Bengal was literally vested in the Governor-General, and he had to assist him in making the law, and administering the government of that enormous province, a single secretary, a few subordinate officers, a board of revenue, and two independent supreme courts of judicature sitting in Calcutta, with their judicial officers throughout the country. So complete was the separation between the governors and the governed, that not even the best informed amongst the governing classes could tell, with any approaeh to certainty, whether the population of the province was forty or sixty millions. And although there was of course an immense mass of recorded information on many subjects, the greater part of Bengal, even within a few days' journey of Calcutta, was much more a *terra incognita* to the Government of India than many of the extreme provinces a thousand miles off. You may say this is a very astounding statement, but I believe it is literally true, and could be confirmed by many gentlemen present. This state of things was partly due to the immense area, and the great mass of population to be dealt with, partly to the ease with which a vast revenue was collected, but still more, and I believe principally, to a kind of prejudice, the strength and duration of which forms one of the most curious features in the whole history of the Indian Empire, to trace the origin of which you must go back three-quarters of a century. I will not trouble you by going into the history of what you all know by name, the "Permanent Settlement" of Lord Cornwallis. I only ask you to remember that it was a plan which was to be gradually developed, for replacing much of the ancient institutions, machinery, and internal administration which had been swept away, and for organising local government throughout the province. You will find its general features and many of its details very well and very completely stated in the minutes of Lord Cornwallis, and of those who assisted him in forming the settlement. But the author of this great measure left a great part of his work in embryo. He was cut off before he had completed it, although it is quite clear what he meant to do. There was nothing to have prevented his work being carried on by his successors, but this pressing want escaped the attention of succeeding governors-general, and a superstitious reverence for the permanent settlement grew up, which, like every superstition, had no sort of connection with any real respect for the rights created by Lord Cornwallis. Long after the time when I first went to India, it was impossible to propose any measure of reform in Bengal, however little connected with the principles of the permanent settlement, which might not have been, and which not unfrequently was, successfully resisted by the cry "that the permanent settlement was in danger." To such an extent was this carried out, that up to the last 20 years I do not think there was any part of India in which the district officers knew so little of their districts, and had so little hold upon them, as in this province, which ranks amongst the oldest of our landed possessions in India. It was not until Lord Dalhousie's time that a separate Lieut-Governor was appointed for Bengal. Indirectly, of course, whoever ruled Bengal, whether as Secretary or Lieut-Governor, had immense power. But even to this day, the Lieut-Governor of Bengal has nominally and constitutionally less power than many an officer of an inferior grade who rules over not one-tenth of the territory which the Governor of Bengal administers. But ever since a separate Lieut-Governor has been appointed, there has been a steady improvement in the administration of Bengal. One Lieut-Governor gave the Bengal police, another improved the judicial system, a third encouraged education; every one of them left behind him the marks of improvement in Bengal, not as much as he wished to do, but still showing a very great advance on what was possible in his predecessor's time. Since Sir George Campbell went there, more effectual means have been taken to make the government have the same hold over the province that it has always had in other parts of India. Some of the best devised measures which have been proposed for this purpose are still hardly beyond the stage of preliminary discussion, and it must take two or three generations of official life before any Viceroy can feel that he has the same kind of grasp of the whole of his subjects, and the same power of aiding them within 100 miles of his capital, that he possesses over the remotest part of the empire. It is very necessary that you should bear this in mind, as otherwise Lord Northbrook and Sir George Campbell may be held answerable for the shortcomings of their predecessors during the past eighty years, and I can confidently say that no one has crowded into his term of office so much energetie work in the attempt to settle these matters as the present Lieut.-Governor under the present Viceroy, although I believe the task is one which it would require half-a-dozen of the most active men to carry out if their whole lives were devoted to the subject. I must remind you that this want of administrative machinery, which is so felt in Bengal, is not equally felt over all India, and in many parts is not felt at all. In most parts, I may say, out of Bengal there is an existing chain of administration, from the Viceroy through the local governments, of officers, and civil and municipal authorities, which places the central government in fair domestic relations with the whole population; and there are many provinces where nothing of importance can take place in any hamlet without its being promptly known, from the efficient way in which everything is communicated to the head of the supreme government. Sometimes this sys-

tem is one of our own devising; in the best instances, however, which I know of, the old native system has been perfected and perpetuated. Everywhere out of Bengal the facilities for meeting a calamity like the present are far greater than in Bengal itself, and that is the point which I want you to bear in mind in considering the present question relating to the Bengal famine. In drawing a contrast hetween the condition of England and India, with regard to the power of resisting a famine, a very prominent place must he given to the institution of caste, which is perhaps stronger in rural Bengal than in most parts of India. We have here nothing at all like Indian caste in its relations to any question respecting food to which I could draw your attention, so as to give you any notion of the difficulties which a European administrator would find in feeding the starving population of an Indian province. Still, even in this country, we have great prejudices with regard to food. We find in our daily life that new articles of food, however excellent in themselves, do not readily make their way amongst the poor and less instructed classes. I dare say many of us, after enjoying a hearty meal of Australian meat, have found it very difficult to persuade our servants to eat it, and if, in any time of scarcity, you have ever tried to feed a cottager upon tapioca, sago, and various things which you prepare for your own sick rooms, you will find it extremely difficult to get a collier or a miner to swallow that which you would he very glad to partake of yourselves. This is not a matter of taste; it is a prejudice. But these difficulties, strong as we know them to be, are as mere cobwehs compared with what you meet with in India. Rememher, as a general rule, no ordinary Hindoo or Mohammedan will eat food cooked hy one, or which has been touched by one, of an inferior caste, or even drink water from the hands of a man of inferior caste to themselves; thus, to a great portion of the population, the meat, and the spirits, and the fermented liquors which form so large a proportion of our diet, and which we are apt to give when we wish to support strength in a small hulk, are not only in themselves rejected, but the slightest suspicion of any admixture of them is sufficient to ensure the rejection of the whole mass of the best and most nutritious food. So strong are these prejudices, that the greater part of the Indian population, until absolutely heside themselves with the frenzy of hunger, will refuse to eat forbidden food, although it may be of the kind most tempting and nutritious, if it has heen handled by one of inferior caste. I have known the case of one of our own soldiers, embarked on hoard a transport with a great many others of inferior caste, who when his own provisions were accidentally expended, rather than touch the provisions provided for these other men, submitted to voluntary starvation. And that was not a solitary case, or at all an extraordinary case. The man did not murmur or say a word, hut quietly accepted death from starvation, not hecause the food was of a different kind, hut simply because it was prepared by a man of inferior caste, against whom he had no grudge, and side hy side with whom he stood in the ranks and fought. This is a point you must not forget, because it infinitely increases your difficulty in dealing with the famine in Bengal. It is not sufficient that you should provide what they want, you must provide for giving it to them by hands from which they will accept it. These difficulties are well known to Indian administrators, and will be, as far as possible, met and overcome, for cooks of the Brahmin caste, and so on, are not difficult to procure, and it is generally found possible to prepare food and to present water through hands from which the natives will receive it. But still you must not forget that this is one thing which will add immensely to the difficulty of meeting the famine in India. After what I have said, I ask you to bear in mind that, according to my conviction, in none of the particulars to which I have alluded is there any superiority over Asia which can make the European example incapahle of imitation in Asia. There are, of course, differences of degree, hut, as far as my experience goes, there is no natural or inherent inequality in Asia which could justify our despairing of being able to protect India as completely against general mortality from famine as you, with your industries, have protected England, and I hope presently to give you some examples which will go to prove that I am not quite speaking without hook. Now I will turn for a moment to the measures which I think it possible—we can only speak hypothetically at present—may be taken in India to mitigate and meet this famine. First I must remind you of what the government of India really consists. It is generally supposed that the Secretary of State, and those who are his advisers and assistants, as limited by Parliament in this country, are the government of India, hut that, as any one who will only look into the constitution of India must be well aware, is a mistake. No doubt Parliament exercises a supreme power, and, as delegated by Parliament, the supreme power rests administratively in the hands of the Secretary of State. But with regard to all questions of administration, like that of meeting a famine, the government of India and the local government are supreme. There is no measure which they can take which is necessary to meet the famine which requires more than that assurance of consideration and support which the government of India have already received, and which they did not need to receive before they went to work. I say this not by way of anticipation to meet possible censure on the government of this country, but to avert confusion and to do justice. All that can he done here is that the Secretary of State should appoint the best men to the Indian government, and support them manfully in such difficulties as lie before them. They will need all the support you can give them, but to them will justly belong the whole credit of success. I speak from experience when I say that in such cases, after the danger has heen once realised and authority given to meet it hy the assurance of hearty and energetic support and sympathy, it is not easy for those at a distance to guide wisely or to prevent advice from becoming emharrassing. I need not tell you, as you have been already assured hy Lord Napier, that in the officers now filling the posts of Viceroy and Lieutenant-Governor of Bengal will he found every quality which could give Englishmen confidence that the great trust placed in them will be worthily discharged. It may seem presumptuous to say so, hut I cannot help stating my own conviction that it would be difficult to find in the whole range of English statesmen and administrators men more capahle of rising to a worthy discharge of the Herculean task before them. The first thing, of course, is to realise the danger, and regarding this, I do not think there can he any sort of douht that it has heen realised. Whether the most sanguine or the gloomiest views of what is coming should be justified hy the result, this much at least is certain, that on no previous occasion has the attention of the government of India or the local government been so early directed to the impending scarcity as during the present year. I know that hefore the first note of alarm was sounded, as it always must be on these occasions, by the puhlic press, great anxiety had heen felt hy some of the highest authorities in Bengal with regard to the prospects of the season. You will remember that a good or had season depends often on the rainfall within a single fortnight, and that the reports from the native planters and zemindars can be as early communicated to the public through the newspapers as they can be to the Indian viceroy at Simla. Then the danger having been adequately realised, as heing on the most favourahle calculation likely to he a national evil of gigantic proportions, it only remains that the government should at once, to use the expression which I have seen quoted, "Declare war upon the famine," and this has already been done in the most unmistakeable form. There is not a government

official—I speak very deliberately—from one end of Bengal to the other, who is not at this moment fully aware that he will be required by rulers, most intelligent and exacting, to strain every nerve and faculty of his being to prevent the death from starvation of any of the Queen's subjects. It is of course all important to know, in the first place, what will be required to be done; and here we are met in Bengal with the difficulties created by the defects of administrative machinery, to which I have already referred, which prevents us having accurate statistics of the probable wants of the district. We are not well off here in England for agricultural statistics, but the want is supplied by a thousand channels of private information which enable us during any crisis to supply, in some measure, the wants of the country. But in Bengal, even Sir George Campbell, one of the best informed men on every subject connected with India, will find himself sadly in want of any except the vaguest and most general particulars as to the extent of the scarcity. Fortunately there are circumstances in Bengal which render it possible for a man of great resources, with money and authority at his command, and with steady determination to use them to the utmost, to do more than any Englishman who does not know what his countrymen can do, when put to it, would be inclined to believe possible. I have been perpetually asked (many times a day), since this alarm of famine was first talked about, what area is supposed to be affected? what are the statistics within the area? what are the preparations made for supplying the needful aid? I would ask you to consider, even here in England, suppose you heard that one-fourth of the kingdom was threatened with a very serious scarcity—say the neighbouring kingdom of Ireland—would you suppose there is anybody, with all our resources, who could answer this question? The question can only be asked by persons who, instead of ever having been to India, or lived there a long time, still look upon India as something comparatively much smaller than the British islands; but if you will only consider this one fact, that whether you make it a large or a small area, whether you make it an entire or only a partial failure, on the most favourable accounts you must reckon that the area and population affected with the threatened scarcity, and with the famine which may follow that scarcity, is at least five times as large as Ireland. I would ask those who are able to recollect the particulars of the Irish famine, and especially some who did so much to mitigate its sufferings, to explain to you how difficult it was to get any precise particulars on this subject until long after the suffering had commenced, and long after everybody who had anything to say about meeting the famine was engaged as busily as possible in executive measures for supplying food for the afflicted districts. When you feel inclined to find fault with the want of accurate information on this subject, I only ask you to remember that at the best you may look out for a calamity five times as extensive as that Irish famine, and this I say, as some reason why you should not find fault with Lord Northbrook or Sir George Campbell because they did not send you an accurate table of the number of mouths which will have to be fed and of the provision which has to be made for them. Only carry your minds back a very few months, to the time of the Franco-German war. All knew when the war began, and when the German armies invaded France, that there must be great suffering and distress, that many would die of exposure and starvation, besides those who would perish on the field. But did anybody in his senses suppose it was possible to get accurate statistics of where the evil was likely to be greatest or precisely what was necessary to be done to meet it? Such being the case, I would ask you to take that calamity, and consider how very small and restricted it was in comparison with the one which now impends over that great province in which a few hundred of your countrymen are, at this moment, racking their brains to devise some means of meeting the misery of the starving multitudes. But having made the best estimate in his power as to the area and population that will require food, and in what quantities, the next step for the ruler of Bengal is to secure such a supply of food as is likely to be needed to feed those who will be thrown helplessly on his hands, and who, unless fed by Government or by private charity, will, in all likelihood, be starved. It is easy to see that in a case like this great measures are absolutely necessary, but it is equally evident that the great measures must not be of a kind to increase the true evil. For instance, if we sweep into the government stores the store of the corn-dealer, which, if left in his hand, would be carefully doled out to persons able and willing to pay for food, we clearly do worse than if we did nothing. It is impossible we can feed these people as well or as economically as they can themselves, or as the grain dealers will feed them. I do not mean economically of money, for that must be left entirely out of our calculation, but economically of grain. We must not take the grain from careful distributors and careful consumers and render them dependent on the necessarily lavish management of a government depot. Let us then lay down, as the first rule to be observed by the government, that it shall provide stores of its own, without stint, to the utmost limit of any possible demand, without doing anything which shall embarrass the stores of those whose natural and social functions it is to preserve and distribute tho grain supplies of the country. Hence the government may properly buy and store up grain which is likely to be exported, and by coming forward as large purchasers of imported grain they may easily stimulate an inflow of grain from without. It has been suggested that government should prohibit the export of grain from India, and we hear of differences of opinion on this subject between the highest officials in India. I will tell you very briefly why I think Lord Northbrook right in setting his face against any such measure. First, that prohibition would be utterly ineffectual. If it will pay to export grain, that grain will surely be exported, either through French ports, or by other means, which would enable the foreign consumers to outbid the Indian consumer. The only effectual prohibition would be a rise in prices in India, and this can only be delayed by any official prohibition of export. It will be delayed by numerous causes, which a moment's reflection will suggest to you, and which need not be here detailed. But worse than this, the prohibition of export must at once intensify the evil. Local prohibition of exports, or discouragement where there is no power of prohibition, are the long-favoured methods of meeting scarcity, but like many other such expedients they are selfish and short-sighted, and, like everything selfish and short-sighted, are very bad policy. Throughout India and round its borders are numerous states, more or less independent, which would not be slow to follow the Governor-General's example if he were once to sanction the prohibition of export from India. They always do so when they can. When a famine in Rajpootana only a few years ago carrried off hundreds of thousands, the native governments, instead of making roads and encouraging imports, prohibited the export of the food stores in their own dominions, and those who did so lost by thousands, not only their own, but their neighbours' subjects, who might have been their customers, and, by being customers, have saved their own lives. During the whole of the Persian famine, one of the worst cases of late years, the policy of the Persian government, instead of importing grain, was strictly to prohibit its export, and such prohibition, though entirely ineffectual, was sufficiently potent to disarrange the trade and tell most unfortunately on the condition of the people. Lord Northbrook's determination not to prohibit the export of grain leaves him free to use all the means at his command to prevent resort to the same measure by those who would adopt it, even without his suggestion, and he can

now reasonably say to every native potentate that abstinence from this suicidal measure will be a mark of loyalty to the British government, and an effectual aid in enabling the British government to do its duty to its subjects in Bengal. But consider for a moment how he would stand supposing he were to sanction the prohibition of exports. Supposing he gave way, what could he possibly say to the King of Burmah or Siam, or of Nizam, or the King of Nepaul, or any of his feudatories who manage their own affairs. It would be not only illogical but absolutely impossible to prevent them adopting the same measure. I have said I would not mention expense on this branch of the subject; we are at war with famine, and in war requisitions of every kind are necessary, but no sensible civilised general, when he makes a requisition, fails either to pay for what he wants or to promise payment, at least, from the vanquished party. Now in this case the prohibition to export differs in nothing from the confiscation of supplies; and though, no doubt, such confiscation may under certain circumstances be justifiable, it is not, I submit, a wise measure with which to begin a campaign when you know that your wants further on will far outreach the possible means of supply unless you carry with you the entire goodwill of the whole supplying community. There are large communities of Bengal, and also people out of Bengal, at Ceylon, in the Mauritius, and the West Indies, who habitually consume Bengal rice, and for whom, more especially, the usual exports from Bengal are destined. Those people will, of course, be unable to see why they should be starved or straitened to feed their less enterprising brethren who have remained at home; and I may mention, as a matter of fact, that most urgent representations have already been received from persons interested in all these colonies, pointing out the disastrous effects which must be produced were Lord Northbrook to prohibit the export of rice. I see some of the advocates for prohibition confound such a measure with purchasing on account of the government of grain which would otherwise be exported. I need not tell you that nothing can be more entirely and essentially distinct in every character than those two measures. Every pound of grain now lying for export at Calcutta bought up in India must encourage more imports; but every pound arbitrarily prevented from being exported must tend, in more ways than one, to discourage import. One is a measure stimulating the natural operation of trade, and the other is a measure thwarting those natural operations, and you will at once see that the two measures have nothing whatever in common. To meet even a moderate scarcity and a very partial famine, it will be, above all things, necessary to keep up and strengthen such an administrative organisation as already exists, and to prevent people crowding in, helpless and ready to die of disease or starvation, in places removed from their own homes. Although the machinery of government administration in Bengal is singularly weak and inefficient, the necessities of the people have always maintained a *quasi* municipal organisation of their own, the existence of which is often very little suspected by government officials. One of the earliest measures towards meeting the famine will be to trace out and develop such organisations as exist, whether official or unofficial, and to strengthen them with the aim of feeding, as far as possible, in their own homes those who are not likely to leave them. The most healthy state of things would, of course, be that those who can earn wages at a distance should go to that distance and earn food for themselves, and, if possible, for their families. The weak, the young, and the very old, and worst nourished, of course, should not expend the little strength they have in fruitless journeyings, but should be kept near their own homes, where food should be brought to them. It will be difficult to effect this, but I think I shall show you further on, it is not impossible even in India. But the great task of all will be not only to provide food, but to transport and distribute it. Let us suppose that government has wisely calculated the number of mouths it will have to feed, without adding to them any who can possibly be fed by their own exertions. Let us suppose that the millions of tons of food necessary for this purpose are secured at some of the great commercial centres in Bengal; how is this food to be conveyed and distributed over the famine-stricken districts, which, at the smallest possible computation, are five times as large as the famine-stricken districts in Ireland? The task is, in truth, a gigantic one, but I am certain it will be found possible to achieve it. But let us here consider, for a moment, some of the measures which doubtless may be adopted. Note, first of all, that there is no time to be lost. The telegraph tells us that the labourers of the famine-stricken districts are already crowding wherever they hear of work. They will not beg for food while they can earn it. Evidently, then, the first thing to be done is to provide as much work as possible. We all know the usually improvident character of what are called famine works—works undertaken to provide subsistence, and not works undertaken because they were previously known to be necessary, and likely to be executed. But it is one of the consequences of the undeveloped state of Bengal, that in no part of the country is there any lack of work, which might at once be undertaken, if the government had only the means of marking it out, setting the task, and paying for it. Throughout some of the districts where the crops have failed, run the lines of some great canals, and railway works, and works of drainage which, from time to time, have been advised by former governments, and which are only awaiting a better state of the finances in order to be set on foot. Doubtless government will bring forth the plans of all such works as are in a state to admit of early execution. I know this has been done to a very great extent. It will summon to its aid from every part of India all available officers, civil or military, and will at once commence as much digging and embanking as can be laid out, and will thus provide for the able-bodied not only food for themselves, but something which will possibly feed their friends at a distance. But all works of this large kind require much superintendence, to prevent their doing more harm than good by bringing together these multitudes of people into places where the means of living are very imperfectly organised. Still in every part of Bengal probably there is work to be done in the way of cleaning out tanks, improving water-courses, and remaking roads, which would give useful employment to their own people, and add to the resources of the country in time to come. This kind of work will, I have no doubt, be largely undertaken. Every district official will have more or less power to set it going. Every respectable planter and zemindar, and great numbers of officers who can be spared from civil or military duties in other parts, will be sent out into these districts, with power to spend money with no other restrictions than that the wages shall be as far as possible fairly earned and promptly paid. I think you will find we have at present only very imperfect telegraphic summaries of what orders have been issued by the Governor-General and the Lieutenant-General on this subject, and I think you will find, when they come to be seen in full, that they are remarkably well advised in this respect to meet the exigencies of the case. Then there is a great question as to how the wages should be paid, whether in money or in grain, and this is a question which will require great care in handling and much discretion to be left in the hands of the local officers. But you must recollect that the transport, even for a few miles, of a considerable sum of money to be paid in wages, or of a large quantity of grain amongst starving multitudes of people, is no such easy task as it might appear, and that an immense amount of organisation and care will be necessary for the mere transport of the wages, whether in grain or money. And it must be remembered that it is not only

the direct consequences of famine which we have to meet, but various diseases—dysentery and cholera—and other disastrous consequences will rapidly follow, when the powers of resistance of such myriads of people have been seriously weakened. I have not said a word about the countless orphans who will be left destitute, to be neglected, carried off, or sold, as chance may happen, unless some official of government or some charitable interposition steps in to save them. Let any one read the records of the Irish famine; let him multiply every difficulty he reads of by five, and he will have then the most imperfect idea of what, on the lowest computation, has to be done in Bengal. Now we come to another question which interests us more here—what can at present be done in England; what can we do here to assist in this great work? I have explained that the initiative and the executive, of necessity, must rest entirely on India. All the government here can do is to assure the Viceroy and his officers of full sympathy and support. This, as you know, has already been done—not that Lord Northbrook needs any instruction on the subject, for I feel sure that he felt, from the first moment the danger was made known, he would receive the most cordial support in waging war with our deadliest enemy, and that no expense or trouble would be deemed too great to preserve from death any of those millions of our fellow subjects who are threatened with starvation during the coming season in Bengal. But if the government can do but little, I do not say nothing can be done in England to help. In the first place, let us avoid confusing the authorities in India by impracticable suggestions. We may be sure that what we know they know, and are doing to the best of their power. But, besides the duties of government, there is a large area of national duty which must be undertaken and discharged in the spirit of that feeling which recognises Bengal as being as much an integral part of the British Empire as Cornwall. The government will need trustworthy eyes and ears to report, and honest hands to distribute what it has to give, whether in work, wages, or in support of the starving, and there will remain beyond all that the government can do an immense field for private charity, far exceeding what can be reached by the ungrudging and manly spirit of English charity, which I have seen more than emulated by the natives, rich and poor, in difficulties of this kind. Then recollect we have some 33 missionary agencies employed in impressing on the natives of India the truths of Christianity. Can we do better than support this agency in the work, which it has always in all former cases of the kind so largely undertaken, of feeding the hungry, clothing the naked, healing the sick, and speaking comfort to the dying. This is a field at once for the energies and means of all who have any portion of missionary spirit, and they may well support an agency which, however scattered and scanty, is yet all-pervading and capable of indefinite extension. Nor need those who have no faith in such agencies sit down in the belief that there is nothing for them to do. The numbers of helpless, shiftless human beings who will need succour, even if everything henceforward turns out for the best, will be something like that of the late German war, only infinitely magnified, and no man who has within him any feeling of patriotism and charity can doubt that there will be ample field for exertion in all parts of Bengal during the coming season. There is only one class which can be superfluous, and that is the mere idler, who might go for want of something better to do. Every one who goes should have a definite purpose, and provide himself with ample means, and some sort of introduction, which may enable him at once to place himself in communication with the public authorities wherever, under the guidance of the zemindars, or missionaries, or planters, or officials, he may find that an intelligent, hard-working Englishman can be of use. I say nothing of supplying what funds are needed, for they are never wanting in such a cause; and I feel sure that whenever those who usually lead us in works of this kind give the word, the number of those who are ready to obey their call will not be small. But a much larger work remains to be done to prevent famine hereafter. There are many who pretend to know something of India who tell you that famine is one of the normal conditions of native life in India, that the East is unchangeable, and that ordinary laws which we recognise as directing our course in this country do not apply in India. I entreat of you not to believe a word of this. If I have learnt any one lesson during the many years I have spent in India, it is this, that there is no single law of what we call political or social economy, or of common sense, which applies to us in England, which is not equally applicable in India. There are, of course, varying conditions under which those laws are applied, just as the conditions under which such laws act differ in different counties in England, and in different parishes, even in this very city. But if the law does not apply to India, depend upon it your notion of law is mistaken, and it is not a law at all, but only a delusion. What, then, are the kind of measures which we hope to see taken? First of all, Bengal must be organised, and an administration must be provided for it, at least as complete and as well linked together, from the Viceroy down to the villager, as in other parts of India. This work has already been commenced by Sir George Campbell. It has nothing whatever in it hostile to Lord Cornwallis's permanent settlement; on the contrary, it is only a carrying out of what Lord Cornwallis designed, and any incompatibility with the present state of things is due to some non-fulfilment of Lord Cornwallis's intentions and promises. Secondly, you must see that Bengal is provided with ample means of communication. Excellent as is the internal water-carriage, it is really not much better, or more all-pervading, than that which exists in our own country or in Ireland. If you take a pair of compasses and measure the map of Bengal, and see what are the distances from a good navigable stream, you will find that Ireland is just as well provided with water carriage. Then, I need not tell you, how imperfect her rivers and estuaries would be as the sole means of communication, unless supplemented by roads, railways, and canals. Here arises a question, in which the people of England are very directly concerned, for it is through a change in the opinions prevalent in Parliament that the policy of the government in India has of late been changed. It is not much more than thirty years since the whole of the internal communication in India was recognised by the government, and road-making on a considerable scale was commenced. The making of navigable canals and of railways are of still older date. For some years it was agreed that works of this kind ought to be made partly at the expense of the present generation, with such sums as could be spared from the annual revenue, after the expenses of immediate necessity had been provided for, and that a portion should be thrown on posterity, by borrowing capital, which is so readily lent for such undertakings in England. This system received the sanction of some of the greatest administrators and financiers who have interested themselves in Indian affairs during the past and present generations, but of late years a school has grown up which has discovered that India is a very poor country, and that nothing is to be given for works of permanent improvement unless it can be saved from the current revenue. I may mention that this kind of doctrine was, I believe, affirmed, though in contradiction of former decisions, by the House of Commons no later than last session. Such, at least, is the reason always currently assigned for expending nothing in India, unless it can be shown to be immediately and commercially profitable in the sense of returning in immediate earnings more than sufficient to cover the interest which the government borrower must pay. In India government is told to execute these public works

in a commercial spirit—not looking to possible returns ten years after, still less to indirect returns—in the general improvement of the country, but calculating no profits save those which can be realised once the work is paid for; and stipulating that this must be always something more than the current rate of interest. How such doctrine can be reconciled with your principle and your practice in attempting such works as Westminster or London Bridge, the Thames Embankment, or any other large undertaking which fails to make a commercial profit, I do not pretend to say. If I am wrong in supposing that the doctrine, as I have stated it, is that which is laid down by the present House of Commons, I shall be very glad to find I am mistaken. If I am right, I submit that this question requires further consideration, and I am not doubtful as to the result, once the mind of the House of Commons is seriously applied to the discussion and decision of it. I have said nothing of what I believe to be the greatest safe-guard against famines in time to come, namely, the creation of great works of irrigation and internal navigation, of which some have been devised and executed by Sir Arthur Cotton and his colleagues, through the noble schools of engineering which have been formed in India. It is the fashion to deny the facts on which Sir Arthur Cotton's calculations are based. But I am certain the more they are tested, the more clearly it will be seen, that in no other way can money be so well expended in India as in great works of irrigation and internal navigation. Here in England, irrigation works naturally occupy a very secondary place in agricultural estimation, but I think the time is not far distant when works of internal navigation will resume the place occupied in our grandfathers' day as a means of conveying the heavy traffic of the country, and when the shade of Brindley may be invited not only to diminish the cost of living, but the cost of life itself along our greatest lines of internal national traffic. I am afraid time will not admit of my going any further into the subject. I had prepared a few remarks on another part of it, principally to give you some answer to what is very often said, that India is not as England, and that even with the best means of communication, the people will starve when their own crops fail. Now, I happen to be able to give you very conclusive proof, from history, with regard to a very large tract of country, including an area at least very much larger than that now threatened by famine in Bengal, and comprising a population at least quite as large, that in ancient times famines of a most desolating character were of very constant occurrence, and that they continued up to our time, for I myself saw the remains of the last great Deccan famine. I saw most unmistakeable signs of its ravages in every way, and found the country in a state of extreme poverty and desolation, many people, even in what was called a good year, dying of starvation. I talked with men who remembered the time, which you will find very graphically described in the despatches of the Duke of Wellington, who happened to pass through the country in the years of famine, and you will also find allusions to it in Macintosh's account of his "Tour in the Deccan," as given in his life, and in Lord Valentia's travels. That will satisfy you that the part of the Deccan to which I allude was, up to our own time, subject to famines more frequent than, and quite as desolating as those which now threaten Bengal. I could, if time admitted, tell you how, step by step, this state of things has been so far ameliorated, that I believe now famine is really impossible in that district, so far as it can be made impossible by any human means, and this is not mere matter of conjecture, or of sanguine expectation. But I have seen prices rise very far beyond what they were when I saw people actually dying for want of food. I have seen prices rise far beyond that standard without, as far as I know, a single soul dying of want. And that has been effected by the concurrence of a great many causes, which it would take a long time to enumerate, but one of the principal of which is improved means of communication. Better roads have been made, the country has had railways run through it, and irrigation works on a considerable scale have been commenced, until the proof admits, I may say, of something as nearly approaching to mathematical demonstration as is possible with political problems of this kind, that that country is now effectually protected. I would also, if time permitted, gladly answer an objection I have frequently heard raised, that this may all be very true of an active, enterprising people like the Mahrattas, but it is impossible to say the same of the shiftless Bengalees, that they are in some mysterious way, which nobody has ever satisfactorily explained to me, different from other races of mankind, and that the same law does not apply to them. I could easily say a great deal to satisfy you that this is not the case. If you only took the same trouble with Bengal, went into the details of management, showed the same respect to private rights that have been shown in that part of the country to which I have just alluded, you would find that you were able to work in Bengal the same change that has been worked in other parts of India. I have referred to the Deccan simply because I know that better than other parts of the country; but it is within my knowledge that the same thing has been going on elsewhere in that part of India which was so long and ably ruled over by our chairman. I know that districts, of famines in which you may read the most vivid and closely-accurate descriptions in works of men like Sir Thomas Munro, have been made by gradually improved administration, and by all kinds of measures converging to the same object, practically if not entirely secure—much more secure than they ever have been against such calamities as we are considering. And if the same measures can be applied, as I have no doubt they will be applied, if the attention of England is once directed to this matter, to this vastly larger and more important district of Bengal, that the same result may be expected, and you may make India—which is now as much exposed to famine, and no more exposed to famine, than our own country was 600 years ago—you may make India as safe from it as the United Kingdom is at present. Thus out of this great calamity, as I feel sure it must prove, even should our most sanguine expectations be realised, may arise the greatest blessing that has yet been conferred on Bengal.

Sir Charles Trevelyan said this was the most solemn occasion on which it had ever been his privilege to be present in that hall. The great heart of England was moved, and the whole people were straining on the leash to make a larger subscription than had ever yet been made, which was saying a great deal, in order to relieve their suffering fellow subjects in India. He was very glad to find that the discussion had been initiated by so thoroughly able and statesmanlike a speaker. There was only one question of fact on which he was disposed to differ from Sir Bartle Frere, and that was that he seemed to think that famines had become less frequent of late. Probably he meant as compared with the period antecedent to English rule in India; but, taking the period from the pacification of India under the Marquis of Hastings, when the English government was for the first time fully established over the whole of tho country, it would be found that that event was followed by a long course of abundance. The agricultural industry of India was then almost entirely directed to the raising of grain, and after a few years grain became excessively abundant. This lasted from the year 1817 or 1818 to about 1860; but since then they had been perplexed and alarmed by repeated dearths and famines. The only explanation he could suggest for this state of things was that of late years there had been an enormous development of industrial effort

for the production of opium, indigo, cotton, oil-seeds, and so forth, and latterly, to a vast extent in Bengal proper, of jute also, and these had taken the place of food products. God forbid that he should blame this course of action, which promised a glorious future for India, but, still, he believed it to be the proximate cause of the increased number of famines, because it had not been accompanied by corresponding measures for the development of the communications and other arrangements which had been so ably described by Sir Bartle Frere, namely, irrigation, railways, and an improvement in the standard of living, consequent upon which a large importation of food from other countries must take place. If the people in the food-growing districts of India devoted themselves to growing other things, they ought, of course, to import food from abroad, but this had not yet been done. With these preliminary remarks he would ask, what was the real difficulty in regard to Bengal? There was a vast community of peasant proprietors, people of small means, each growing his own food, and that of the cheapest and commonest kind, and thus constantly pressing on the means of subsistence; so much so, that large districts, even in ordinary times, suffered from fever caused by under-feeding and over-crowding, from which causes the mortality had been very great indeed. The consequences of a scarcity following upon such a state of things as this would be far more serious than in England, where the standard of subsistence was much higher, where food was largely imported from abroad, and where the means of communication and circulation were in a very advanced state. Now as to the remedies to be adopted. The first indispensable condition of relief was that the void created by the large failure of the crops should be supplied by importations from elsewhere. There were two ways of doing this. One by buying in the home markets of Madras, Bombay, and the Indo-Chinese countries, and the other by importing from abroad. He was sorry to see that the attention of people in India had not been sufficiently directed to the foreign markets, because buying in the home markets of course raised prices, and what was a famine in Bengal might thus become a dearth in Madras and Bombay. On the other hand, the effect of importing from abroad was to reduce prices; indeed, the mere rumour of any considerable importation of food from abroad would reduce the prices all over India. By the Suez canal the Black Sea was as near to India as to England, and even the grain-producing districts of California were quite within reach. He therefore hoped that attention would be directed to the superior benefit of importing food from abroad. But after all, the providing food in gross was not the great difficulty; the real difficulty was in distributing it, when not merely had the supply failed, but the entire social system, whereby it is stored and distributed, had broken down, so that unless it were supplemented by administrative machinery, dire would be the consequences. The popular remedy for such a state of things was relief works, and he was not going to say a word against them if they are properly limited and applied. A dearth, limited in area and intensity, might be entirely relieved by these means, as was the case with the Irish distress in 1845. In that year there was a dearth in Ireland which was satisfactorily relieved by these works, and the government were encouraged to organise them on a larger scale to meet the impending famine of 1846; but when that famine came they entirely failed. Nevertheless, so far as useful works were available, by all means let them be tried, although it would be a great error to rely upon them as the sole, or even the main, source of relief for this great calamity. It had been proved by bitter experience that when a real famine sets in, famishing multitudes throw themselves on the relief works, and leave others still more helpless perishing behind. In Ireland even the so-called able-bodied men on the relief works perished from lack of nourishment, and their poor families, and those who had no male relatives who could earn money on the public works, were in a still more pitiable condition. In the presence, then, of such a calamity as that now pending, the only effectual mode was a detailed distribution of food brought into the immediate neighbourhood of the homes of the people; and the food must be cooked, for if it were in a raw and marketable condition there would be no means of checking its misuse, and the supplies would rapidly be exhausted. This, which is the only effectual mode of relieving famine, requires the active co-operation of the people. An appeal must be made to the zemindars, who had profited so largely by the permanent settlement, and to the educated middle-class, for whom the means of liberal instruction had been so largely provided. They must come forward to support the authorities; there must be "a long pull, a strong pull, and a pull altogether," Englishmen and Indians all fighting to the death to prevent the destruction of life. As to the relations with private trade, he thoroughly agreed with the arguments against the prohibition of exports; for, although the ordinary social machinery for the provision and distribution of food required to be largely supplemented by administrative action, in order to meet the pressing difficulties of the case, it would be a great mistake to extend this interference to the prohibition of exports. On the contrary, the only hope of salvation depended upon trade being left entirely free. During the great distress in Ireland, notwithstanding the immense efforts made by the government, much more was accomplished by the exertions of private merchants than by the Admiralty and the Commissariat. During the first six months of 1847 nearly three million quarters of corn, worth at the then current rates nearly nine millions sterling, were imported into Ireland; in fact, the Irish market was cheaper and better supplied than that of any other country in Europe where distress prevailed; and the highest praise to which those great operations were entitled was that they were carried through without any sensible disturbance of the ordinary course of trade. There was another view which did not seem to have occurred to those who advocated a restrictive policy. Great exertions and constant watchfulness were necessary to protect the transport of provisions from one part of Ireland to another during the famine. The plunder of bakers' shops and other deeds of violence were matters of daily occurrence. Mobs prevented food from leaving the towns, and the country people resisted its being carried in; and if this was so while trade was free, what would it have been if the government had themselves set the example of prohibiting the removal of food? The very same reasons which might be adduced for prohibiting the export of grain might be given for forbidding the transfer of grain from any town or district in the interior; nay, the people in each town might appeal more strongly to the principle of self-preservation to prevent what supplies of food they had from being taken from them. Besides this, such a policy would produce sudden derangements of trade, and it already appeared that Ceylon and the Mauritius were in danger. All these commercial operations were like a vast machine, in which if a single wheel were deranged the whole would be put out of gear, and the consequences must be disastrous. Trade was not injuriously interfered with by the government entering the market and purchasing grain to the necessary extent, though no doubt it would be better if the necessary supplies of food could be provided by the private trade; and the tendency to this result would be greater in proportion as trade was left free from legislative restriction and protected from illegal violence. In considering what preventive measures should be taken to avoid such calamities in future, they must bear in mind the great change which had come over the agriculture of India, which, from being almost entirely devoted to the production of grain, was now, as he had before stated, largely employed in pro-

ducing articles which were not edible. This called for the most active exertions, in order to adapt the means and habits of the people to these new circumstances. The great requisites were—first, irrigation; next, roads; next, railways; and next, education. When the millions of Bengal could read, write, and think, they would not be content with so low a scale of subsistence as that with which they had hitherto been satisfied, and which low standard was in fact the real danger, because they had nothing to fall back upon. If they had a reserve such as was gradually appearing in the Deccan and Madras and the more advanced parts of India, then the failure of one crop might leave them comparatively unscathed. The great thing, in fact, was to raise the standard of subsistence, and not to allow the people to continue to rely upon the commonest and cheapest description of food, raised only by themselves. There was precisely the same need both for temporary aid and permanent change in Bengal that there was in Ireland, and like causes produced like effects whether in Europe or Asia.

Mr. Hyde Clarke moved the adjournment of the discussion until the following Friday, in order to afford an opportunity to the many gentlemen interested in and acquainted with India to express their views upon this important subject.

Mr. A. Cassels seconded the motion, which was then put to the meeting by the noble chairman and carried; and the conference was adjourned accordingly until the following Friday evening.

The adjourned meeting was held on Friday, Dec. 19, Lord Napier and Ettrick, K.T., in the chair.

Mr. Hyde Clarke said he moved the adjournment of the previous meeting in his official capacity of chairman of the Indian Committee, not so much with the object of speaking himself, as for the purpose of giving an opportunity to elicit the views of the many gentlemen connected with India who were in the assembly. He should therefore make but very few observations, and those chiefly in support of one portion of the subject brought forward by Sir Bartle Frere—namely, the periodicity of famines, and the phenomena attendant upon them, which had been so accurately described. Allusion had been made to the circumstance that for many centuries England had suffered from the same inflictions and anxieties, but in later times these had been alleviated by the various measures to which reference had been made, so that though we had the experience of the famine in Ireland, there had been no instance of anything approaching a great famine in England. He could quite confirm these observations, because some years ago he had occasion to tabulate the occurrence of famines in this country for several centuries, when he discovered that there was an apparent regularity in the phenomena, that there were periods of about $26\frac{1}{2}$ years, divisible into three epochs, during which there appeared to be a recurrence of the same phenomena, though there were some wider cycles always interfering with the calculations, so that you could never appreciate beforehand exactly what would be the extent or maximum of the scarcity. He thought all must have listened with great interest to the admirable exposition given by Sir Charles Trevelyan of the principles applicable to the question of prohibition of export of food. But there was another statement made by him which ought not to be allowed to pass without comment. He had intimated that there was reason to believe that the food produce of India had been shortened in consequence of the attention paid to other crops, and that consequently there was a less production of food than would otherwise have taken place. Now, against this view of the subject he must beg to protest, because there was no evidence of a statistical kind to support that view, and if erroneous it must have a very prejudicial effect in India in keeping up a wrong tone of opinion and thereby tending to retard the prosperity and advance of the country. If true, it would lead one to believe that all that had been done for the promotion of the culture of indigo, cotton, jute, and other products requiring great care and attention, had been thrown away, and that instead of producing improvements, the progress of the country had been retarded. Now that was contrary to all experience, even he believed of Sir Charles Trevelyan himself, and probably he would hardly like such a view to go forth to the public of India. It was opposed to the fact of great increase of population promoted by the increase of food. Sir Bartle Frere had pointed out, amongst some of the particular conditions of India, that there was a very great disparity in the state of agriculture in different districts, in some parts a very near approach to perfection being observed, whilst in others the state of agriculture was very rude indeed. Now if more food was required for the population, it could not be obtained by driving out these modes of culture which created new resources, but rather by raising a larger weight of crops on the surface now under cultivation. For instance, it had been stated that in the case of cotton, in some parts only 50 lbs. per acre was raised, in others it reached 400 lbs. Now if the condition of the country was to be raised, it would not be by making people believe that agricultural improvements tended to throw them back, but on the contrary, by leading them forward in the path of progress. England had suffered for centuries from famine in consequence of influences which were now removed, but these had still remained in India, except so far as they had been alleviated by the improved arrangements introduced under English administration. What was required, therefore, was to apply to India the experience obtained in England, which, so far as it had been applied there, had conferred great benefits upon the country, and would yet do still more. It was chiefly to increase the English element in India. If such a contingency should arise—which he believed the natives of India would regard with dread—as the removal from India of English protection, amongst consequences such as the spread of internecine war and the slaughter of the population, there would also arise other evils no less deplorable—viz., the spread of famine and consequently of disease.

Mr. Andrew Cassels remarked that there seemed to be some differences of opinion on the subject of this impending famine, some of the official telegrams being less alarming than they had been; whilst on the other hand, some of the private accounts were rather the reverse. For instance, one writer in the *Times*, who said he was well acquainted with India, thought we must expect to lose ten millions of lives in this famine, but Englishmen were often apt to look at the darkest side of things, and it was quite possible that fear might exaggerate the coming evil. At the very best, however, we must be prepared to face and grapple with very great distress, for history taught us that one year of drought and scarcity is almost always followed by another, and that sickness as surely succeeded famine as night followed day. He understood that the stocks of old rice in India would be exhausted by the end of the year, and that the scanty harvest reaped during the last month might carry the people on until the month of May, but after that all the imports of rice which could be brought into India would be insufficient, unless supplemented by large imports of maize and wheat. Now it unfortunately happened that the crop of maize in America was very short this year, being estimated at one-fourth below the average; and he knew that cargoes of oats had been shipped from this country to New York within the last week or two—a thing, he believed, without precedent. No doubt they were intended to feed horses as a substitute for maize. As he understood, no

fall of rain now would be of much service, as the ground in the month of October was so dry that it was impervious to the plough, and consequently no seed could be got in.

A Gentleman in the room said it was not quite so bad as that.

Mr. Cassels said he was very glad to hear it. He was very pleased to see that government appreciated the importance of the question, and that public works on a large scale were in contemplation; but as yet they had only heard of two, viz., the Soane Canal and the North Bengal Railway. Now, these two could only employ 200,000 or 300,000 men, whilst some millions would have to be fed. He should be glad, therefore, to hear of works on a more extensive scale being set on foot, particularly in the shape of irrigation works. He had for a long time been convinced of the wisdom of the policy so long and ably advocated by Sir Arthur Cotton, and he thought that if half the money spent on railways during the last quarter of a century had been spent on irrigation, there might have been years of scarcity, but not of famine. For himself, he was strongly averse to any interference with the natural course of trade, but it appeared that Sir George Campbell and many others were of a contrary opinion. After giving the matter the best consideration he could, he was clearly of opinion that Lord Northbrook's policy was the sound and right one, and that whatever immediate good might be done by forcibly retaining in the country any stocks of rice now existing there, it would be more than neutralised by the evil consequences which would arise from any interference with the freedom of trade. No doubt the subject was surrounded with difficulties, and even if the government purchased as much rice as they could, probably nothing short of absolute prohibition would prevent all exportation of food. Many merchants were under contract to supply certain quantities to the Mauritius and elsewhere, and unless absolutely stopped the rice must go. It might be asked, why should those coolies who had gone from India to the Mauritius be starved, in order that those who remained at home should be fed? and it must be remembered that it was difficult to prevent exportation without checking importation at the same time. If the government should be compelled, by the pressure of public opinion, to prohibit exports, it would have to do single-handed a great deal of work, which would other wise be done for it by the commercial world. Government, however, could do a great deal by making contracts for the supply of rice in large quantities, and he understood there was a very large crop, in fact the largest ever known, in Burmah, so that there would be million of tons available there for export. Now, it seemed to him that, through the agency of the rice mill owners in Rangoon, the government might make large purchases of rice, and by entering into some kind of agreement with the merchants of Burmah some of the rice intended for this country might be made available for direct shipment to Bengal. No doubt many of these merchants had chartered vessels for the conveyance of grain to Europe, but still it was very possible that they themselves might make arrangements with the shipowners for diverting these cargoes from their original destination and shipping them to Bengal. One thing was quite clear, viz., that the government must be prepared to make any outlay necessary in order to secure food for the people, and possibly these evil times might do some good, by drawing attention to the defects of our administration in India. Sir Bartle Frere had pointed out that the perpetual land settlement of Lord Cornwallis had never been supplemented by those measures of internal organisation which he designed to append to it, and he for one had always thought the system, as it existed, a great and fatal mistake. It had impoverished both the people and the state, the ryot being placed at the mercy of grasping landlords and middle-men, and the state being deprived of the rent from the land, which, under the thirty years assessment, it might have attained. Thus the revenue obtained in Bengal was only four or five millions sterling, whereas the true rent was probably three or four times as much. He was sure Sir George Campbell deserved the warmest support from this country for his earnest endeavours to remedy some of the defects in the settlement, and as he had ventured to differ on some points from Sir George Campbell, he would say in conclusion that no one had a greater admiration of his ability and zeal in the public service than himself. It was understood that when he went to India to assume the duties of Lieutenant-Governor of Bengal his health was not strong, and long before the present famine was heard of his medical advisers warned him that he must not remain there through another hot season. Now, all admired the chivalry of a soldier who braved death rather than desert his post, and he considered Sir George Campbell was equally chivalrous in remaining in India under the present circumstances, and he trusted that his brave and self-sacrificing conduct would be remembered, to his lasting honour, both by the people of India and by his countrymen at home.

Mr. Trelawney Saunders said he was anxious to speak on the last occasion, because he feared that some of Sir Charles Trevelyan's views might be liable to misconstruction if not controverted, when he stated that the famine was largely due to the transfer of labour from the cultivation of food produce to that of other articles of a non-edible nature. This point had already been taken up by Mr. Hyde Clarke, and he need not therefore go further into it. Other causes, however, had been stated which were equally erroneous. For instance, at a meeting, held by the East India Association, some native gentlemen from Western India seemed to him to be quite mistaken in the arguments they put forward. They expressed themselves of opinion that the cause of the famine was the increased taxation of land, forgetting apparently that the present famine was in Bengal, under the permanent settlement. He hoped in this discussion the question of the cause of the famine was considered settled, for if there was any one thing indubitable, it was that the famine was simply due to a deficiency in the rain-fall, and to nothing else. He hoped, therefore, this discussion would not be diverted from its proper object by any question as to the cause of the famine. He believed the wish of Sir Bartle Frere in bringing forward this subject was that the public should be fully informed on the matter; so that while understanding the panic which might exist amongst the poor famine-stricken people of India, they might be spared from a different sort of panic in dealing with the remedies necessary to prevent the evils which were dreaded. The best way to avoid famine was to be fully informed, and to that end he had come prepared with a large map, and with a few figures, in order to give some real idea of the problem before the country. It must be remembered, in the first place, that India was three times as long as Great Britain, and three times as broad in its widest part, and the portion of the country in which a famine was apprehended was plainly marked out on the large map on the wall. It embraced the western part of Bengal, and a portion of the eastern part of the north-west provinces, including altogether the five districts of Burdwan, Rajashae, Bhangulpoor, Patna, and Benares. The Patna division included 23,732 square miles, being itself almost as large as Ireland, and with a population of thirteen millions spread over 29,038 towns and villages. In Bhangulpoor the area was 18,000 square miles, the population 6,600,000, with 19,000 towns and villages. Rajushae contained 17,000 square miles, 8,800,000 population, and 26,000 towns and villages. Burdwan, 12,000 square miles, 7,000,000 of population, and 25,000 towns and villages, being a total of 88,386 square miles, nearly 31,000,000 of population,

and 128,000 towns and villages. Now these figures would give some clue to the magnitude of the question to be solved. Amongst the measures proposed, those which had been prominently put forward by the government were the great works of the Soane Canal, shown on the map, which had for some years been in progress, and the present occasion had been seized upon with great advantage to turn them to account. The water had already been turned on and made to irrigate a considerable quantity of land. Besides that there was the North Eastern Railway, which was to convey the overheated people of Calcutta to Darjeeling and the hills in the North, forming a continuation of the Eastern Bengal line. Besides that, there was a reference to the formation of roads from the centre of Tirhoot towards the Brahmapootra. Now he wished, with great humility, to make a few remarks on this question, on a point on which he had not as yet heard any distinct expression of opinion. They all knew that one of the dangers to be apprehended in case of famine, where the people became terrified, was that they should rush from their homes, which they would be the more induced to do by the attraction of these great works, and if some method could be employed to prevent this, it would be a great advantage. It must be remembered that they would have not only famine, but fever and other sickness to deal with. Now, when England had to deal with the cotton famine in Lancashire, how was it met? First, like prudent housewives, by cleaning out all the dirty corners, and putting the paths and roadways in order; and the result of Mr. Rawlinson's labours in Lancashire at that time was, that he had advanced those parts of Lancashire which he had dealt with by at least a hundred years. Now, it seemed to him worthy of consideration whether this calamity, which brought home trouble to every man's door, might not be made the occasion of improving, in the same manner, these vast communities. There were 128,000 towns and villages. What if each of these were empowered to examine the state of their conservancy, as it was called in India—their sanitary arrangements—and thus counteract those causes which were always ready to bear fruit in the form of fever and diseases of all kinds, when nature became weakened? How much might be done amongst these people if arrangements were made for improving those unhealthy conditions amidst which they live! It seemed to him that this was a method by which work might be provided for the people without taking them from their homes, calling forth industry in exchange for the food which would have to be provided for them. Strange to say, this country, where such a frightful calamity was apprehended for want of water, was more abundantly supplied than any with water in ordinary times, and the fact that famines occurred more frequently at some times than others was, he believed, due to the recurrence of cycles in the operation of the rainfall in those regions. They were under the tropics, and more subject to disturbances of the same nature which produced the monsoons, and no doubt it would be found that this recurrence of dry periods was one which arose from the same causes which brought about many of the other great phenomena of nature. One of the centres of this famine was bordered on one side by the Brahmapootra, and was intersected by many other rivers; it was a singularly fertile and populous district, and, ordinarily speaking, the rainfall was excessive. It consisted of 3,476 square miles, with two millions of inhabitants, and towns and villages to the number of 4,800. Yet in that populous district there were only two administrative officers, one to each subdivision, besides the magistrate of the district, and it might be imagined, therefore, what work would fall upon these individuals in such an emergency. It was evident that if this district were properly intersected with canals the water might be brought from the slopes of the Himalayas, and rendered available in case of deficiency in the rainfall. There was another point also of great importance, namely, inland navigation, with regard to which information was singularly deficient. During the administration of Sir George Campbell, however, he had already paid considerable attention to this question, and he hoped the occurrence of this calamity would call forth further attention to it. By a very rough estimate, which he believed to be greatly under the mark, there were at least 300,000 people employed on the inland waters. At one point of the Ganges, where it was concentrated in a single channel, about 100 boats per diem had been observed to pass during the six months of the year in which the least traffic took place, and fifty years ago Major Reynolds estimated that there were 30,000 boats on those waters. Considerable attention had been paid to the subject with reference to the Nuddya river and to those which crossed the Sunderbunds, but not to others, and he thought a great deal might be done in the establishment of landing places, and in various other matters for facilitating traffic, by which much labour might be employed. The subject of prohibition of export had been so well dealt with from his own point of view by other speakers that he would not detain the meeting by discussing it, but he must say one word with reference to Sir G. Campbell's last report. That report was unexampled in the history of Indian administration, for not only was it by far the bulkiest ever issued by any government, but it was the most readable, interesting, and instructive. It would be impossible to over-estimate the loss which India would sustain if Sir George Campbell should unfortunately fall a victim to his sense of duty, and he hoped both India and England would be sensible of the high example afforded by this great man in sticking to his post under such terrible circumstances.

Mr. Labapathi Jyah (of Madras) said that Sir Bartle Frere, in his able speech, though he had treated of the causes of the famine, the means by which it should be remedied, and what could be done to prevent a recurrence of such things hereafter, had omitted one cause, which, unless remedied, would, he was convinced, bring about the recurrence of famines in future years, however great might be the improvement in agriculture, and however numerous the canals which might be constructed. In order to explain this, it was necessary to go back a few hundred years, to the time when the Mohammedans conquered the country. According to their laws, as laid down in the Koran, it was their duty to murder all the male portion of the infidel population and take the females as slaves; however, instead of doing that they proposed to tax half the produce of the land, and this was the origin of the land-tax, by which even now between 40 and 50 per cent. of the whole land was taken by the government as revenue; because, when the English took possession, they followed the system which they found existing. That was the real origin of the land-tax in India. It produced about twenty millions sterling out of an annual total revenue of about fifty millions, and this was the real cause of famines. It was entirely a mistake to suppose that they were caused by deficiency of water. In the north-eastern part of the country there were numerous rivers carrying large quantities of water, and there, no doubt, canals would be of great use, as there would be enough water, even in case of failure of rain, for irrigating purposes; but in the southern part of the country, where the rivers were generally dry in the summer season, and where, in fact, there was not one stream which conveyed any large quantity of water to the sea, whatever number of irrigation works were made, they would not avert famine if there were a deficiency of rain-fall. As an instance, he might mention the irrigation canal in the district of Kurnool and Kuddapah, made by the Madras Irrigation Company. They found they were not able to get sufficient water to irrigate the lands on both sides of the canal, and consequently they made sluices on one bank only, leaving the other side perfectly helpless, and even on the side where the sluices were made

they were only able to irrigate, to a very limited extent, not more than two or three miles from the side of the canal. And there, although they were connected with the largest rivers in Southern India, he had known seasons when they were not able to supply water to a few acres which were connected with them. If there were no rains or floods in the river for a year or two consecutively, the canal would become perfectly dry and useless. Then, again, the Tanjore district was extremely well supplied with irrigation works; the water of the river Cauvery being very advantageously utilised. But this river rose in the Mysore country, and if large irrigation works were carried on there, the consequence must be that Tanjore must suffer. If any method could be suggested by which the waters of the river Godavery and the other great streams further north than the Ganges could be brought down to Southern India, such a system would be a real boon. He had already said that the land-tax was the great cause of the famine, and he might prove it in this way. If half of the produce of the land were taken away for the tax alone, and that in money, when the harvest was on the field, the cultivator, who had generally a very few acres of land, was obliged to sell his produce in order to obtain the money to pay the tax. Then there were other taxes as well, the local conveyance tax, the educational cess, the salt tax, and the income tax, all equally affecting the cultivators of the land, so that these men really were those who suffered most; in fact, the taxes were not fairly apportioned on the different classes of the community. As a consequence, however hard these cultivators might work, they were always in the condition of living from hand to mouth, without any reserve whatever. He did not allude to the zemindars, or great landed proprietors, who had hundreds of thousands of acres, but to those who really laboured on the soil. Such being the case where there was a failure of rain, these poor men could do nothing but sit at their doors and starve to death. Some people said that the permanent settlement in the Bengal Presidency had produced very great results, but it appeared to him that it went on a wrong principle, the only parties benefited being the zemindars, who got all the profit, whereas the cultivator or sub-tenant had to pay quite as much as half the whole produce to the zemindar himself. He did not say, because the land-tax produced all these evils, that it should be at once abandoned by the government, at a loss of revenue of twenty millions; but it ought to be laid down as a principle that it was a baneful tax, and one which would have to be ameliorated before the country could be improved. In his opinion, all which could be saved by retrenching expenditure, and by prudent courses, ought to be devoted to reducing the land-tax on the country. As far as the measures which had been taken to meet the present famine were concerned, he was convinced that the authorities in the country would do their best; and, indeed, all Hindoos were quite certain that Englishmen would do what they could; and the Hindoos themselves were never wanting in rendering help in such cases. He was in India in the years 1866, '67, '68, when there was a great famine in Dharwar, there being no rainfall for two or three years, and the ground being so dry that seed could not be sown. Thousands then died, and hundreds of thousands suffered severely from starvation. Not only did the government have recourse to works of various kinds, but he knew of hundreds of families of native cultivators who opened their houses to those poorer than themselves, and gave them freely of what they had, although it was simply gruel and water. He was quite satisfied that the Governor-General and Lieutenant-Governor, with all their officials, would do their best; but to prevent the recurrence of future famine the only effectual means would be to elevate the condition of the cultivators.

Mr. John Fleming said the discussion had lasted some considerable time, but yet they had heard very little about the effects of the famine or the measures taken to meet it, in fact the great heart of the question had not been gone into. It might seem rather a bold thing to call in question the wisdom of the measures taken by Lord Northbrook and Sir George Campbell, but this was a time when no one ought to hesitate to speak out boldly. When he said that the measures taken in India for dealing with this famine fell short of what was necessary, he felt that he gave utterance to a statement which required strong support; but still he believed that the able men who were now at the head of affairs in Bengal had failed to grasp sufficiently early the magnitude of the danger that impended. It was not strange that rulers should be frequently so slow to realise a danger, and so tardy in putting in action special means to meet it, because it was the natural tendency of the official mind to oppose action of all kinds, and in fact it was a duty forced upon them by the continual pressure from without to do that which it was not expedient to do. On this occasion, fortunately, our rulers seemed to have been more early aroused to the proximity of the danger than on any previous occasion, but still he thought the measures adopted were inadequate. On the occasion of the first meeting he had been much struck with the measures sketched out by Sir Bartle Frere to meet the difficulty, when he said that the government must "declare war upon the famine," and fight it with all the intelligence and prodigality of resource with which we should wage war against a powerful and deadly enemy. After referring to the measures advocated by Sir Bartle Frere, he said that he himself was a merchant, and therefore should be the last man to despise commercial enterprise, but he believed that if that alone were trusted to in this matter to supply food for Bengal, it would be utterly inadequate, and if that course were persisted in, it would land them in an unparalleled calamity. What was the history of all famines? They had tried to apply the law of supply and demand, and people had died by thousands, tens of thousands, and hundreds of thousands, and if they continued to trust to the same means people would now die by millions. Mr. Saunders had already given a very valuable sketch of the real state of facts in Bengal, but he might be excused for still further impressing upon the meeting the magnitude of the danger. According to the latest official accounts, the failure of the crops extended over districts containing about 29 millions of people, and it was estimated that the failure would be equal to $\frac{10}{16}$ or $\frac{12}{16}$ths of the whole. In other districts, containing even a larger population, there had been such a failure of the crops that, although actual famine might not ensue, there would be great scarcity, and that over the whole of Bengal, containing about 60 millions of inhabitants, the crops would not amount to more than one-half of the average. Now, if Bengal were in the habit of exporting or importing largely, such a failure would not be so dire a calamity, but Bengal imported no food, and exported very little in comparison to the amount it produced for its own consumption. The average consumption per head was three quarters of a seer, or one and a-half pounds per diem per head, which was equal to about 50 millions of tons per annum for the whole district. Now, the exports of all kinds of grain were something less than 400,000 tons.

The Chairman asked if Mr. Fleming meant that the whole agricultural population consumed per head, men, women, and children, a pound and a-half of dry grain per day, which was equal to three pounds of boiled rice. He did not think it could be quite so much as that?

Mr. Fleming said he had taken his information from the late Col. Baird Smith, who calculated in 1861, with regard to the North-West Provinces, that every individual consumed a pound and a-half of grain per day. But even supposing it to be an over-estimate, taking it at eight millions instead of fifteen, then, seeing there

was a failure to the extent of half the crops, there would still be a deficiency of four millions to be got. Even after making allowance for the stocks in the country, and the economy practised under the pressure of high prices, there would still remain such a deficit of food as would tax all the resources of the empire to supply them. These circumstances, he believed, had not been realised by the rulers of India. Either the statements published regarding the failure of the crops were very much exaggerated, or else the measures they had taken were wholly inadequate. Whence was this immense quantity of food to be procured, from what means, and what time was there at their disposal? Ten days previously he had telegraphed to Calcutta to ascertain the facts as to stocks, so far as they could be ascertained, and the reply he received was that the stocks were very small. That was quite consistent with facts within his own knowledge. He knew that for years past there never had been any large stocks of old rice obtainable in Bengal. Then it had been said that supplies could be obtained in the North West, from Central India, and the Punjaub. Now, in July last, he endeavoured to purchase wheat at Cawnpore, but although he offered 50 per cent. above the usual prices, he got but very little, as the first stocks were said to be exhausted. More recently, when he had endeavoured to buy wheat in Central India, at Jubulpoor, he found there were no stocks at all. During the past year the price of wheat had been very high, and there was a large demand for it in Scinde, and yet during the whole twelve months only about 23,000 or 24,000 tons had been sent from Kurrachee. That would give some indication of what surplus of food there was in that great province. In fact, the people of India were not in the habit of producing quantities of food to be stored up for future use, and in the Punjaub they were more accustomed to produce oil seeds, and other things that could be more readily sold, and their stocks of food stuff had not been large. A hundred thousand tons seemed a very large figure, but it was really nothing to meet this great void which had to be filled up in Bengal. With regard to sources of supply outside Bengal, he might say that Madras would only be saved by a timely fall of rain, and, in fact, the province was actually importing grain now. The only great source of supply in the East was Burmah, and it was within his own knowledge that, at this moment, ships were chartered for the conveyance of grain from Burmah to Europe to the extent of 250,000 or 300,000 tons of that crop, nearly one half their available surplus. It appeared that no effort was being made to purchase food for Bengal. They were waiting for the ordinary operations of trade. Within the last fortnight a large quantity of rice had been sold in London at a profit, which had been exported from Calcutta, and though those very men who exported it knew, if they kept it at home and waited a little, they would probably get a much larger profit there. But the natural operation of trade was to take a quick profit and send away the food; in fact, trade did not recognise compassion, and thus, if the people were to be left to the natural operations of trade, they would be left to starve. As to the conveyance of food, if the deficit was to be measured in millions, it was an enormous amount, and to give some conception of what two and a-half millions of tons of food was, he might mention that the total trade of Calcutta, export and import, only amounted to two and a-half million tons per annum. That would give some idea of what it was to import such a quantity of food into Bengal. Again, the total traffic on the East Indian Railway, including the Jubbulpoor section, was only 900,000 tons in the year. With such a work to be done, therefore, every day was important, in order to get the food into the country while it was still open to traffic, because it must be remembered that although along rivers and canals communication was open all the year, that did not take food up to the doors of the people, and as soon as the rainfall began, Bengal became practically impassable, except where the main road or a railway passed. He understood that the government had laid down the principle for themselves, that they should provide work and food for the very indigent people who had not the means of paying for it, but those who had means should be left to the operation of commercial enterprise; but he believed that if everything possible were done, and if every day and hour at their disposal were employed, and every source of supply throughout the world ransacked, they would fall all too short of what ought to be done, and still many would perish. It was this conviction which had induced him to speak as strongly as he had, in the hope that public attention would be aroused, and every pressure brought to bear upon the government to induce them to strain every nerve to meet this great calamity.

Mr. Peterson said he had some experience in Bengal, and took a lively interest in the country, being largely concerned in public works there. The first question was to meet the famine, and then afterwards they might discuss what could be done to prevent such occurrences in future; and really, when one came to consider the figures now put forward, it was appalling to see the magnitude of the danger to be met. The real state of things was not yet ascertained, but he had letters in his pocket, some stating that it would be a four-anna crop, which was equal to about a quarter of the average, and others said a five-anna, but in no one single letter which he had seen was it estimated that in these districts would there be more than a 6-anna crop. It must be recollected, however, that the greater part of Bhangalpoor was only a partially rice-eating country, and that the failure of rice would not affect them so much as in the lower parts. But it must also be borne in mind that the wheat had to be put in the ground in October or November, and from the accounts he had heard, the ground was then so hard that the seed would not enter. Therefore there was a population in round numbers of 30 millions who required food, and with regard to the quantity which they required he did not hesitate to say that Mr. Fleming was under the mark in putting the average consumption of a man, woman, and child at three-quarters of a seer of rice per day. Taking seed, and everything else, he believed it would be more correct to say one seer, and he had had a great deal to do with the inhabitants of that district, having purchased rice largely during the famine in 1867 in order to provide for the people in the employ of the company with which he was connected. It was evident, therefore, that some energetic action was necessary in order to provide food for these people, especially bearing in mind that every man woman or child directly or indirectly paid 5s. a year in taxes. As a mercantile question it was very difficult to find fault with what had been done, and knowing the energy of Sir George Campbell and the Governor-General, he had no doubt that when they once brought their minds to realise the extent of the danger they would do—as the Indian service always had done—their duty nobly and well. However, the agitation of this question in England would strengthen the hands of the government and let them know the public eye was upon them, and that they would be supported in the expenditure necessary, but would not be allowed to let one single case of starvation happen if it could be avoided. He came to the conclusion, taking the production of the country at one seer a head per diem, and assuming there was a crop of six-sixteenths of the average, there would be a deficiency of at least four or five million tons. Now where was that to be purchased? The whole of the ports to the eastward had not exported at any time 1,300,000 tons, so that that was a very small part of filling up the void. Bengal itself had no resources, as was shown by the small quantity of exports, because people did not grow wheat and store it up for the insects to eat. He did not believe that the export of cereals from Calcutta ever ex-

ceeded 500,000 tons. He feared there would be great difficulty in meeting the demand, but they must do all they possibly could in every way to save as many as possible, and he was afraid, doing their utmost, they would save but few. Now as to the future. He believed if vigorous action were taken they might be able to save the present, and, at the same time, to prevent the recurrence of famine in the future. Let the country come forward prepared, not for an expenditure of one million or two millions, but prepared to pay as for an expensive war, twenty or thirty millions, and not lose a soul if they could help it, and let them get the equivalent in labour for the money expended, and try if possible to put India beyond the possibility of want for the future. There had been a considerable contest going on for years between the Neptunists and the Vulcanists, Sir Arthur Cotton being at the head of the Neptunists, and others at the head of the railway system. What was past could not be undone; but India had now railway sufficient for all military purposes, though she still wanted a cheaper mode of communication, so that there might be an inducement to the natives to grow cereals and other things in the centre of the country which might be transported at a less rate than the railway companies could carry it. A short time ago a most able letter from Sir Arthur Cotton had appeared in the *Daily Telegraph*, and he need not therefore repeat his arguments. But he believed that if the Soane Canal, which had been before the public for years, had been completed with proper vigour, the whole country would have been intersected, there would have been abundance of water and plentiful crops. The evil of delay was shown in the fact that four millions of revenue were now endangered in that very district; whilst a gentleman near him, who knew Patna very well and its necessities, assured him that if the canals had been made this disaster would not have occurred. It was very difficult indeed to find work for all the population, but instead of 40,000, 400,000 ought to be put upon these works so as to finish them at once, so that the government might have some return for the outlay as soon as possible. It was said, as an objection to this irrigation system, that the revenue must pay for all these works, and that they had no right to pledge posterity. He denied that position. That principle was not acted upon in America, where posterity was pledged for the benefit of the present; and he hoped that now a number of the plans for irrigation, which had been proposed years ago and laid by, would be brought out and carried into execution. This was the third famine which he had witnessed in India. Some five or six years ago there was a great scarcity in the north-west, with reference to which they had the report of one of the ablest men who had ever entered the Indian service, Colonel Baird Smith, who showed what had been done, and what could be done, but nearly all of the plans then proposed had been shelved, and nothing done to carry them out. Yet, as Sir Arthur Cotton showed, 130 millions sterling had been spent on railways, whereas if canals and irrigation works had been made, they would not have had only a means of conveyance, but also a means of preventing calamity for the future. He recollected that when the irrigation works were started, it was asked how would it be fair in Bengal, where there was the perpetual settlement, to make the cultivators pay for water which they did not want. Now, he was quite ready to admit that, taking the whole of the left bank of the Ganges, it was not above once in twenty years that water was required. The Ganges seemed to be a great drain, which absorbed all the water and intercepted it from going to the right bank, but he did not hesitate to say that there was not one district or one inch of ground on the right bank of the river which would not be the better for water, and where they would not be doing a service to the cultivator in compelling him to pay for it. Englishmen were accustomed in analogous cases to do the same thing. Thus, the Commissioners of Sewers compelled every person who was directly or indirectly benefited by the making of embankments, sea walls, and the like, to bear a share of the expense, and if these constantly occuring famines were to be provided against, it was the part of a bold statesman to say, "We will not allow this to occur; if you choose to exert yourself and make use of the water you will be amply repaid for the taxation we impose, but whether you use it or not you must pay for it." He had been much pleased with that part of Sir Bartle Frere's speech which referred to the uselessness of hampering the government with impractical suggestions, but still he thought it was as well that the governors of India should know that the people in England were watching with interest the steps they took, and that while any necessary expenditure would be sanctioned, starvation, in any shape whatever, would not be allowed.

Mr. W. Tayler, late Commissioner of Patna, said that although the discussion which had taken place was exceedingly interesting, still he thought there was a certain want of practical utility in many of the points discussed. He might perhaps be looked upon as one against whom the ancients used to warn their disciples, *Homo unius libri*—a man of one idea—with regard to the cause of the famine, but he certainly must contend that the famine was caused by want of water. Now, water had been given by the Almighty, and in no limited quantity to India. It came down in volumes, and only required to be properly utilised. The English prided themselves on their scientific knowledge, and they had the means of utilising that water in unlimited quantity, and by so doing they might really prevent the possibility of famine. This was a most practicable point. A nation going to war was not content with conquering its enemy in a single battle without providing for future peace, and the father of a family laid up money for his children and posterity. In the same way it was their duty as a nation to recognise their responsibility, and acknowledge the truth that it was their own miserable short-sighted policy which prevented them saving millions of lives, and that a terrible responsibility would rest upon them for all future time if they did not insist upon the government of India adopting those plans which the Almighty himself had pointed out, and which would be entirely sufficient to prevent one life from being destroyed. This might be thought enthusiastic, but he maintained that it was a simple physical fact. With plenty of water and means of intercommunication, no single life need be sacrificed from agricultural scarcity. All that was necessary was to carry out with zeal, vigour, and conscientiousness the task which God had placed before them. He was acquainted with every district in Bengal, some pleasantly and some unpleasantly, and some parts he was very familiar with indeed. He had seen the people and conversed with them, and knew their characteristics and weaknesses. If the canal works depicted on the map were only completed, the country would be saved from all further distress; and if the English left the country to-morrow, at least they would be able to point to something in which they had fulfilled the duties committed to their charge. One hundred years ago, when England first entered on this mighty task of governing India, nature placed before her, as it were, a warning and an example; for in 1770 one of the most fearful scenes ever witnessed by humanity took place, namely, a famine, in which ten millions of people were swept away. That might have been accepted as a warning, and probably it was by some people, but circumstances prevented the government for many years from doing anything towards preventing a recurrence of such catastrophes. After fifty or sixty years there was a little brighter prospect, but then things were altered, and Sir Arthur Cotton had almost singly for many years been advocating the recognition of the great fact that, in a country dependent entirely on water for its subsistence, a country whose population was numbered by

millions, the first great object must be to provide that water, necessary for the crops, to save the lives of the population. Why should not this work be done? They had the necessary knowledge, they had money, and there was the water; they only required the will. For the last five years they had had Governors and Lieutenant-Governors who seemed by their vigour and activity to be marked out for the execution of works like this, and he felt sure they would not fall short in the discharge of their duty. Believing that they would fully recognise the responsibility cast upon them, that they had the ability, the means, the knowledge, and the experience, he thought they would be equal to the occasion, and rather doubted whether it was wise to trouble them with too much advice. He hoped that Englishmen would confine themselves to the advocacy and support of this one great measure, which he believed to be so essential—the employment of our skill, our science, our experience, and our money to supply the dry fields of India with water, and at the same time with a cheaper means of communication. If this were done, though twenty millions died this year, twenty thousand millions might be saved during the next fifty years. If one could imagine one's-self on some lofty elevation, looking down on these millions in India, governed by a few white faces, and see the railways and the palaces, and the profligate expenditure, compared with the wants of the country, it would surely be a startling sight. Even the railways would appear almost criminal, and the palaces and other expenses to be a scandal and an offence so long as the people of the country were deprived of that which was necessary, not only to their comfort, but to the preservation of their lives—a sufficiency of water.

One or two gentlemen arose to address the meeting, and suggested that the conference should be again adjourned.

Mr. Hyde Clarke, however, explained that the room would not be at liberty for the purpose, otherwise the Council would have been very happy to accede to the suggestion.

The Chairman said under these circumstances he must impose upon other gentlemen the same silence which he should practice himself, although he should have liked to have said a few words, and would call upon Sir Bartle Frere to close the discussion.

Sir Bartle Frere said he could not help thinking that, short as the discussion had been, compared with the importance of the subject, good would have been done by what had been brought forward, and doubtless many of the suggestions made would not be fruitless. While he agreed with all that had been said with regard to the authorities in India, it was quite true that in a case like this bystanders saw as much of the game as, and sometimes more than those who were playing, and he had not the least doubt that the practical suggestions of gentlemen like Mr. Peterson and Mr. Fleming would afford to those at a distance most valuable hints with regard to what should be done. He entirely agreed with what had been said regarding the practicability of everything which had been proposed by Sir Arthur Cotton, and by the large and increasing school of his disciples. In fact, Sir Arthur Cotton might, he thought, now congratulate himself that the battle he had so long fought was won. The question was now one simply of expense, but with regard to that point he would remind the meeting of what he had said at the beginning, that this was a matter which rested more with England than India. A very few years ago, when Lord Lawrence was Governor-General, the measures which had been proposed at different times by Sir Arthur Cotton and his school were one by one brought forward, a great many of them matured and put in shape for execution, and Lord Lawrence laid before the public and before the government very large schemes for the execution of those works by means of capital to be borrowed in such a form as to lay a portion of the burden on posterity. This was the policy suggested by the practical sagacity of Mr. Peterson and Mr. Fleming, regarding the wisdom of which he never had the slightest doubt. But here, at home in England, obstacles were found, and he would beg gentlemen who had any voice in the legislature to consider this matter seriously. If it was the view of those who had directed the government of late that India should not be allowed to throw any burden of this kind on posterity, it was quite time it should be altered. But after all, the main point was the present—how was the famine to be met, and with regard to that, what had been said was of the greatest possible value. He was quite sure that whether the calculation which had been made was strictly correct or not, the way in which the subject had been dealt with would throw a great deal of light upon it, and it would be most valuable in determining what was to be done. The task was truly an enormous one, but even in these days the facilities derived from a vast amount of steam-power were hardly yet realised, and when they were brought into play, together with the means of immediate communication with the remotest markets by the electric telegraph, he had not much fear of the result. He did not think that within four months it was at all impossible to throw such a large amount of grain into India from different quarters, perhaps many of them most unexpected, as would enable a great deal more to be done than just at the present moment might appear possible. At any rate, he was quite certain it was only necessary for the able men at the head of affairs in India to realise the full extent of the task before them, and everything which men in their position could do would be done.

Mr. Eastwick, C.B., M.P., proposed a vote of thanks to the noble chairman who had so ably presided over the conference; and he must notice that after all the grand duty of England to India was to send able men to govern it, and he hoped that this duty might always be recognised, and that men like their chairman, who had taken his full share in the task of government, might still be forthcoming and sent out as occasion rose.

Mr. Hyde Clarke seconded the proposition, and hoped they might again have the benefit of the presidency of the noble chairman on future occasions; and he begged to say, that should it be necessary to hold any further conference on the subject, the Council of the Society of Arts would, he was sure, give all the aid in their power. He must beg also, on behalf of the meeting, to thank Mr. Trelawny Saunders for the loan of the valuable map which had added so much and so graphically to the practical information afforded during the evening.

The proposition having been carried unanimously, and briefly acknowledged by the chairman, the meeting separated.

The Executive Committee of the Glasgow Technical College have resolved to take steps to establish a weaving school.

Railway extensions are being developed with all possible vigour in Queensland. On a line from Ipswich to Brisbane considerable progress has been made. There are several cuttings in a forward state, and the embankments have also been progressing well.

In Germany alone the manufacture of beetroot sugar from 1,400 tons in 1837 had expanded to 263,000 tons in 1871. There was also an increase of 150 per cent. in the amount of sugar consumed per head between these dates.

The Syndical Chamber of Paris have determined on the formation of a Commission of Commercial Geography, which is intended in the words of the report, "to furnish export commerce information which may aid its development, and encourage geographical studies and discoveries."

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

Sir,—Her Majesty's Commissioners for the Annual International Exhibitions propose, as a feature of each year's Exhibition, to have a collection of objects illustrative of the ethnology and geography of various races and parts of the British empire.

It is intended to pursue the work systematically, in the hope of ultimately forming a complete museum.

The commencement of the series in 1874 will, as far as possible, have reference to the West Coast of Africa, and with this view the Commissioners will be much obliged by publicity being given in the *Journal of the Society of Arts* to the enclosed paper on the subject.

The Commissioners are desirous of receiving offers of suitable objects either as gifts or on loan, for the period of the Exhibition of 1874.—I am, your obedient servant,

Henry D. Scott, Major-General.
Secretary.

Upper Kensington Gore, London, S.W.,
December, 19th, 1873.

Her Majesty's Commissioners have resolved to commence, in connection with the series of International Exhibitious, permanent collections which shall illustrate the ethnology and geography of the different portions of the British dominions, and ultimately form a great national museum of the empire upon which the sun never sets. They will be arranged for the present in the galleries of the Royal Albert-hall. Many portions of the empire are inhabited by aboriginal races, most of which are undergoing rapid changes and some of which are disappearing altogether. These races are fast losing their primitive characteristics and distinguishing traits.

The collections would embrace life-size and other figures representing the aboriginal inhabitants in their ordinary and gala costumes, models of their dwellings, samples of their domestic utensils, idols, weapons of war, boats and canoes, agricultural, musical, and manufacturing instruments and implements, samples of their industries, and in general all objects tending to show their present ethnological position and state of civilisation.

It is proposed to receive for the Exhibition of 1874 any suitable collections, which will be grouped and classified hereafter in their strict ethnological and geographical relations. As, however, there is at present great public interest in the various tribes inhabiting the West Coast of Africa, including the Ashantees, with whom this country is at war, all objects relating to the Ashantees, Fantees, Dahomeys, Houssas, and the neighbouring tribes are especially desired. The Indian empire, the Eastern Archipelago, and the islands of the southern hemisphere, are also able to afford abundant and valuable materials for the proposed museum, of which it is believed that the nucleus can be formed at once from materials in private collections.

Her Majesty's Commissioners confidently appeal to the civil, military, and naval officers of the British service throughout the Queen's dominions to assist them in these collections.

Her Majesty's Commissioners have secured the services of eminent gentlemen to advise them from time to time in giving effect to these intentions.

It is requested that offers of gifts and loans of objects should be made known at once to the Secretary of her Majesty's Commissioners, Upper Kensington-gore, London, S.W.

The third meeting of the Committee for Leather, Saddlery and Harness was held on the 20th December. Major Sir W. Palliser, C.B., in the chair. There were also present Captain Fenn, Messrs. Essex, Hooper, Husband, Jones, Leek, Norris, Oldaker, and Rickatson.

The second meeting of the Sub-Committee for Sanitary Apparatus and Construction was held on Tuesday, 16th instant, Dr. W. Hardwicke in the chair. There were also present Mr. W. Clode, Captain Douglas Galton, C.B., Messrs. C. Gatliff and George Godwin, and Dr. George Ross.

The second meeting of the Committee for Scientific Inventions and New Discoveries was held on the 19th December, Mr. C. B. Vignoles, F.R.S., in the chair. There were also present Mr. F. J. Bramwell, Major Bolton, Major Du Cane, Professor Goodeve, Messrs. J. Hick, J. Ramsbottom, and T. Sopwith.

The Indian Government has placed a grant of 500,000 rupees at the disposal of the Committee for the Kensington Exhibition of 1874. The following gentlemen are to form the Bombay Committee:—Colonel Ballard, R.E., Colonel Fuller, R.E., Colonel Hancock, R.E., Kahandas Muncharam, Esq., J. Adams, Esq., T. Ormiston, Esq., M.I.C.S., A. W. Ford, Esq., and C. Banks, Esq. Mr. Terry will act as secretary, under Colonel Ballard as chairman.

PUBLIC MUSEUMS AND LIBRARIES.

The following returns of the numbers of visitors for November (some of which have already been published) have been made up to the present date:—

	Number of Visitors.
National Gallery (Trafalgar-square)	75,708
Kew Gardens and Museum	7,707
South Kensington Museum	58,134
Bethnal-green Museum	35,636
Geological Museum, Jermyn-street	3,739
Patent-office Museum	17,143
Edinburgh National Gallery	none*
Edinburgh Museum of Science and Art	26,392
Edinburgh Museum of Antiquities	none†
Royal Dublin Society:—	
Natural History Museum	4,946
Botanic Gardens, Glasnevin	5,376
Dublin National Gallery	
Zoological Society, Dublin	6,258
Museum of Irish Society, Dublin	
Tower of London	5,711
Royal Naval College, including Greenwich Painted Hall	26,341

* Gallery shut. † Museum shut.

SIR F. KNOWLES ON THE MANUFACTURE OF IRON.

The following letter appeared in *Iron* last week:—

"Sir,—I have read with some interest your report of Mr. Isaac Lowthian Bell's remarks on Sir Francis Knowles' paper, which had been read before the Society of Arts about a fortnight ago. In that report you make Mr. Bell to state that he met Baron Gruner at the Langley Mill Works, and while there they both agreed in an opinion, in which they were confirmed by the observations of Mr. Williams, that the process could have but one termination, and that a failure.

"I am sorry to see such a statement made by Mr. Bell, as I am bound, in the interest of truth and in justice to myself, to contradict it. In the first place, Mr. I. L. Bell was only a very short time at the Langley Mill Works, and while there he could not come to any opinion by observation, as the process was not in operation. He himself told me at the time in question that his only fear as to the adoption of the process would be the difficulties

attending the supply of nitrate of soda. He farther added that, could carbonate of soda be substituted, the matter would, to his mind, be likely to succeed, as that could be manufactured in England. Second, Mr. Bell and Baron Gruner never met at the Langley Mill Works, as Mr. Bell was compelled to leave the works before Baron Gruner arrived there, and I went on with Mr. Bell to the Langley Mill railway station, in the hope of meeting Baron Gruner, whom I was expecting, with other gentlemen, from Paris. In this we were not disappointed. The company arrived shortly after we got to the station, which gave Mr. Bell an opportunity of having a few words with Baron Gruner, as Mr. Bell's train had not come up. I was present during the whole of that interview, and certainly Mr. Bell never then stated that he believed the process to be a failure; however, he did make the same statement to Baron Gruner that he had made to me relative to the difficulties attending the supply of nitrate of soda, and suggested for Baron Gruner's consideration the adoption of carbonate of soda. This I distinctly remember, as Baron Gruner, when he came to my office, wrote out a formula as to the reaction that would probably take place where carbonate of soda was used as a substitute for nitrate. This formula I have at my house at the present time. Third, Baron Gruner had not, at the time he met Mr. Bell, formed any opinion, he being one of a deputation of three that had come from France for the purpose of investigating the merit or demerit of my process. Fourth, I enclose an extract from Baron Gruner's report of the investigation referred to, which will show that he did not entertain an opinion, at the end of his investigation, that the nitrate of soda process is as complete a failure as Mr. Bell would make it appear.

"The following extract is from the last paragraph in Baron Gruner's report:—'It is certain that the Heaton process, properly carried out, would seem to realise purification of common brands better than any other known method. We are not, however, as yet in a position to affirm that the purification is as complete as we could wish.' These words cannot be from the pen of a man that looks on the process as a failure; and if any one will take the trouble to read his report, they will see that he does not so look on it, but considers it a process of the greatest importance.

"In conclusion, I say that the Heaton process never failed from a commercial point of view, which statement can be proved by any one taking the trouble to examine the books of the old Langley Mill Company. Its misfortunes were legal, not commercial.—Yours, &c.,

"John Heaton."

NOTES ON BOOKS.

A Dictionary of Artists of the English School.—By Samuel Redgrave (*Longmans, Green, and Co.*, 1874).

It is perhaps only those who have experience of the amount of labour required in literary and biographical researches who can appreciate at once the value of such works as this, and the extent of patient and careful toil their preparation involves. The work is by their help done once for all, and future labourers in the field are saved time and trouble; but then, if the work is to be worth anything at all, it must be compiled with such minute accuracy, such wearisome exactness, that it is small matter for wonder if the number of good biographical dictionaries is so limited. In this respect we English fall far short of the French, whose talent for dictionary-making is unrivalled; and if it were said that we have yet to wait for a good general biography, though the statement might be contradicted by interested parties, it would not be easy to disprove it. Till the preparation of such a work we may well be content with dictionaries whose field is narrower and whose aim is more special, such as the one now under discussion.

The definition of "artist," as given by Mr. Redgrave makes the word include painters, sculptors, architects, engravers, and ornamentists, while he has included not only such as were actually born in the country, but also foreigners who lived and worked in England, and who have therefore a right to be considered as belonging to the English School, rather than to that of the country where they were actually native. It has seemed preferable to the author to widen, rather than narrow, the scope of his work; and he has, therefore, seen fit to include a few artists, whose right to appear may seem questionable, rather than risk the omission of any who should have been included. The slight additional length of the book will be objected to by but few, while its superior completeness will certainly be considered a merit by very many.

The notices are in every case as short as they could well be made, consistently with the need for giving a due amount of information; and the intention of the writer has obviously been, not to forward the claims of this or that school, of one artist or another, but to collect and arrange in a clear and simple form all needful information about the life and the works of the artist. In most instances the amount of space allotted to each person is proportionate to the importance of his works, and where this has not been done it is only in the case of ancient artists, where it occurs not unfrequently that the amount of memoirs left by some obscure artist greatly exceeds the amount existing of one of eminence.

The number of names included may surprise some who consider that the English are not an artistic people but Mr. Redgrave has endeavoured to make his book as exhaustive as possible, and he has included very many whose claim to the title of artist is but slight. It is hardly necessary to say that the names of living artists are not included. The information, however, is brought down to so late a point that a full biography of Sir Edwin Landseer is given.

To members of the Society there is one cause of congratulation that is brought very prominently forward by the book, and that is the great number of artists who were assisted in early life by its prizes. It is very satisfactory to see again and again that men who rose to be great and distinguished artists have been helped in their first start in life by the Society's recognition and endorsement of their powers. There is here a plain proof of the good work done in former days, and an encouragement to persevere in the present.

The Law of Trade Marks. By F. M. Adams, B.A., Barrister-at-law. (*G. Bell and Sons.* 1874.)

Though there appears some probability of a change in the law, Mr. Adams considers that an analysis of a large number of representative cases under the present law will not be without its value. This is the form the present volume takes. The principles of the law are stated under various headings, and the illustrative cases classified in accordance, as is usual with legal books devoted to a special subject.

MEETINGS FOR THE ENSUING WEEK.

Tues....Royal Institution, 3. Prof. Tyndall, "On the Motion and Sensation of Sound." (Juvenile Lectures.)
Anthropological, 8.

Thur....Royal Institution, 3. Prof. Tyndall, "On the Motion and Sensation of Sound." (Juvenile Lectures.)

Fri......SOCIETY OF ARTS, 8. Mr. Frank Buckland, M.A., "The Structure and Habits of Beasts, Birds, and Fishes, as showing Beauty and Design." (Juvenile Lectures.)
Geological Association, 8.

Sat......Royal Institution, 3. Prof. Tyndall, "On the Motion and Sensation of Sound." (Juvenile Lectures.)

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No. 1,102. Vol. XXII.

FRIDAY, JANUARY 2, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

JUVENILE LECTURES.

Members are requested to take notice that no person, member or other, can be admitted without a special ticket to these lectures. The attendants have strict orders to carry out this arrangement, which is made solely for the convenience and comfort of those attending.

(By order.) P. Le Neve Foster.

POST-OFFICE SAVINGS BANKS.

DEPUTATION TO THE POSTMASTER-GENERAL

On Tuesday afternoon, by appointment, a deputation waited on the Right Hon. Lyon Playfair M.P., C.B. (Postmaster-General), on the subject of a memorial presented by the Society of Arts, having for its object an extension of the advantages of Post-office Savings Banks. The deputation consisted of Sir Daniel Cooper, Bart., Mr. Robert Rawlinson, C.B., Mr. G. C. T. Bartley (secretary to the Provident Knowledge Society)*, Mr. E. C. Tufnell, and Mr. P. Le Neve Foster. The Postmaster-General was attended by Mr. F. J. Scudamore, C.B., Mr. A. Christie Thomson (Controller of the Savings Bank Department), and Mr. Rodie Parkhurst.

Sir Daniel Cooper, Bart., said—I have been asked to introduce the deputation, in order that it may bring under your notice a memorial sent in by the Society of Arts. There are certain points which we wish to impress upon you, to see whether, with your large establishment, you cannot give us some assistance, so as to extend the Post-office Savings Banks, and make them better known among the poorer population, in parts where it is almost impossible to spread information. In these parts it is thought the Post-office might lend a helping hand; but Mr. Bartley, who has given the subject a great deal of attention, will bring the different points more prominently before you.

Mr. G. C. T. Bartley read the following address:—

"On the 11th April, 1872, the Society of Arts sent a memorial to your predecessor, the Right Hon. W. J. Monsell, urging that the following alterations in the Post-office savings banks and other means of encouraging thrift were much required:—

"1. The opening of the Post-office savings banks in the evening, particularly on Fridays and Saturdays.

"2. The abolition of the restriction that whole shillings alone can be paid into Post-office savings banks.

"3. The reduction of the minimum deposit, now fixed at one shilling.

"4. The abolition of the following rules:—

"*a.* That no depositor may pay in more than £30 in any one year.

"*b.* That no depositor may have more than £150, exclusive of interest, in the Post-office savings bank.

"*c.* That no depositor in the Post-office savings bank may be a depositor in any other savings bank.

"5. The greater ease and readiness of withdrawing money, both by depositors and after the death of the depositors.

"6. The introduction of some plan of providing in all small villages where a post-office is established a Post-office savings bank, to be open periodically.

"Since that time the third report of the commissioners appointed to inquire into the friendly societies has been published. From this we are further convinced that extensions and increased facilities are more than ever required; and from the evidence given by Mr. Scudamore we are led to imagine that the Post-office is not unfavourable to carrying out decided extensions in the facilities afforded for encouraging thrift among all classes.

"We would wish, in the first place, to urge the adoption, at as early a date as possible, of the first four points referred to in the above memorial. It seems to us that the minimum deposit of one shilling would with great advantage be lowered. The difficulty is to induce persons to *begin* putting by, that is, to open an account, and the lower sum this can be commenced at, the less effort it requires to make the start. In agricultural districts also, a shilling can rarely be spared at a time, except at harvest. We also think that the maximum sum which may be paid into a Post-office savings bank during one year, might, with great public benefit, be raised above £30; and also, that the maximum amount to be held by any one person, which is now fixed at £150, and with interest at £200, should be made considerably higher. It seems indeed hardly wise to make any limit to the amount to which the accrued interest on an account shall rise, and the arbitrary stopping at £200 does not seem to be based on any definite principle. It often induces a depositor to draw his savings out just when they are getting of great value to him, because they would lie without interest in the Post-office savings bank, and to embark them in some dangerous investment of which he knows little, whereby he is at great risk of losing the fruits of many years of care. These points we dwell on at considerable length in our memorial, and in the memorandum sent with it, and we have sought this interview for the purpose of bringing them especially to your notice.

"We have also particularly in view the adoption of paragraph 6 of the memorial, at as early a date as possible, or of some provision of a similar nature. This paragraph urges the introduction of some plan of providing a means for the Post-office collecting money under the ordinary rules of a Post-office savings bank in all villages where a Post-office exists, but where no Post-office savings bank business is at present carried on.

"At the present time there are, as nearly as may be, 2,750 Post-office savings banks in England and Wales, that is leaving out London and a few of the large cities. This gives one savings bank to every 21 square miles; or, supposing they were all placed in the most advantageous position, each bank would embrace a circle with a radius of nearly three miles. Scotland and Ireland we have omitted from this calculation, not that we wish to exclude them from the advantages we seek to obtain for England and Wales, but because the nature of the countries would render this estimate inappropriate.

"As a matter of fact, however, very many places, instead of being only three miles from a savings bank, which of itself is too far, are considerably farther, so

* Offices, 112, Brompton-road, London,

that the inhabitants are practically debarred from making use of this excellent provision which the country has established for them. Money obtained in harvest and other times is often dissipated, instead of being kept for the winter, as it might be if it were at once put away; and further, persons who are willing to save regularly in small, though to them very important sums, find it impossible to do so, as they have not learnt, and are not likely to learn, the art of literally keeping money in their pockets, which are never over-full, without its very soon burning a hole in them.

"The educational advantage of accustoming persons to a Post-office savings bank account is also not unimportant. But the great antidote to intemperance, which a habit of thrift almost invariably is, can hardly be over-estimated.

"We would urge, therefore, that at least in all villages where there is a Post-office—and there are about 9,000 Post-offices, exclusive of pillar boxes, in England and Wales, or more than three times the number of savings banks—that one of the officers of an adjacent Post-office savings bank be sent, once or twice a week, as the case may be, in the evening, if possible, in order to hold a Post-office savings bank at the village Post-office—that is, to take deposits and to pay withdrawals under the ordinary rules.

"We would also urge that the proposal made by Mr. Scudamore, before the Friendly Societies' Commission, of making some of the postmen collectors from door to door, be also taken into serious consideration as soon as possible.

"Further than this, it would seem desirable if some arrangement might be made by which a collector of the Post-office could visit manufactories, works, and other places (when invited officially to do so by the authorities), in order to hold a savings bank at some fixed time each week. Persons who are willing to put by are very apt to find it difficult to go to the bank. By this means the bank would be brought to them; a step so pointedly recommended a short time back by Lord Derby, in his address at the annual meeting of the Provident Knowledge Society. This collector might either be a regular officer of the Post-office, or one of the employés at the place of business specially authorised by the Post-office. The success which this would be likely to secure has been clearly demonstrated by the Provident Knowledge Society, which, in taking advantage of the Post-office Penny Bank arrangement, has already in many places induced the employés to form penny banks with great results. Where I am myself engaged we have adopted this; we employ 450 persons, and in the first year, nearly 200 have joined the bank, and our weekly takings from seventy or eighty persons average £8. It would of course be better and safer if such penny banks were really Post-office savings banks. The cost of effecting transactions in this way would probably be less than those at an ordinary Post-office savings bank, so that the balance would remunerate the collector.

"The remarks which we have just made concerning increased facilities for Post-office savings banks apply equally to life insurances and deferred annuities. Up to the present time these great advantages have scarcely been made use of by the people, for up to the end of 1872, for the whole of the United Kingdom, only 3,347 policies, for £255,789, had been taken out, and 390 deferred annuities, for £8,385.

"Every temporary Post-office savings bank, the opening of which we have above advocated, should be, of course, an office for the transaction of life insurance and deferred annuity business.

"I may remark that, as honorary secretary of the Provident Knowledge Society, I can speak confidently of the popularity of deferred annuities when they are understood. We prefer to call them pensions, as it takes a great deal to make many persons clearly see the meaning of deferred annuities. Whenever the system of buying a pension for old age gradually during a life-time of health is explained, it is astonishing how many are taken with the idea, and, if I may be allowed to say so, our agents report repeatedly on the wonder so often expressed by persons in the industrial class of life that these schemes have been so little made known. One great means of extending both the life insurances and the deferred annuity schemes would be by the payment of a much larger commission to the postmaster for every new case he secures. At present the remuneration (I believe 2s.) does not really pay him for the great trouble he is put to.

"As an instance of this, showing how little they care for the business, I may mention an incident which happened to myself. I went to a post-office for a form of life insurance; the man seemed hardly to know what I meant, but suddenly it dawned upon him, and looking up at the clock, which was five minutes to ten o'clock, he said, 'We don't begin that business till ten o'clock.' I need hardly say that to get a working man up to the point of applying for a form is no small matter, but if he met with any rebuff, I doubt if he would ever have gone near the place again. Had the man known that a reasonable fee was likely to follow, he probably would not have been so particular as to the time. Another point of importance is the simplification of the forms of application to be filled up, particularly for life insurance. They are far longer and more complex than most of the best offices.

"Mr. Scudamore, in his evidence before the Friendly Societies Commission, spoke in favour of making known the provident schemes of the Post-office by means of travelling lecturers appointed by the Post-office. I would strongly urge the adoption of this system, for the ignorance of the schemes, even among educated persons, is almost complete. The Provident Knowledge Society has been and is trying this experiment, and with success. In a great many works, where the subject is brought before the men by a popular lecture, they see the good of it at once, and establish a penny bank, particularly if the employer has sense enough to let them manage it their own way. I think Mr. Scudamore will bear me out when I say that the work of the Provident Knowledge Society has caused not a few of these excellent penny banks to be started. It has been done entirely in this way, chiefly by one agent at work at a time, as our funds are very limited, and we should be glad to surrender this important branch of the Post-office work to the Post-office itself.

"Another point is the establishment of penny banks in schools. The London School Board has passed a resolution approving of such penny banks in all Board schools where the managers will undertake them, for the purpose of encouraging habits of systematic care and thrift in the children — habits which may be made most powerful antidotes to intemperance in the rising generation. The great difficulty, particularly in London, in establishing these penny banks in schools is that of obtaining a collector, as the teacher is often overworked. If the plan of a Post-office official visiting the school and collecting could be adopted, it would not be long before flourishing penny banks were started in all schools, and the reduction of the minimum deposit from one shilling would of course be necessary in this case. We may add that in schools where efficient penny banks are started it is no remarkable thing for even hundreds of pounds to pass through them in a single year.

"In conclusion, we would wish it to be clearly understood that we do not in any way undervalue what has been already done by the Post-office. We regard the various schemes which have become law as some of the wisest acts of legislation—acts which will influence the country for good, more than many which are better known and have a more distinguished fame. We cannot, however, but see that the experience of the first few years of their establishment naturally enables us to detect where they may be improved. We are convinced that the greater the facility for saving,

and the more the opportunities for careful provision for the future are extended, the more will they be taken advantage of. We would wish that means for encouraging thrift, and the consequent improved well-being in the community (for a thrifty household is always more comfortable, better fed, and more sober than a thriftless one) be made to forestall the want, rather than to be behind it. A publican places his drinking shop in some likely place, and *makes his trade*, and, to beat him with his own tools, we see no reason why facilities for self-improvement should not be planted, even where there does not seem to be immediately a large demand for them.

"We trust therefore, Sir, that the extensions which the Society of Arts have proposed for nearly two years, and any others which the experience of the Post-office itself may suggest, will meet with your approval, and that you will signalise your tenure of the important office which you hold by extending to the utmost the facilities and opportunities for encouraging persons, by present care during health and plenty, to provide for future wants, so as to keep clear, to a far greater extent than at present, of the degradation of the parish pittance, or of the humiliation of having to become the recipients of their neighbours' alms."

The Postmaster-General.—May I ask whether, in the proposals you make, sums less than a shilling should be taken? You have made allusion to a penny. You suggest that the Post-office savings banks should take deposits of a penny.

Mr. Bartley said he should like to see it done; but threepence would be perhaps low enough at present.

The Postmaster-General.—At present £30 is the maximum sum which may be deposited in any one year by a depositor. You propose to abolish that limit; but you have not indicated any maximum.

Mr. Bartley thought there should be a maximum, but it should be very much higher than at present. He considered £100 would not be too high. Many cases came before him in which a man saved until he reached his maximum; he then drew it out, and put his money into something not so good, for instance, a building society, the security of which was in some instances doubtful.

The Postmaster-General—You have not suggested any maximum as the amount to which a depositor might allow his annual savings to accumulate.

Mr. Bartley said he had hesitated to do so; but he thought the maximum ought not to be less than £500; and the interest should be allowed to run up to any extent. At present it must not exceed £200. This restriction he considered quite unnecessary, for he could see no objection to its going on accumulating in the bank.

Sir Daniel Cooper drew attention to the fact that such a restriction was at variance with commercial principles.

The Postmaster-General—Gentlemen,—I need hardly say that I think the Society of Arts, and the Provident Knowledge Society, which Mr. Bartley represents with so much vigour, could scarcely take up a more important subject than that of the Post-office savings banks, which have already had so much influence upon the thrift of the people, and which, if properly worked, as is now being done very actively, are likely to have a very considerable influence upon the character of the working classes. You have laid before us some very important proposals, which will require to be considered with the greatest care before I could in any way commit the Post-office to their adoption. Take, for example, the proposal to reduce the amount which may be deposited by any depositor, which is now a shilling, to threepence, or even to a penny, as has been suggested. That taken alone, without reference to other proposals you have made, which I will presently show will have a tendency to correct the hazardous nature of such a proposal, involves a very important consideration as to what is the duty of the Post-office. Some persons think it is simply to give facilities to the public, and not to obtain revenue for the State. You are aware the Treasury has long held that the Post-office is a legitimate source of revenue to the State, and that, therefore, all increase of expenditure should be jealously guarded, in order that revenue may be obtained. I am perfectly of accord with the Treasury in that view. I think the Post-office is a very legitimate source of revenue to the State; and that we should do all we can, in its different branches, so as to carefully guard against increasing expenditure, and render each portion of the Post-office at all events self-supporting. The old savings banks were conducted at a considerable loss to the State, amounting to about three millions. The existing Post-office savings banks, on the other hand, have been conducted on self-supporting principles. They have cost the State nothing, and the amount of assets over liabilities is rather more than £600,000. I think it desirable that that state of things should continue. Every transaction of a depositor, whether he pay in or draw out money, costs the State very nearly 6d. Supposing, then, a depositor deposited a penny and drew out a penny, it would cost the State nearly a shilling. Therefore, if there were no deposits of much larger amount to compensate for that loss, it would be perfectly impossible to decrease largely the amount of deposit, and carry on the savings bank on self-supporting principles. You doubtless saw this when you made the further proposal, that deposits should not be limited to £30 in a year and to £150 in all. The money from which the Post-office obtains the expense fund is the difference of interest which we pay to the depositor and that which the State receives from investing the depositors' money. Therefore, if we increase, say from £30 to £50 the amount which any depositor may invest in one year, of course we get a larger expense fund, and in that way might be able to meet the expenditure which would result from lowering the amount receivable from the depositor from a shilling to a sum below that. I do not know whether you have considered that, while a good deal might be said in favour of that, there might be a very large amount of opposition on the part of the bankers of the country. I do not say that the opposition would be just, or that there would be sufficient grounds for it. Upon that I make no remark, because I think the objects of the Post-office savings bank and those of other banks are different. The purpose of the Post-office savings bank is to get a slow and gradual accumulation of the savings of the poor; and it is quite possible that the benefit to the State would be so great as to justify the extension which you propose. But that is a point which will require serious consideration, and upon it I am not in a position to express an opinion. One of the points of your memorial is that a depositor in one Post-office savings bank may be a depositor in another. That would practically extend the limit which is now fixed; because, if two accounts could be opened in different savings banks by one depositor, it would do away with all limit. [Mr. Bartley—Not two Post-office savings banks, but in any other savings bank.] You very properly dwelt upon the importance of extending facilities in small villages and other places by opening savings banks, permanently or periodically. That is an object which I think we should all agree is desirable, to what extent I do not just now say, but I think we should extend the operation of savings banks as much as possible. We do so now to the extent of nearly one a day, for from 25 to 30 new savings banks are opened every month. Still I do not say you do not make out a case for increased facilities, and the mode of giving them we will take into our earnest consideration as soon as we can. You also make a point of opening savings banks in the evening, particularly on Friday and Saturday. There have been a good many opened on Saturday evenings; but, as yet, it is not so extensively done as it may be in the future. We have also opened a few on Friday evenings. Our attention is fully

drawn to the matter; and while I do not commit myself to any definite opinion upon your larger views, I quite agree it is extremely important that the benefits of the Post-office savings banks should be extended as much as possible, by giving increased facilities. As to the point about the accumulation of interest to the extent of £150 and no more, according to the existing rule, I can frankly say, I think with you that is not a reasonable rule. It exists, but I do not see much reason for it; and that subject, if there were any changes, would be favourably considered. Upon the subject of the Post-office employing persons to make known the facilities which it offers for encouraging thrift, we have done so as far as we are able, by publishing and extensively circulating a circular addressed to the prudent and the frugal, in which attention is drawn to the advantages derived from savings, with which circular, I am sure, you are by no means unfamiliar. I can only promise that the points which you have brought before me will receive my own attention and that of the officers of this establishment; and if, upon consideration, we deem them to be of a practical character, I will afterwards draw the attention of the government to them.

Mr. Rawlinson thought the government might employ the savings of the people in carrying out works of a national character. He referred to the successful experiment tried in Lancashire during the cotton famine, where the government lent money to carry out works of a purely sanitary character at the lowest rate of interest compatible with not making a loss. The government had now the means of lending money for sanitary purposes at 3½ per cent., and he was almost every day of his life passing estimates on to the Exchequer Loan Commissioners, that money for such purposes might be received. The Post-office savings banks might collect the money in small driblets, as suggested, and pay what rate of interest might be fixed upon, and then use the money for carrying out works which would reduce the misery now existing. He was sure the government would be most amply rewarded if it contented itself with the lowest possible interest on the savings of the people, and even if it did the work at a small loss.

The deputation having thanked the Postmaster-General for his courtesy, then withdrew.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

The Portuguese Government has telegraphed, through the British Minister at Lisbon, to have a space reserved for the exhibition of the wines of Portugal, in the cellars of the Royal Albert Hall.

His Royal Highness the Duke of Edinburgh presided over a meeting of the Committee for the Army and Navy Amateur Fine Arts Exhibition, held at Buckingham Palace, on the 23rd instant. There were also present Colonel Gallwey, Colonel the Hon. W. J. Colville, Admiral Olliver, Colonel H. H. Clifford, Brigadier-General Sir John Adye, Rear-Admiral Ewart, and Capt. Count Gleichen, R.N.

Her Majesty the Queen has graciously consented to lend pictures by Wilkie, "Blindman's Buff," "The Penny Wedding," "The Siege of Saragossa," "The Guerilla's Departure," "The Guerilla's Return," "Guerillas' Council," and others, in all nine pictures, to the Art Instruction Department of the Exhibition, which will illustrate the career of artists.

EXHIBITIONS.

THE INTERNATIONAL EXHIBITION OF 1876 AT PHILADELPHIA.

Acceptance by Foreign Governments of the Invitation to Participate.

The Honourable Hamilton Fish, the Secretary of State of the United States, has officially notified the Honourable A. T. Goshorn, the Director-General of the Exhibition, that the governments of the German Empire, Belgium, Ecuador, Mexico, and Hayti have decided that those countries shall participate in the exhibition. The Resident Commissioner for Ecuador was the first to present his credentials at Philadelphia. His Government promptly made a liberal appropriation with which to commence the organisation of its representation.

Prince Bismarck, with his usual sagacity and promptness, recommended to the assembled representatives of the several States composing the German Empire the appointment of a commission from each of those States, and of a Plenipotentiary to reside at Philadelphia to represent the Empire. This suggestion has been adopted; and the government and people of the United States cannot fail to be pleased at the friendly interest thus evinced in their success in this great undertaking.

The executive consider that European manufacturing nations have in this exhibition the grandest opportunity yet presented of extending the markets for their productions. The people of all the nations of North and South America will be represented by numerous visitors, and their magnificent profusion of raw materials and minerals will be fully illustrated. Their commercial and scientific reporters will take careful note of the manufactures of all European nations, to ascertain what can most profitably enter into the exchanges for their raw materials and precious metals. It is therefore hoped that the government of Great Britain will act promptly, and on a scale commensurate with her prestige as the leading manufacturing and commercial power of the world, and not be outstripped in the race by other nations.

PRIZES OFFERED BY THE PARIS SOCIETY FOR THE ENCOURAGEMENT OF NATIONAL INDUSTRY.

In addition to the grand annual medal of commerce, Chaptal prize, and a prize of 2,000 francs in the class of cotton industries, the society offers the following prizes for the year 1874:—

	frs.
For a small motor for home industries	2,000
Combing cotton and short fibres	1,000
Dressing of mill-stones (Ferté-sous-Jouarre prize)	5,000
Practical and economic production of oxygen	2,000
Utilisation of waste matters in factories	1,000
Transformation yielding a natural useful product, such as quinine, sugar, &c.	4,000
Artificial production of fatty acids and wax	4,000
Disinfection of the residue of the purification of gas	3,000
Conservation of food in the fresh state	1,000
Apparatus for small workshops, producing high temperatures	1,000
Cultivation of grass and trees in mountains	2,000
,, ,, ,, (2nd prize)	500
Irrigation	3,000
,, (second prize)	2,000
Production of healthy seed from French silkworms	500
Reclamation of land and embankments	2,000
A drill for sowing manure in powder	1,000
Study of the progression of the phylloxera from one vine to another	2,000
Fabrification of good photographic paper	2,000

Details of these and other prizes to be obtained on application to the secretary, No. 17, Rue de l'Abbaye, Paris.

THE CITY COMPANIES AND THEIR EARLY HISTORY.

About 40 years ago, a commission was appointed to inquire into municipal corporations, and with the view of throwing additional light on that inquiry, a work entitled "The History of the Twelve Great Livery Companies of London" was edited and published by William Herbert, Librarian to tho Corporation of London. As much has been said and written of late in relation to the City Companies, and but little is generally known of their history, and as the Society of Arts has obtained the aid of some of the companies in the promotion of technical education, it may perhaps prove not uninteresting to the members of the Society if a short review of their history and foundation is given in the pages of the *Journal*. The following abstract of the general history given in Mr. Herbert's work, may, therefore, it is hoped, prove acceptable.

The records of some of the companies extend back to the reign of Edward III., and give detailed accounts of how they first formed themselves into societies, the places they met at before they built halls, the custom of admitting sisters, their feasts, set modes of dress, or wearing of livery (from which they derived their name), their religious ceremonies, pageants, &c.

Anglo-Saxon gilds were at first political, and had their origin in the Saxon law or custom of frank-pledge, which required that every freeman of fourteen years of age should find securities to keep the peace, or be committed. This led to certain neighbours or families associating together, and mutually binding themselves to each other to produce him who committed an offence, or to make satisfaction to the injured party. In order tho better to do this, they subscribed a sum of money as common stock, and at stated periods assembled at a common table, where they ate and drank together, that they might identify each other, as well as ascertain whether any man was absent on unlawful business. As the association of pledges consisted of ten families, it was called a Decennary, or Tithing, and subsequently, as being composed of such frank-pledges, a Fribourg, or Frithgild. The frithgild was succeeded by guilds, either ecclesiastical or secular. The former were for devotion and alms-deeds, the latter for trade and alms-deeds, but both partook much of the character of monastic institutions, and derived their name gild from the fact of their being associations, the members of which contributed money to the common stock. The Gildhall was the common hall in which they gathered, and which was maintained at their mutual costs. The only three Anglo-Saxon metropolitan trade gilds were the Knighten Gild, or Gild of Portsoken; Gilda Theutonicorum, or Gild of the Steel-yard Merchants; and the Gilda Sellariorum, or Gild of Sadlers.

Of the government of the Anglo-Saxon trade gilds but little is known, but it appears to have consisted of a triple estate, or head council, and associates. The favourite number of the council with its head was thirteen, in imitation of Christ and his apostles.

Knighten Gild is mentioned by Stow in his survey of London; it was a secular gild, and to it he assigns the origin of Portsoken Ward. The gild appears to have originated in the grant of certain land on the east of the City, left desolate and forsaken by the inhabitants. This grant was made by King Edgar to thirteen knights or soldiers for service by them done, with the liberty of a gild, for ever. Edward the Confessor granted a *written charter*, the first that was ever given to a fraternity of this sort, and the same was confirmed by William Rufus, and it remarkably exemplifies the threefold sense stated anciently to have attached to the term gild, viz., a fraternity, a soke, and the privileges of a soke. On the founding of Trinity Priory by Queen Maud, in 1115, certain burgesses, descendants of the Knighten Gild, gave that convent all the lands and the soke or franchise, but reserved the right to be a trade corporation, a right which does not appear to have been assigned either by the original grant or its confirmations by Henry I. or other sovereigns, and, in consequence, the prior of Holy Trinity became the territorial lord or alderman of Portsoken Ward. He rendered an account to the crown of the taillage imposed upon the men of the ward in the 6th of Edward II., as the other aldermen did for their respective wards; like them held courts or wardmotes, and rode in procession with the mayor and his brethren, the aldermen of the other wards, who wore scarlet gowns; and was only distinguished by his gown, which was an ecclesiastical purple.

"Gilda Theutonicorum," or the Gild of the Steelyard Merchants, was a trade gild of earlier date than Knighten Gild, and gave rise to the Hanseatic League, a commercial confederacy first formed in the eighth century on the east shores of the Baltic, which gave rise to the Easterlings. The Easterlings are known to have settled in London before the year 967. A regulation of King Ethelred declares that the Emperor's men, or Easterlings, coming with their ships to Billingsgate shall be accounted worthy of good laws. The Easterling Gild was governed by a council of twelve and an alderman, and their Gildhall was in Dowgate Ward, where their principal factory was situated. They ultimately acquired, in addition to their other property, a house called the steel-house or steel-yard, full and free possession of which was secured to them by Edward IV. in the Treaty of Utrecht. The members of the gild lived under strict regulations. They were obliged to remain single, and were not even allowed to have a housekeeper or bed-maker, under liability of loss of trading privileges. The direction of their factory was vested in an alderman and two deputies, or co-assessors, with nine councilmen, which together composed the chamber of commerce. In 1282 it was arranged between the Corporation of London and the Hanse that they should continue to have their alderman—provided always that he were of the City, and presented to the mayor and aldermen of London when chosen, and took oath before them to maintain justice in the courts of the fraternity, and to behave themselves in their office according to law and as it stood with the customs of the city. If an alderman was prevented by illness from performing his duties, or had to travel within the kingdom, his co-assistants took his place, but if beyond the seas the commonalty of merchants was summoned, and a stadtholder was elected in his place till he returned. If one of the assessors or nine councilmen were required to travel beyond the sea, another was elected in his stead, and he who refused to accept office on election was fined 40s. for a first offence, and if again elected, and he refused, was deprived of the merchant privileges.

When the alderman, by virtue of the merchant law, commanded any one not to leave London without his and the company's permission, if he attempted to depart he could be arrested, and kept prisoner till the law was satisfied.

"The Gilda Sellariorum," or Gild of Sadlers, appears to have been of Anglo-Saxon origin, and of nearly coeval date with the foregoing, though the earliest mention of it indicates its officers and constitution to have been Norman.

The members of the Gild of Sadlers were admitted into brotherhood and partnership of masses, orisons, and other good deeds with the canons of St. Martin's-le-Grand, as appears by a convention thought to date back to Henry II.'s reign. The convention is addressed to the alderman, chaplain, four eschevins and elders of the said gild. They were to be partakers of all benefits with the church of St. Martin both by night and by day, in masses, psalms, prayers, and watches, they

were to be separately prayed for on the day preceding the resurrection in two masses, one for the living, the other for the dead brothers, and for the latter the bell of St. Martin's was to be tolled, and procession made with burial freely and honourably. The members were accustomed to present wax tapers, and offer their alms in the Church of the Blessed Martin, and their alderman, on account of the receiving and tolling of the knell of each deceased brother of the gild, was accustomed to pay for the same 8d. There is little doubt of the sadlers being of Saxon foundation, and the oldest on record of all the present Livery companies.

Mr. Herbert next refers to the Anglo-Norman gilds, —"Gilda Tellariorum"—but he says strictly speaking we have an account of only one gild of this era, namely, that of the Tellarii, or Woollen Cloth Weavers, though there must have been many others. This gild is mentioned in the "Placita de Quo Warranto," dated 14 Edward II. (in which pleas is also recited the charter given them by Henry the Second), which confirms to the said Weavers' Gild all the liberties and customs they had enjoyed in the reign of Henry I., and under which it is prescribed that none who are not of the said gild shall intermeddle with their ministers within the City or Southwark, or other places of London adjacent. The members of this gild held their court every three weeks, and in 1406 paid to the king for their privileges nearly two marks of gold (10s.) yearly, by force of which and their charter they used to have bailiffs and a commonalty, together with the governance and correction of their said mystery. Their rights being interfered with in the reign of Edward III. by foreign weavers, who were exempt from the said gild, the company petitioned that such foreign weavers may be obliged in all things to be of their gild, and to pay their proportion of the payment to the king.

Of foreign gilds, one of the most ancient in France was that of St. Riquer, in Ponthieu, incorporated by Louis VI., in 1126. It and similar communities in that country consisted of a mayor, eschevins, and a common council or fraternity, a belfry, and a bell to call them together, and a common seal and jurisdiction. In Rome, in the 15th century, there was the Ars Mercantiæ Pannorum and other artes, and the Company of Mercers were styled "Universitas Merciariorum."

In Scotland there were many gilds, and in the reign of William the Lion, it was enacted that the merchants should have their merchant gilds with freedom from tolls; but it is asserted that they were only ordinary traders and retailers, and such as frequent fairs and markets. Gild, in the royal borough of Scotland, is still used for a company of merchants or tradesmen, who are freemen of the borough, and each of them has a dean of gild, who is the next magistrate below the bailiff. He judges of controversies among men concerning trade, disputes between the inhabitants concerning buildings, lights, water-courses, and other nuisances; calls courts, at which his brethren of the gild are bound to attend, manages the common stock of the gild, and amerces and collects fines, &c.

English Gilds.

In the reign of Henry II. gilds were common institutions, and a list of eighteen were amerced as adulterine, or set up without the king's licence.

King John is said to have granted the Weavers a charter of confirmation, in consideration of an increased annual payment of 20 marks yearly. In 1226 (Henry III.'s reign), a great quarrel arose between the Goldsmiths and Taylors; they met completely armed, and many were killed, and the ringleaders, thirteen in number, were arrested, condemned, and executed.

But little progress was made in mercantile affairs till after the reign of Edward I., and nearly all commerce was in the hands of the Steel-yard Merchants. The means of internal communication were so bad, that by Act xii. Edward I. chap. 5, it was directed that those ways should be enlarged where bushes, woods, or dykes stood where men might lurk, so that there be neither dyke, tree, nor bush within 20 feet on each side of those roads, great trees excepted. If the lord of the soil neglected to comply with the Act, and robberies ensued, he was to be answerable for the felony.

In 1268, the total sum paid to the crown upon foreign merchandise and as tolls at the City gate, amounted to only £2,187 19s. 3d. of our present money.

The Fishmongers and Linen-Armourers obtained charters from Edward I.; the early grants to the Weavers were confirmed, and the Statute 28, Edward I., mentions the wardens and craft of Goldsmiths.

In the 30th of Edward I. the Bakers were allowed to hold hallmotes three times a year, to determine of offences committed in their business, and were restricted to selling bread in the market, which was then held on the site of Bread-street, and gave rise to Bread-street Ward.

In Edward the Second's reign the mercantile nature of the civic constitution of London, and the mercantile qualifications requisite in candidates for freedom of the City, are mentioned. One of the articles ordained by the citizens, confirmed by the King, and incorporated into a charter, provided that no person, whether an inhabitant of the City or otherwise, should be admitted into the civic freedom unless he be a member of one of the trades or mysteries, or unless with the full consent of the whole community convened, only that apprentices might still be admitted according to the established form.

Livery Companies.

In the reign of Edward III. an entire reconstruction of trading fraternities took place, and distinctive dress or livery was generally assumed by the gilds, and they were thenceforth called Livery Companies. The title of master or warden was substituted for that of alderman; the name alderman being henceforth restricted to the head of the City Ward. The companies at this date were only entitled to meet for mercantile purposes; they had no grant of a common seal, nor liberty to accept or buy lands, to sue and be sued, or to enjoy various other liberties necessary to establish them full incorporations as at present. Edward III. found that trade fraternities were the mainspring of trade, and he became himself a brother of the Merchant Taylors, who were the great importers of woollen cloth, a trade which he sought to make the staple manufacture of England. Richard II. afterwards became a brother of the same company; the formation of these gilds ultimately led to the establishment of monopolies, and a petition was presented to the king against the Merchant Grocers, who engrossed all manner of vendable merchandise, and this caused an Act to be passed which ordained (37th Edward III., cap. 5,) that in future merchants shall deal in or use but one kind of merchandise, but this Act was repealed in the following year. In the 49th Edward III., an enactment passed the whole assembled commonalty of the City, by which the right of electing all City dignitaries and officers, including members of Parliament, was transferred from the ward representatives to the trading companies, a few members of which were selected by the masters or wardens to come to the Guildhall for election purposes, but by a subsequent Act of Common Council it was opened to all the liverymen, an act which was confirmed to all liverymen as being freemen by the 2nd of George I., cap. 18; 148 members were returned as Common Councilmen by the 48 Livery Companies in the 50th Edward III.

The companies were first compelled to enrol their charters in the reign of Richard II., and the Lord Mayor was enjoined to make proclamation, that all and singular masters and wardens of gilds and fraternities, within the City of London and suburbs of the same, should deliver into the king and council in the

Chancery a full, distinct, and proper account in writing, of the manner and naturo of their several foundations, their beginning and continuance, together with the rules of such fraternities; the manner and kind of oath to be taken by the community or assembly of brothers and sisters and others, and all other particulars appertaining to such gilds; as likewise respecting their liberties, privileges, statutes, ordinances, usages, and customs. Moreover, an account of all lands, tenements, rents, and possessions, whether mortgaged or not mortgaged; and of all goods and chattels whatsoever belonging to the said gilds, in whosoever hands they might be holden for the use of such gilds; and to return, with the answers to these queries, the true yearly value of the same; and whatsoever, in any manner or form concerned, all and singular, the premises, together with all other articles and circumstances whatsoever, touching or concerning the same; under penalty, on neglect, to forfeit for ever such lands and other things to the king and his successors; also that the said masters and wardens should have before the king and his council at the same time whatsoever charters and lettors patents they possessed from any grants of the king or his predecessors to the said gilds and fraternities; under further penalty of having all such grants and all privileges contained in them revoked and annulled.

The returns from the trade companies, which must have thrown wonderful light on their nature, property, management, and other particulars, required to be set forth as above, are now missing; though such undoubtedly have been made, and may yet remain amongst the mass of unsorted records in the Court of Chancery. It was during the same reign that the great companies became distinguished from the general body of liveries, as paying the highest fermes, and it is the history of the Mercers, Grocers, Drapers, Fishmongers, Goldsmiths, Skinners, Merchant Taylors, Haberdashers, Salters, Ironmongers, Vintners, and Clothworkers, that Mr. Herbert has chiefly recorded. In the 10th Richard II. petitions were presented to Parliament against the usurpation of rights by the companies, and resulted in the ordinance that four aldermen should be chosen from each ward for common councilmen, and the number of aldermen members in each company was restricted. The charters of Edward III., and of his grandson Richard, distinctly point out that the whole of the societies were at first associations of persons actually professing the trades from which they took their names. The charters are stated to be mostly of great antiquity. Those of Edward were first granted to the Goldsmiths, Linen-Armourers, and Skinners, and in the 27th, 28th, and 37th years of his reign, he confirmed the Grocers, Fishmongers, Drapers, Salters, and Vintners. The patents of Richard II. confirmed the charters to the Goldsmiths, Fishmongers, Skinners, Linen-Armourers, and Taylors; and in the 27th year of his reign, he gave their first charter of incorporation to the Mercers, and chartered the Booksellers, Saddlers, Weavers, Parish-Clerks, and other minor companies.

The first proceedings of the Grocers, upon their reformation, exactly resembled those adopted in establishing our common benefit clubs. Twenty-one persons, carrying on the business of pepperers, assembled, dined together, elected after dinner two persons as their first governors or wardens, and appointed a priest or chaplain to celebrate divine offices for their souls. Their government was by bye-laws, framed by common assent, and chiefly regarded the keeping of trade secrets, a primary ordination of all fraternities. The regulation of apprentices formed a second grand article in the ordinances of all companies. The Grocers onjoined their wardens "to go and assay weights, powders, confections, plasters, oyntments, and all other things belonging to the same craft, and prescribed that no man of the fraternity should take his neighbour's house that is of the same fraternity, or enhance his rent against the will of the aforesaid neighbour, and in default was to be fined." The Merchant Taylors' records state that that company kept "a silver yard," weighing thirty-six ounces, for the admeasurement of cloth, the company's arms being engraved upon it. With this standard they attended the cloth-fair in Smithfield, at the time when cloth formed the great article of commerce during Bartholomew fair, and persons were committed to prison for using an unlawful yard. The companies had the supervision of their respective trades, and many curious records are preserved in their books—thus, the Brewers' Company fined William Pagon 3s. 4d. for a swan for the master's breakfast, a fine imposed in consequence of his refusal to contribute a barrel of ale, to be sent to the King Henry V., when in France. From the reign of Richard II. to Henry VII., the chief officers of the companies are styled "wardens of the craft," "wardens of the said mystery," "warders," or "wardens." The Merchant Taylors were the only company styling their principal "pilgrim," on account of his travelling for them.

The Grocers appointed "a bedel," in 1348, to warn and summon the "felship," as often as bidden by the wardens; but the office of clerk, now the most important one the companies have at their disposal, does not appear to have been instituted till 1460, though tho Brewers' Company record the death of their clerk, John Morey, in 1418. The bedel had "his clothing of the livery," and fourpence per week. The clerk's yearly salary was £6 13s. 4d.

The first mention of assistants in the livery companies occurs in the records of the Grocers, in the year 1379, when six persons of that company were chosen to aid the wardens in the discharge of their duties. In 1346, in place of the assistants, four persons are stated to have been chosen by all the company to superintend the accounts and to deliver the wardens. The Brewers' books, in 1420, mention in decided terms the establishment of what may be called a court of assistants, though not so named. The first mention of assistants by name is in the books of the Merchant Taylors, in 1512, when the common clerk of the company is recorded as having transacted certain affairs of the master and wardens, with the advice of the more part of the most substantial and discreet persons, assistants, and councillors of the said fraternity.

(To be continued.)

SIR F. KNOWLES ON THE MANUFACTURE OF IRON.

The following appeared in *Iron* last week. It is in answer to Mr. Heaton's letter quoted in last week's *Journal*:—

"Sir,—I have read Mr. John Heaton's letter in your impression last week. When Sir Francis Knowles' paper was read at the Society of Arts, at the request of the Chairman I took part in the discussion, but I did so with evident reluctance. This arose from my inability to see or say anything favourable to the proposed method of converting cast iron into steel. Sir Francis alluded to the process known as that of Mr. Heaton, and, as I understood him, he expected, by the use of nitrate of soda, to free iron containing phosphorus of this substance more economically than can be done by the means previously employed, and that he had the authority of Baron Gruner's pamphlet for this assertion.

"If, in my remarks, I said the conversation I had with this metallurgist took place at the Langley Works, Mr. Heaton is perfectly right in correcting me; for we met, as he states, at the station, and before Baron Gruner had examined the process; but I have met this gentleman on different occasions since, and my strong impression is, he does not look for any important results from the use of nitrate of soda, in the manner recommended in the Heaton process.

"If Mr. Heaton, on the other hand, infers that the language of Baron Gruner's report is very encouraging, then I must take the liberty of correcting him. This author states, page 16:—'M. Heaton appelle ce fer du steel-iron; mais au fond c'est du fer doux ordinaire, qui, le plus souvent, est fort peu aciéreux. L'épuration par le nitrate n'est pas possible au point de vue économique si le metal est transformé en *fer homogène* ou *acier fondu*, et non en *fer à loupes*.' Page 35:—'On voit que les fers de Hayanges préparés au nitre peuvent être assimilés aux fers communs écossais.' Speaking of wrought-iron *cakes* made at Langley, he says, page 51:—'On voit malheureusement que, même dans le cas le plus favorable, la déphosphoration est bien incomplète.' Page 73:—'Le métal raffiné n'est pas de l'acier et encore moins du fer homogène; c'est une fonte simplement épurée, qui doit subir un nouveau traitement.'

"What struck me when I visited the Langley Works was, that with the alleged means of converting pig-iron, containing phosphorus, into steel by its previous treatment with nitre, the metal so purified should be puddled at a cost almost equal to that incurred in using unpurified pig, and rolled into iron-bridge rails worth little more than half the price of steel. Since that time, pig-iron, suitable for Bessemer works, has risen enormously in value, and yet we do not hear of nitrate of soda being used to convert the ordinary brands into a material suitable for steel making.

"If I am wrong in the estimate of the Heaton process, I hope I have given some valid reasons for my belief. Nothing can be further from my wish, and, indeed, from my interest, than to discourage any attempt to separate phosphorus from pig-iron; and I only regret that, in my opinion, Mr. Heaton's plan, ingenious in many respects, has not attained more success than I understand has been the case.—I remain, Sir, yours, &c.,

"I. Lowthian Bell."

THE IMPERIAL COLLEGE OF ENGINEERING AT YEDO.

(From *Iron.*)

We have been favoured with a sight of a recent communication from Yedo, regarding the progress which is making in the way of developing the scheme of technical education which was entrusted a few months ago to Mr. Henry Dyer, C.E., late of Glasgow, and his professional colleagues. When those gentlemen arrived in Japan, they found the arrangements to be in a more backward state than had been anticipated, the buildings intended for the Imperial College of Engineering, although in progress, not being nearly finished. It may be remembered, from a former notice which appeared in our pages regarding this important educational institution in the far East, that Mr. Dyer was appointed to the conjoined offices of principal and professor of engineering; and it is to that gentleman that the entire work of organising the engineering college was entrusted. Soon after reaching the scene of his future labours, Professor Dyer presented the authorities with a general scheme of technical education, which was at once accepted by them in every detail. That scheme gave them an enlarged notion of what a college of engineering ought to be, in order to be suitable to the growing wants of the Japanese empire; and in accordance with that scheme Professor Dyer, since his arrival in Japan, has designed a building for the college, which will, doubtless, be worthy of the name by which it is henceforth to be known, namely the "Imperial College of Engineering." When the college proper is finished, which it is expected to be in about two years, the building which is now being erected will be converted into a technical museum, and, in the meantime, while the building is in the process of erection, a house which formerly belonged to one of the Daimios has been secured as temporary premises for holding such classes as have been formed. The official opening of the college will take place on the 3rd of January next, and it is expected that the Emperor of Japan will be present on the occasion. At an entertainment given to Professor Dyer, at the Summer Palace of the Mikado, by the Prime Minister of Japan, that gentleman took great interest in all the details of the college, and congratulated his guest upon the scheme which he had devised; and notwithstanding the ultra-officialism which has generally to be encountered by those persons who require to come into contact with the Japanese authorities, Professor Dyer has had the good fortune to get from them everything that he asked, in order to complete the important educational undertaking in which he is engaged. In addition to the college, he has designed a large chemical laboratory, and a workshop, in which the young Japanese students will be practically trained in the principles of engineering construction.

THE OIL RIVERS OF THE WEST COAST OF AFRICA.

Consul Livingstone, in his report from Old Calabar, furnishes some interesting information respecting the oil rivers of Biafra and Benin, extending over 800 miles of coast, and including the Island of Fernando Po. The chief exports consist of palm oil and palm kernels; the minor exports of ebony, barwood, ivory and india-rubber. The staple imports are tobacco, rum, gin, cotton prints, gunpowder, muskets, salt, brass rods, and manillas. Many other articles are in constant demand, such as soap, matchets, or African cutlasses, iron pots, knives, glass and earthenware, furniture, tin boxes, waterproof cloaks, silk umbrellas, caps, felt hats, and a variety of fancy goods. Barter, unfortunately, is the only medium of trade between white agents and black brokers; but black brokers and oil producers have risen above this rather primitive stage of civilisation. The brokers rarely offer trade goods to the producers in exchange for oil. They take the goods to one of the great country fairs, and there sell them for native money, and with this money purchase the oil from the producers. The manilla, a bronze coin from Birmingham, not unlike a bracelet in shape and size, and worth about sixpence, is the native money of Bonny, Opobo, and New Calabar markets. Copper wire and brass rods, three feet in length and bent double, are the coinage of the Old Calabar markets. In 1866, sixteen British firms traded in these rivers, and one Dutch. In 1872, the number of Liverpool, Bristol, and Glasgow houses was twenty-four, and there were two foreign (Dutch and German). These 26 palm-oil traders have 55 trading establishments in seven rivers, and employ 207 white agents, clerks, mates, &c., 419 black coopers, carpenters, cooks, and stewards, from our settlements at Accora, Cape Coast Castle, and Sierra Leone; and 2,000 Kroomen, from Cape Palmas and other parts of the Kroo coast. Most of the above live in large, airy hulks, moored near their cask houses on the beach; a few have houses on shore. For many years the carrying trade was done by sailing ships, and as they remained in the sickly rivers for months, numbers of their men died of fever; but since the two lines of steamships began in 1869 with reduced rates, and five steamers a month, they have secured nearly the whole of the carrying trade, and sailing ships and seamen's deaths have almost disappeared from the principal rivers. Steam has also developed a goodly number of black traders, and the time may not be far distant when the entire trade of the coast will be in their hands, and whites be relieved from the grave risks of such unhealthy rivers.

The Fernando Po oil crop never exceeds—seldom equals—400 tons a year. A trustworthy observer, who trades in various parts of that island, states that, from the number of oil palms he has seen, at least 4,000 tons might easily be obtained. But the 25,000 aborigines, or Bubés, do not choose to work beyond 400 tons. Their

wants are few—a cheap market, a little powder and shot, pipes, tobacco and rum are nearly all. On the mainland the oil producers have many more wants, and therefore work harder, *i.e.*, the women and children do; for the men think they have done enough when they climb the palm trees and bring down the masses of palm nuts. Probably not many of the palm nuts of the countries drained by the oil rivers remain ungathered near the native villages. More oil palms might be planted; there is abundance of room for them in the oil district, though but a mere fringe of the African continent. But natives never plant oil palm, though they plant the palm which produces the best palm wine. Fruit trees, such as the bread fruit, orange, and mango, were introduced by the missionaries a quarter of a century ago. Natives like the fruits, and steal them year by year, yet few can be induced to plant the trees. None of our present traders can hope to see an expansion of trade from palms planted by natives, though, as population increases, natives may go further into the bush and gather nuts now left to rot. It is now pretty generally understood that no new oil markets remain to be discovered in this district. All the oil made finds its way to the old markets of the well-known rivers. The india-rubber of Africa is obtained, not from a tree, but from a creeper. It is not an export of the oil-rivers, but of the southern part of this district, and beyond. By their clumsy mode of extracting the rubber the bush people invariably kill the vine, and it does not spring up again. Its manufacture, therefore, recedes from the coast year after year, and this ever-increasing distance from the sea and the small rivers must diminish the quantity and raise the price. It is somewhat startling to find that the best kinds of Manchester goods, such as Madras, have been driven out of the oil market by Swiss prints of the same class. Swiss Madras is cheaper, and its colours much superior to that of Manchester. The cheapest Manchester prints, such as guinea-cloth, as romals and baros, still retain the market, and will probably continue to do so. Birmingham cheap markets are superseded by Belgian, which can be delivered on board the African steamer at Liverpool, carriage-paid, with cases included, for the price charged in Birmingham for the bare markets. For a time, Belgian matchets, costing less than Birmingham ones, were largely imported; but natives complained that the iron was inferior, and refused to buy them, and the Birmingham matchets recovered the markets. No staple sells better than rum and gin. There is no restriction on the liquor traffic; it pays no tax or duty to our own or to any government. In view of the quantity, and especially the quality, of the stuff sold, terrible results to black consumers might be anticipated; but years of observation, and the testimony of traders and of missionaries, force on the mind the conviction that somehow liquor, though it does mischief, does not produce the demoralising effects which it does at home. Though apparently doing but little harm to blacks, the evil rum has caused to whites on this coast is something appalling. Time, property, business, character, and life have been lost through drink, which is thus the most costly trade article the merchant ever sent to Africa.

Her Majesty's Government, encouraged by traders and missionaries, has done good by judicious and well-timed treaties for the abolition of the slave trade, human sacrifices, twin murders, poisoning, substitutionary punishments, &c. When the late King died, none were suspected of bewitching him, none known to be butchered and buried with him—a happy contrast to former royal deaths. The greatest of all hindrances to missionary operations is the unhealthy and deadly climate. Nevertheless some valuable work has been accomplished. The whole of the Bible has been translated into the Efek and Dualla languages of Calabar and Cameroons. School-books and dictionaries have been printed, many have been taught to read, and a few trained and employed as schoolmasters. Sunday markets in towns have been abolished, and hundreds of decently-dressed natives of both sexes regularly attend Divine services; and these, wearing clothes, give employment to dressmakers and tailors, most of whom own sewing-machines. Some half-dozen years ago Bishop Crowther began missions in Bonny and in Brass. This excellent man is a native African, and all his clergy are Africans, well able to stand their native climate. Most, if not all, were educated at Sierra Leone, where considerable attention is paid to learning, and a good education for teachers and clergymen can be obtained. This is an encouraging phase of the missionary enterprise, and, in view of the frightful loss of white life and health, all must hope that the time may soon come when the entire missionary work of the West Coast of Africa and all the trade will be in the hands of African Christians. The river chiefs, now oil brokers, were slave brokers formerly, and sold to the slavers consignments of slaves received from the interior, whence came most of the slaves for exportation. The poor and aged King of Bimbia occasionally mourns over the loss of his large commissions as a slave broker, but readily admits that his people are better off in every respect with the palm-oil trade. At times, when the conduct of bad characters among the domestic slaves is worse than usual, a chief may be provoked to wish the slave trade back again, in order to sell the criminals at a profit, being a loser when he imprisons or kills his incorrigible slaves; but no one really wishes the slave trade back. The native authorities would oppose its revival as strenuously as our own merchants. In the first year of legitimate trade after the abolition of the English slave trade in 1807, 300 casks of palm oil were exported from the Calabar and Bonny rivers. In 1871 the same rivers sent to England 32,200 casks of palm oil.

SAFFRON GROWING IN FRANCE.

The production of saffron is considerable in France, but it is confined to three departments, of which Loiret produces the largest amount and of the best quality. It is a peculiar industry, and little known even in France.

A saffron field is not in full bearing till the end of the second year, and at the end of three years it is exhausted, and, according to the local proverb, the land is then so poisoned that it cannot be used for the same purpose for fifteen or sixteen years more. The average crop of the second and third year is various, from ten to thirty kilogrammes per hectare, or from 9 to 27 lbs. per acre, of dry pistils; each acre produces about six to seven hundred thousand bulbs, and each bulb two or three flowers. About 30,000 flowers are required to produce two pounds of fresh pistils, which when dried are reduced to one-fifth of that weight; the pistils are the only productive portion of the flower, the rest is waste.

The labour of picking such enormous quantities of flowers by hand is great, and when the crop is large and labourers scarce, the flowers are carried into the villages and small towns round about, to be picked by women and children at home; in such cases all the world is busy saffron picking; artisans, shopkeepers, gentlemen, and ladies all assist in the work, the poor working for their own profit, the rich for the benefit of the necessitous. The farmer has to pay from about 10d. to 4s. a pound for the picking, according to the abundance of the crop.

When the pistils are separated they have to be dried, and this operation is effected by placing about a pound of fresh pistils at a time in a horsehair sieve suspended over a little charcoal furnace. As soon as it is dry the saffron is ready for sale. Commercial travellers generally buy up the saffron, which goes by the name of the most famous district, Gâtineus, principally for Germany, where it is said to be mixed with Spanish saffron and re-sold as a German product.

Saffron requires a peculiar soil, and the land which suits it is worth three to four pounds per acre, or double the rent of ordinary land in the same district; but the saffron itself sells, on an average, for thirty shillings to two pounds per lb., and when very fine, for double those rates; in very extraordinary years, which, however, occur only once or twice in a century, saffron is worth as much as £8 per lb. Altogether it is an interesting example of agricultural industry.

THE LAURIUM MINES OF GREECE.

It has hitherto been the general opinion of European mineralogists, who have hastily examined the district of Laurium, that the ancients entirely exhausted all the valuable veins of metalliferous ore near the surface, and that shafts must be sunk to a great depth, and a very heavy outlay incurred, to make mining operations profitable there in the present day. It is stated that, had this not been the case, the mines would never have been abandoned in ancient times, but it must likewise be borne in mind that the ancients worked with very rough implements, that the smelting furnaces of those days were probably rudely constructed, and fed with fuel obtained by cutting down the pine forests which then clothed the sides of the mountains, and, also, that only the very richest galæna was used, as proved by the enormous heaps of *ekbolades* (rejections) resulting from dressing the ores in those days. When the pine forests were consumed in the mining districts, it must have been a work of great labour to procure fuel from a distance, and this, taken in connection with political events of that period, and the cessation of slave labour, is quite sufficient to account for the mines being abandoned as unproductive. The German, French, and Greek engineers, who have recently had the best opportunities of studying the formation of the metalliferous basin of Laurium, by long residence on the spot, are far from believing that even the first bed has been worked out. Mr. E. Gromand, a Saxon engineer, employed for the last two years by the Pericles Mining Company, who has studied at Friburg, goes so far as to give it as his opinion that the ancients only exhausted about one-half, or, at the utmost, two-thirds, of the first metalliferous stratum, and estimates the value of the ore still existing in the concession of the Pericles Mining Company alone at 655,000,000 dollars, or £23,392,857 sterling, without taking into account a second bed, presumed to be intact, and probably still richer than the upper one, the existence of which Mr. E. Gromand believes he has already discovered certain indications of. He further states that the proportion of silver contained in some of the lead extracted from the richest ore in these mines is as much as from 2 to 5 per cent.

The quantity of scoriæ, or slag, left by the ancients at Laurium has been roughly estimated at about 2,000,000 tons, and calculating from the samples still existing in the mines, the ore, when originally smelted by the ancients, must have contained at least 50 per cent. of argentiferous lead, 30 per cent. of which was then extracted. It results that 600,000 tons of lead contains at least 2,000 grammes of silver per ton, or a total of about 1,200 tons of the latter metal was obtained from the Laurium mines in ancient times. As slave labour was then employed, and the value of the ore is calculated to have been fourteen times greater in those days than at present, the importance of these mines to the ancient Athenians may be easily understood. Consul Merlin mentions that while the Hellenic Government has not hesitated to lavish thousands of pounds in bringing learned professors from Germany and England to estimate and assay the value of the *ekbolades*, which might easily have been done, at a trifling expense, by sending samples of them to well-known assayists in London, Belgium, and Germany, and comparing their reports, no properly detailed geological survey has yet been made, either of the metallic districts of the Laurium, or of Greece in general, by any experienced professor of mineralogy.

TECHNICAL EDUCATION IN FRANCE.

The following official report of General Morin, the director of the Conservatoire des Arts-et-Métiers, Paris, to the Minister of Agriculture and Commerce, furnishes some interesting details as to this technical educational establishment:—

"The total number of persons who attended the lectures of the fourteen professors amounted in 1872 to 135,443, at 559 lectures, or in the proportion of 241 to each lecture. The smallest number of lessons given by any one professor was 40, from the opening in the commencement of November, until the last days of April. The total number of persons attending is smaller than in preceding years, which is explained by the decrease of the floating population of Paris. This year, as in all others, the decrease commenced when the days got longer, and work kept the people in the workshop.

"I would here limit this report if I did not think it necessary to add a few words upon the means of instruction which the Conservatoire offers to the public and the working classes of all ranks.

"This establishment, as is known, owes its origin to the illustrious Vaucanson, inspector of factories, who, after having made at the Hotel du Montagne, rue de Charonne, a collection of machines, instruments and tools, for the instruction of workmen, presented it to the Government, on the sole condition that its original purpose should be maintained. Louis XVI. accepted the gift by an act of council, and the illustrious Vandermonde, member of the Academy of Sciences, was named administrator and conservator of this first industrial museum. Later, by the decrees of the 15th and 18th of August, 1793, the Convention created a temporary commission of arts, to put a stop to the dispersion of objects of art, science, and industry. This commission succeeded in collecting a large number in a depot formed at the Hotel d'Aiquillon, rue de l'Université. The value of these collections soon after determined the Convention, upon the report of Gregory, to make a decree, the 19 Vendémiaire, year 3, that there should be formed in Paris, under the name of Conservatoire des Arts-et-Métiers, a public collection of machines, models, tools, drawings, descriptions, and books of all kinds of art and science, the use of which should be explained by three lecturers attached to the establishment.

"It may be well to mention that the title of 'demonstrateur,' or lecturer, often corresponded to that of professor, and that the professors of the Jardin des Plantes remained long after they had commenced giving regular courses. However that may be, the organisation of the Conservatoire, which was checked by several circumstances, was again mooted by Alquier at the Council of the Ancients, on the 27th Nivose, year 7, which urged the great advantage of such an institution to workmen, by saying that it is of more use showing them articles, than merely speaking to them. It was not, however, until the 12th Germinal, year 7, that the buildings of the priory of St. Nicholas of the Fields were put into the possession of the members of the Conservatoire, who were then composed of Le Roy, Conti, Molard, and Benvelot, designer. The names of these savants, and that of Montgolfier, who soon after replaced Le Roy, did not allow of any comparison being made between the functions of these lecturers and those who are differently named now a-days.

"At length, in the year 8, all the models and machines belonging to the State were definitively removed to this building, and formed collections destined solely for the instruction at sight. The functions implied by the title of lecturer were never exercised, and this will easily be believed when it is said that the numerous

visitors who are attracted by the rich collections sometimes amount to 200,000, which makes all verbal explanation on the spot impossible. But that which is not possible to do for the public has been for a long time afforded by the Conservatoire to persons who are really desirous of information. A complete and methodical catalogue has been made out and published, and to it are added, from time time, all new acquisitions; this has already passed through four editions. The galleries have been sytematically classified, a guide has been placed in each, who, if he cannot give any practical explanation, can at least show where such and such a model is to be found, each of which is ticketed and numbered, both in the catalogue and in the inventory. Should an engineer or a workman wish to examine separately a machine or machinery, a study card for the necessary time is given to him. Or should any more complete information or explanation be required, either the curator of the collections, the under director, or the director, is always ready to furnish them, their office being freely open to all.

"The staff in charge of the collections consists of the conservator, an assistant conservator, and of fourteen chosen guardians, who, for the most part, are picked from old non-commissioned officers or soldiors. The wish to give explanations by these, even with the aid of written details for the 9,000 models or articlos which are there, would lead to great errors and confusion by a zealous but a badly instructed staff. In asking that popular conferences, such as are held at the Polytechnic Institution of London, should be introduced here, account has not been taken of the great difficulties which stand in the way, and greatly exaggerated ideas exist as to their value.

"It is not by common and vulgar explanations that the principles of science can be spread amongst our workmen, and the facts and experience which are so necessary; their minds and intelligence are developed enough, so no fear need be had to speak to them on difficult scientific questions, if it is done with wisdom.

"All the professors who have followed this mode of teaching have often been convinced, on meeting some of their old hearers in workshops, that what may be termed the knowledge of truth and scientific principle has more deeply entered into their minds than into that of scholars of more celebrated schools. Hence it was not without reason that, in 1819, a decree of tho king, brought about by the respected Dean, M. le Baron Charles Dupin, added to the instructions at sight given by the collections, that of oral instruction in the amphitheatres, by professors chosen from among the ranks of science. The number of chairs, at first only three, is now fourteen, and the half of the professors are members of the Institute, who diffuse and popularise science, the progress of which they promote by their labours. This instruction, unique of its kind in Europe, only takes place during winter; it is free to all without any condition for admission or any examination, and the number of persons who have frequented it during the last few years amounts to from 150,000 to 180,000.

"To the honour of workmen it must be said, that a more attentive audience can nowhere be found; never does the slightest disorder arise, and I am happy to say that during the unhappy events which have taken place in France, the Conservatoire was always respected, and underwent no disturbance or invasion.

"But if we think the part of casual lecturers in the galleries useless, and if we are convinced that the real duty of the Conservatoire des-Arts-et-Métiers consists in the classification, maintenance, and increase of its collections, and in the teaching of the applied sciences, which it gives on such a large scale, we also believe that the Government should attach great importance to that teaching, which, during twenty years, we have developed under the name of technical education, and which has produced such good results in several of our great industrial centres.

"Your department pursues the realisation of this wish, and we hope it will be able, with the aid of the resources placed at its disposal by the National Assembly, to develop more and more this practical instruction, which, beginning at the primary school, gradually enables men, according to their intelligence and love of study, to rise from the lowest to the highest grades of society."

CORRESPONDENCE.

PRESERVATION OF MEAT.

SIR,—So far from taking exception to Mr. Edward Hart's observations on my meat preserving process, I feel thankful to him for calling attention to a matter in reference thereto which appears to be misunderstood I quite agree with him in regard to the importance of. cold air and desiccation; but he seems to have overlooked that portion of my paper which says, "Throughout my experiments I attended to the desiccation of the air of the meat chambers, so as, in fact, to keep up a slow but constant evaporation from the surfaces of the meat." Upon that point Mr. Hart and I are of one opinion.

Mr. Hart has an objection to the meat being actually frozen, but I think he will find a difficulty in pointing out any part of my paper wherein I insist on the necessity of freezing the meat. What I said was this:—"Even if it be not requisite to freeze the meat (and on this point there is room for much discussion) it is certainly desirable to have the control of a very low temperature." My own experience is that freezing does not injure the meat, and Mr. Gamgee's illustration of the mischief caused by attempting to cure meat while frozen with brine below the freezing point has not the most remote bearing upon the question. Meat so maltreated is, when sent into a distant market, neither frozen nor salted. But meat which has been frozen, and is afterwards put into comparatively warm brine, takes the salt well and is excellent.

Although I do not insist on the freezing of the meat in all cases, it will probably be found indispensable to do so on long voyages. There is another advantage attending it—its cheapness. It will positively cost less to bring to England a cargo of frozen meat than to bring it unfrozen. The reason is obvious. By freezing the meat you lay up, within the meat itself, a store of cold. To this extent the cost of artificial refrigeration during the voyage is saved.

My object in reading the paper referred to was to give the public the benefit of my experiences, not to vaunt my own process. The conclusion to which I have come, in my own mind, is, that it is unsafe to rely upon either freezing or desiccation alone. The best process will be that which best combines or gives control over both operations.—I am, &c.,

JAMES HARRISON.

52, Mornington-road, December 20, 1873.

SIR,—Referring to Mr. Hart's letter in the *Journal* of Dec. 19th, calling attention to the "Dry Cold Air" system of preserving meat, permit me to inform your Society that this system was patented by Mr. Clarke Ash, of the Piston Freezing Machine and Ice Company, as far back as 1871, and it has been constantly and effectively at work upon the Great Western Railway Company's lines ever since, for the purpose of bringing slaughtered meat to the London market.—I am, &c.,

J. M.

60, Cumberland-street, S.W.,
Dec. 22nd, 1873.

AUSTRALIAN WINES.

Sir,—I was surprised to read Dr. Thudichum's assertion, at the meeting of the Society of Arts on the 3rd of December, to the effect that the statements in the *Times* respecting the Australian wines having taken the diploma of honour at the Vienna Exhibition were not verified by a reference to the official records. I do not know what special "official records" Dr. Thudichum has secured access to, but I can state of my own knowledge that the Austrian official records confirm the announcement in question, which is also "verified" by the only official record as yet published on the subject, namely, the *London Gazette*, the number of which for September 2nd distinctly avers the fact. This being the case, I think I am entitled to retort on Dr. Thudichum his own advice—"That it is above all things necessary to be accurate in making statements of such a character."

I wish to add that the twenty-two exhibitors of wine from the Australian colonies secured at Vienna one diploma of honour, three medals of progress, seven medals of merit, and six diplomas of merit or honrurable mention, which, altogether, are equal to 77 per cent. of rewards.

Moreover, it is not only the fact, as stated by Mr. Tallerman and Mr. Booth, that the French experts assisting the jury seriously believed the Australian Hermitage wines to be products of the vineyards of the Drôme, but they further required an authoritative assurance that such was not the case before consenting to continue their labours.

Incidentally, I wish to make a few observations with reference to a second assertion of Dr. Thudichum's, to the effect that a natural wine showing more than 26 per cent. of proof spirit would "simply upset the whole scientific facts established throughout the world!" This is an alarming statement, which it was indiscreet to support by pretended proofs. Dr. Thudichum, after somewhat inaccurately remarking that the British Parliament, in 1858, sent its emissaries to all the wine-producing countries in the world, proceeds to assert that the result showed "that nowhere was any wine made which naturally had above 26 per cent. of proof spirit." If Dr. Thudichum will turn to the reports made by these gentlemen he will find that among the natural Spanish and Portuguese wines collected by Mr. Bernard there were certain samples which gave the following percentage of proof spirit, verified by Syke's hydometer:—Sherry, 27·2 and 27·9: Montilla, 29·9, 32·0, and 33·3; Val de peñas, 27·9, and 31·3; Valencia, 28·6; Alicante, 28·6 and 29·2; some special Malaga, 37·5; and natural port, 27·2. Further, Mr. Ogilvie procured in France a St. Gilles showing 27·2 per cent.; two samples of Roussillon indicating 27·9; and a La Tour blanche, 26·5; and Mr. Davies secured in Sicily a sample of Terreforte, the per-centage of proof spirit in which amounted to 29·9. Moreover the published analyses of MM. Salamon and Tiunoff prove that several of the white Crimean wines contain upwards of 29 per cent, of proof spirit; while those of the professors of the Agricultural Institute of Lisbon show that three of the natural wines of Portugal contain 27·1. Some of the foregoing were unquestionably exceptional wines, but others were the ordinary products of their respective districts. With these facts within his reach, it was at least imprudent for Dr. Thudichum to tell the astonished Australian wine-growers, because they produced natural wine containing moro than 26 per cent. of proof spirit, that they were "simply upsetting the whole scientific facts hitherto established throughout the world."—I am, &c.,

Henry Vitzetelly

(Juror for Great Britain in the wine section of the Vienna Exhibition).

Paris, Dec. 17, 1873.

SWAN RIVER MAHOGANY.

Sir,—About the year 1829, the late Sir James Stirling arrived in Swan-river, commissioned to form a colony where no attempt had been previously made. Of course the first object on landing in a desolate, unknown country, was to construct some kind of shelter, office, or hut, where the officials of the expedition might meet and transact business; but, utterly ignorant of the nature of the country, of its products, and of the character of the natives, and being surrounded by an interminable forest of trees, His Excellency the Governor decided to cut one down, and go through the ceremony of laying the first log of the government hut.

It was well known that trees of the *Eucalyptus* tribe abounded generally in Australia, so it was proposed to cut down one of the iron barks for that purpose, as the standard wood of the colony. But I, who held the position of civil engineer and superintendent of public works, should there be any, had already been chopping and cutting about, and I made known to His Excellency the governor that I had discovered a red wood tree, very similar in appearance to mahogany, and very abundant, but not found in the other settlements, and that it would form the most appropriate corner log for the inauguration of our government hut, or rather central colonial office. The ceremony was accordingly gone through, with all the honours, the ladies of the party duly attending.

From that time we colonists obstinately named it the Swan-river mahogany, though it is of the *Eucalyptus* tribe, and has nothing in common with west India mahogany but its appearance. At first, in our ignorance, we were anxious to obtain every bit of European timber, such as oak, elm, ash or pine, that could spared from the ships. But we found, to our great loss, that the intense heat of the summer sun soon caused all our foreign timber to perish miserably, and become as friable as tinder, independently of the ravages of the white ant, which does not touch Swan-river mahogany. Those who built boats of foreign timber, found them destroyed in a season or two by innumerable aquatic devastators.

We were compelled, therefore, to adopt our native mahogany for every purpose, and quickly found that it defied both land and water destroyers of every description. You have already had an excellent account of the first timber jetty we built in Perth water. I afterwards built a small stone cottage for the governor, timbered entirely with native mahogany. Also a court-house, with an ornamental Norman roof, 32 feet span, without a tie-beam. Also a commissariat store, 42 feet span, three storeys high, without pillars in the upper flat to support the roof, timbered and floored with native mahogany, and doors and window frames of the same. I had a boat of the same afloat for ten years in Perth water, the planking of which was as clean as the carpenter's plane had left it.

From the very outset of the colony I continually wrote home recommending our timber, as, without doubt, it would be invaluable for every kind of water-works, and may equally be used for all sorts of furniture, there being many varieties, possessing great beauty of grain.

The subject, however, has met with nothing but neglect, from 1830 to the present year 1873, or more than 40 years, while the colonists would only have been too thankful to supply any amount of Swan-river mahogany, especially considering how the colony has been allowed to pine in disgrace and indigence for so long a period. There may still be in the possession of the Society a specimen of the commonest kind, a rude carpenter's tool, that I gave to it many years ago.

The secret of its preservation may be perhaps that its blood red juice is somewhat similar to gum kino, and is fatal to insect life, though thero are both tobacco and pepper destroyers. It has also the valuable property of never becoming what is called iron-sick. The only objection is its weight, but that is not out of proportion to

its strength, for I have made archery bows, which, though much inferior to yew tree and lancewood, were still effective, and terrified the natives out of their wits, because they knew nothing of bows and arrows, and only understood the throwing of spears. There are two other beautiful woods—the sandal and the raspberry jam wood —but they are not of any size, or in any quantity.

The iron-bark, blue-gum, and others, are useless as timber, owing to their enormous weight, and having a coarse ugly grain, and would be only valuable for mill work, where they would outlast iron.—I am, &c.,

Henry W. Reveley.

Reading, October, 29.

WHITBY JET.

Sir,—I shall be glad if you will kindly insert a few remarks, in reply to the chairman and one of the speakers at the reading of my paper on Whitby jet, before the Society, on Wednesday, December 17, 1873. First, in referring to the number employed in the manufacture of jet, I stated it to be about "1,500 hands, or as giving support to nearly one-third of the population of Whitby." The chairman thought it would be more correct to say one-sixth; he will, however, kindly permit me to say that, taking the population of Whitby at about 16,000, my statement was nearly correct.

Secondly, in reply to Mr. J. Jones, of the Turners' Company, who said that, since their award was made, "he heard that it had made the men so proud that they had become rather disorderly," such is not the case; there is only one general regret among them, *i.e.* that more of the workmen did not compete. The silver medal of the Turners' Company was awarded to E. H. Greenbury, and not to the workman who sent the ink-stand—the latter having received a certificate of commendation. In my paper I should have stated that the freedom of the City of London was awarded, with the silver medal, to Edward Heselton Greenbury, and not to Matthew Greenbury, as mentioned.

Hoping this will answer the points omitted in my reply on that occasion,—I am, &c.,

John A. Bower.

OBITUARY.

Mr. C. W. Eborall.—The death of Mr. C. W. Eborall, general manager of the South Eastern Railway, took place on Friday last, the 19th ult. Mr. Eborall was attacked by an apoplectic seizure on the Tuesday previous, and from it he never rallied till his death, which took place at the London-bridge Terminus, whence it has been impossible to remove him. Mr. Eborall began life as an officer of one of the oldest railways in England, the Birmingham and Manchester, or Grand Junction, by means of which the ports of the Thames and the Mersey were first brought into communication. Subsequently he became general manager of the East Lancashire Railway, from which, on the resignation of Captain Barlow in 1856, he was promoted, under the chairmanship of the Hon. James Byng, to the important post of general manager of the South Eastern Railway. He became a member of this Society in 1861. He was a member of the Society's Committee on Channel Passage, and gave useful evidence before it.

The number of locomotive engines in the United Kingdom has increased from 9,379 in 1870, and 10,490 in 1871, to 10,933 in 1872; and the number of vehicles, exclusive of locomotives, increased from 285,994 in 1870, and 311,427 in 1871, to 337,829 in 1872.

The aggregate length of railways in the United Kingdom authorised during the three years 1870, 1871, and 1872, alone amounted to more than 1,100 miles.

NOTES ON BOOKS.

Strains on Girders, Arches, and Trusses. By E. Young. (*Macmillan & Co.* 1873.)

Mr. Young's object in publishing this treatise is to provide a full yet simple book on the subject. The only mathematical knowledge presupposed is a knowledge of simple equations, so that the problems are all put in their simplest form. The first chapter gives a little instruction in elementary mechanics, just enough to elucidate the mechanical principles of the subject.

GENERAL NOTES.

Cinchona in India.—In the first six months of the present year, over 10,000 cinchona plants of the new varieties were planted out on the Hooker estate, Neilgherries. More than 43,000 lbs of green bark were supplied to Mr. Broughton, and 23,646 lbs. of dry were shipped for sale in the home markets.

Ailanthus Silkworm.—Mr. J. N. Strettell, Deputy Conservator of Forests, Rangoon, proposes the introduction into Burmah of the *Ailanthus*, or the *Bombyx cynthia*, silkworm. The very hardy nature of the *Ailanthus*, its indifference to rain, and its partiality to a tree that will undoubtedly grow well in Burmah, renders it peculiarly adapted to the province.

England and Central Asia.—Trade between the Punjaub and Yarkund is steadily on the increase. Some 500 horses and mules laden with merchandise have already started from Ladakh, and more are proceeding daily. Owing to the competition, the hire of animals from Ladakh to Yarkund has risen to 75 rupees for each, while the sum of 35 rupees for each mule or pony has been fixed for the distance from Ladakh to Shahdah, which is about half-way between Ladakh and Yarkund. Mr. Shaw, the Joint Commissioner at Ladakh, allows two rupees for each mule or pony carrying goods for Yarkund from the Punjaub.—*Oriental.*

Street Pavement.—A new street pavement has been tried in San Francisco. It is called "hydrocarbolised brick," and is made of bricks of a soft porous nature, which are boiled in coal tar, which, it is said, renders them tough, and nearly as hard as granite. A road bed is made by levelling the sand and packing it with water. A layer of prepared brick is then laid flatwise, each brick being dipped in boiling tar as it is laid down. This is overlaid by a second course of prepared brick placed close together edgewise, each brick dipped as before. The interstices are then filled with boiling tar, and the whole covered with a thin layer of screened gravel. The cost is about 36c. to 37c. (about 3½d.) per square foot.

Indian Silk.—The entire duties in connection with the cultivation of silk in Kashmere devolve on the Chief Justice, Baboo Nilambur Mookerjee, and it is entirely owing to his exertions that the sericiculture has attained to its present thriving condition. Praise has been given to Italian reelers, but the Baboo has used reelers imported from Bengal to teach the Kashmerees and Battees, who are now nearly equal to their tutors in the art of reeling silk. We recently stated that "sanguine expectations are entertained that the yield for 1874 will be at least 10,000 lbs.," whereas, in reality, the out-turn for 1872-73 has already been 12,800 lbs. of silk, worth about a lakh of rupees. Besides this, a large quantity of floss silk is being utilised for carpets and coarse silk stuff, and the original quantity of eggs has been increased one-half. From such a good beginning the present proceeds of a lakh of rupees are expected to be increased tenfold in the course of a few years. Prior to the Baboo's undertaking the direction of sericiculture in the valley, the people produced, as their best annual crop, silk to the value of about 12,000 rs. (£1,200.) Silk reeled after the old Kashmere fashion sells at 5 rs. or 6 rs. (10s. to 12s.) per seer; the Baboo's best silk, reeled by natives, has been valued in England, by Messrs. Durant and Co., at 24 rs. (£2 4s.) per seer.—*Oriental.*

Substitute for Coal.—The Belgian *Echo du Parlement* prints the following curious letter from Hasselt, bearing on the question of a substitute for coal:—"Ten days ago a poor peasant of our neighbourhood went the round of all the coffee-houses with a sack containing earth. He said he had found the means of heating rooms with that substance impregnated with a solution of soda [and added to small coal]. He made the experiment before a crowd of people, and succeeded. Next day the whole town was in great excitement. Everybody had tried the new discovery, and I did the same. Following the man's instructions, I filled a scuttle three-quarters with small coal, and the remaining fourth with vegetable mould; I then sent for a halfpenny worth of common carbonate of soda, which I dissolved in half a litre of water, and then mixed up the solution with the rest. This quantity has been sufficient to warm my room from two o'clock in the afternoon to seven in the evening, at which time I am penning this." Such fuel has, at all events, the advantage of being plentiful and cheap.

Savoury Australian Meat.—A new patent has just been granted to Mr. S. S. Ritchie for "Improvements in the Manufacture of Preserved Meat." In his specification he says that to obviate the necessity of our cooking the meat when it is boiled for preservation purposes in large pieces, it is first cut up into minute particles by means of a chopping-machine. Herbs, salt, spices, &c., are added to render the whole savoury. The mass is then divided into small cases of convenient size, and desiccated in an oven, &c., at a heat of from 400 to 420 degrees Fahrenheit. After this the cakes are packed in tin cases, one oz. of strong meat jelly is added to create steam, the tins are subjected to heat in a bath of chloride of calcium; and as soon as a jet of steam issues from a hole left in the lid, such hole is firmly closed, the canisters being subsequently subjected to a temperature of from 250 to 260 degrees Fahrenheit for a short period. This meat is reported to be admirable in flavour, and we are promised an early shipment.

Snow-clearing Machine.—On the 1st December a machine, designed to clear the snow from the streets of New York, was exhibited in Lexington-avenue and in East Fortieth-street. It was drawn by four horses, and as it passed over the surface of the street at the rate of from three to four miles an hour, the snow lying between the wheels was immediately dissolved. "The annihilator," as the device is called by its inventor, is a simple contrivance, consisting of a boiler of suitable capacity, mounted upon wheels. Connected with the boiler is a superheater, the steam from which is discharged into a tank, or steam distributor, placed between the wheels. This tank is 3ft. long by 7ft. wide, and is provided in the bottom with nearly 300 pipes, through which the superheated steam is ejected upon the snow as the machine is drawn over the surface of the street. Covering the escape of the steam from the sides of the tank is an apron or curtain, which also serves to confine the heat within the limits covered by the tank."

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

JUVENILE LECTURES.

Two lectures will be given by Mr. Frank Buckland, M.A., her Majesty's Inspector of Salmon Fisheries, on "The Structure and Habits of Beasts, Birds, and Fishes, as showing Beauty and Design," on Friday, January 2nd, and Friday, January 9th. For the lectures special tickets are required, and these have already been issued to members up to the full extent of the space at the disposal of the Society.

ORDINARY MEETINGS.

The following arrangements have been made for the month of January:—

January 14.—"On Museums of the Industrial Arts and their Utilisation for Instruction in Technical Knowledge, and the Appropriation of the Surplus Funds Derived from the Fees taken from Inventors on the Issue of Letters Patent." By Thomas Webster, Esq., Q.C., F.R.S. On this evening, Thomas Hughes, Esq., Q.C., M.P., will preside.

January 21.—"On German Music, with Especial Reference to the Works of Richard Wagner." By Ferdinand Praeger, Esq.

January 28.—"Account of a Recent Visit to the Coal and Iron Fields of Virginia, United States of America." By Professor T. D. Ansted, F.R.S.

THE LIBRARY.

The following works have been presented to the Library:—

The Iliad of Homer, translated by J. G. Cordery, 2 vols. Presented by J. G. Cordery.

The Thirty-Seventh Annual Report of the Art-Union of London.

Vienna Universal Exhibition, 1873, Catalogue of the Indian Department, by J. Forbes Watson, M.A., M.D.

Patents and Patentees (Victoria), vol. 6, Indexes for the year 1871, by W. H. Archer, Registrar-General of Victoria.

A Dictionary of Artists of the English School, by Samuel Redgrave. Presented by the Author.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Entomological, 7.
Institution of Surveyors, 8. Mr. F. A. Philbrick, "The Lands Clauses Acts, with Suggestions for their Amendment."
Medical, 8.
Victoria Institute, 8. Rev. J. H. Titcomb, "Magnitudes in Creation and their Bearings on Biblical Interpretation."

Tues. ...Pathological, 8. Annual Meeting.
Biblical Archæology, 8½. 1. The Sallier Papyrus, containing the Wars of Rameses Meriamun with the Khita (Hittites). Translated, with Annotations, by Prof. E. S. Lushington, Glasgow. II. Mr. H. Fox Talbot, "On some Illustrations of the Book of Daniel, from the Assyrian Inscriptions."
Zoological, 8½.
Sculptors of England, 7.
Anthropological, 8.
Royal Institution, 3. Prof. Tyndall, "On the Motion and Sensation of Sound." (Juvenile Lectures.)

Wed....Geological, 8. 1. Mr. J. Clifton Ward, "The Origin of some of the Lake-Basins of Cumberland." 2. Mr. D. Mackintosh, "On the Traces of a great Ice-Sheet in the Southern Part of the Lake-District and in North Wales." 3. Mr. A. Wyatt Edgell, "Notes on some Lamellibranchs of the Budleigh-Salterton Pebbles."
Microscopical, 8. Mr. Alfred Sanders, "Further Notes on the Zoospores of the Crustaceæ, &c."
Royal Colonial, 8. (At the House of the Society of Arts). Mr. P. Lund Simmonds, "On Colonial Aid to British Prosperity."
Royal Society of Literature, 4½.
Obstetrical, 8. Annual Meeting.

Thur....Royal, 8½.
Antiquaries, 8½.
Royal Society Club, 6.
Mathematical, 8.
Royal Institution, 3. Prof. Tyndall, "On the Motion and Sensation of Sound." (Juvenile Lectures.)

Fri ......**SOCIETY OF ARTS, 8.** Mr. Frank Buckland, "The Structure and Habits of Beasts, Birds, and Fishes, as showing Beauty and Design." (Juvenile Lectures.)
Astronomical, 8.
Quekett Club, 8.
Clinical, 8½. Annual Meeting.

Sat......Royal Botanic, 3¾.

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FRIDAY, JANUARY 9, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ECONOMICAL USE OF FUEL.

Arrangements are being carried on to prepare for the testing of the stoves which have been sent in for this prize. Mr. Davis, of the Royal School of Mines, has been engaged to superintend the practical experiments which will shortly be commenced. Due notice will be sent to each exhibitor of the day when his stove will be tested.

PROCEEDINGS OF THE SOCIETY.

JUVENILE LECTURES.

The first of a course of two lectures, under the title of "Birds, Beasts, and Fishes," was delivered on Friday evening last, to an audience consisting mainly of young people, by FRANK BUCKLAND, Esq., M.A., Her Majesty's Inspector of Salmon Fisheries.

Mr. Buckland commenced by referring to the numerous kinds of living creatures by which the world is peopled, all of whom are specially adapted for living happily in the circumstances amongst which they are placed; and recommended his hearers to make friends with, and learn the language of, all the animals with which they came in contact, and always to be kind to them. Every living creature was a wonderful machine, perfectly adapted by its Creator to perform its part in the world, whether on the earth, in the water, or in the air; and though he admired the genius and patience of Mr. Darwin, he could not follow his reasoning or adopt his conclusions. Darwin seemed to think that different creatures developed themselves through what he called the struggle for existence; whereas he (the lecturer) maintained that everything was made perfect at the beginning, as was laid down in the "Bridgwater Treatises," which, he was happy to see, were being reprinted. He had no desire to hide the light of science under a bushel, but he wished theories to be fitted to facts—not facts to theories. Taking, for the first great division of the subject, vertebrate animals, Mr. Buckland illustrated with sundry pieces of wire the unity of plan upon which they are all constructed, and the mode in which the wings of birds, and fins and tails of fishes, are related to each other. The monkeys were first treated of in detail. Though he did not think they were the ancestors of man, still, monkeys must be looked upon as our poor relations, the old story being that they would not learn to talk for fear they should be set to work. The difference in structure between the hands and feet of monkeys and gorillas, as distinguished from the human species, was then pointed out, with the aid of pictures, casts, and skeletons, particular attention being called to the fact that monkeys had their thumbs on their hind feet. The cheek-pouches of monkeys were also adverted to, as serving them in place of pockets, and their thievish and mischievous propensities were done full justice to; indeed, the lecturer asserted that two rogues in the Zoological Gardens had formed a company (limited) for stealing spectacles, one engaging the attention of the spectator, while his comrade stealthily approached, and with a sudden dash, made off with the coveted prize. Others had a great fancy for bonnets, and one lady had lately sued the Zoological Society in the County Court for the value of one, but happily she was unsuccessful, or else the number of ladies in old bonnets visiting the monkey-house would probably have been something alarming. The capabilities of a chimpanzee, named "Joe," were fully narrated; and it appeared that a gentleman, rather famous for his success in teaching deaf-mutes to speak, had declared that, if a sufficient time were allowed, and it were worth his while, he could teach Joe to talk. The black monkeys, it was stated, had been almost exterminated a few years ago, in consequence of their skins being considered fashionable for ladies' muffs. Elephants were next introduced, and their intelligence and specialities of organisation described. Thus, on a recent occasion, when it was desired to make certain alterations in the house of the large elephant at the Zoological Gardens, it was not until the third or fourth attempt that the door could be so fixed that he could not open it, and when at last he had to confess himself beaten, he got angry and repeatedly charged the door with his tusks, so violently that the iron plate with which it was covered was pierced like a sheet of cardboard. The consequence was, that he had the toothache very badly, an abscess being formed from the concussion; and when, after some difficulty, Mr. Bartlett succeeded in lancing it, the elephant was so much relieved that he presented himself the next day to have the operation repeated. The tusks being hollow at the upper part, it sometimes happened that a bullet entered the cavity, and if the elephant were not killed by another shot it would remain there until it gradually became imbedded in the solid ivory, finally coming out at the tip. Unfortunately, elephants were so much hunted for the sake of the ivory, that there was a danger of their becoming exterminated, and the tusks of fossil elephants from Siberia were already coming into the market. Elephants lived to a great age; and it happened, curiously enough, that in their own country their greatest enemies were the flies, which, by causing inflammation in any wound which they might have met with, not unfrequently caused their death. A very fine elephant, at Bristol, which appeared very ill, being hardly able to walk, was found to have had his feet gnawed by rats, and when the vermin were destroyed he speedily recovered. The King of Siam lately wished to dispose of his four white elephants, and Mr. Jamrach was going to have them brought to England, but at the last moment the King's courage failed him, as he feared great discontent on the part of his people if the white elephants were sent away. It was now proposed, therefore, that their skins should be stained black, to bring them away, and when safe in England the colour could be rubbed off again. Several anecdotes of the rhinoceros and hippopotamus were next given, as also a full account of "Guy Fawkes," whose advent at the Zoological Gardens, some fourteen months ago, caused so much excitement. One of the old hippopotami having lately had a bad tooth, Mr. Bartlett, with the aid of several men with ropes and a tremendous pair of forceps, had succeeded in extracting it, much to the huge animal's relief. A live sloth, kindly lent for the occasion by Mr. Jamrach, was next exhibited, and his adaptability to his condition in life pointed out.

Being intended to live upon trees in the forests of South America, eating the young leaves, its claws were suited to such habits; but it was almost incapable of locomotion on the ground, and this led early observers to call it a stupid and sluggish animal, whereas it was nothing of the kind when in its natural position. The carnivora next came under review, some very fine skins of lions, tigers, and bears being exhibited, kindly lent by Mr. Nicholay and Mr. Keilch; and the harmony between the colours of the skins and the *habitat* of the animals was pointed out. It was also stated, as a curious fact, that lions and tigers born in captivity were more savage than those captured in their native countries, and that very often they had cleft palates; this, however, was not found to be the case with those born at the Zoological Gardens at Clifton. Tigers were very destructive in India, and it was very difficult to catch them, but, probably, if a little valerian were used, they might be more easily taken, as they were inordinately attracted by that drug. Some years ago a large lion got loose from a menagerie at Taunton, and was found by the keepers on the common eating a goose; the man who knew him best went up to him, got a rope round him, and the van being brought close up, the lion was ordered into his cage, and obeyed instantly. These carnivora were represented in England only by the cats, and very few of the wild species were now to be found in the British isles. He had seen one kept by a lady in a drawing-room, not knowing the danger to which she exposed her children; she, however, had bought it in India. After a brief reference to the kangaroo, the lecturer proceeded to deal with the deer tribe, explaining the manner in which their horns grow and are shed annually, differing entirely in this respect from the horns of oxen and sheep. A cage of prairie dogs, from South America, was next introduced, after which a short time was devoted to birds; the beautiful arrangement of the woodpecker's tongue, and its great resemblance to the ant-eater, which lives on similar food, was especially remarked upon. These things, it was contended, proved that there was a pre-arranged design in nature, and Mr. Darwin's conclusions were not justified. Some beautiful tail feathers of the Lady Amherst pheasant were next exhibited, after which were introduced some Rosella paroquets, a rare cockatoo, a laughing jackass from Australia, and a piping crow. Various costly furs, as the silver fox, black fox, and ermine were then shown; and the evening's entertainment was terminated by the exhibition of Mr. Saxe's beautiful mechanical piping bullfinch. Mr. Buckland announced that on the following Friday he intended to speak especially of fishes, seals, whales, &c., but keeping up the same leading idea which he had that evening endeavoured to inculcate, that design, beauty, and order reigned throughout the animal creation.

Mr. Buckland will be glad to meet those who have attended his juvenile lectures at his Fish Culture Museum at South Kensington, on Friday, the 16th inst., at two o'clock; entrance in the Queen's-road.

Iron says that experiments have been made at the blast-furnaces of Maxéville to increase the calorific power of coal, by mixing it with earth and soda, and the results have passed all expectation.

The revenue of the Suez Canal Company amounted in November to £85,880. In the first eleven months of this year the transit revenue of the canal was £831,720, as compared with £587,086 in the corresponding period of 1872.

The official trade return estimates the production of iron and steel rails this year in the United States at 850,000 tons, as compared with 942,000 tons in 1872. It is expected that about 3,000 miles of new railroad will be completed this year in the Republic.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

The third meeting of the Committee for Building Contrivances and Materials was held on Wednesday; Colonel Gallwey, R.E., in the chair. There were also present Messrs. J. Bird, J. Elger, G. Godwin, J. Grant, H. Grissell, D. Kirkaldy, T. Roger Smith, and Colonel Wray, R.E.

The Committee for Wine held its sixth meeting on January 6th. The following gentlemen were present:—Sir Daniel Cooper, Mr. F. Cosens, Mr. Apps Smith, Mr. H. G. Smith, Mr. Robert Gray, Mr. C. S. de Luc, Mr. Matthiessen, Mr. John Corlet, and Mr. M. Yeatman. The applications for space were considered in detail, and the committee made recommendations as to the disposition of the space at the disposal of her Majesty's Commissioners. The determination of the Board of Management to make a charge of sixpence per visitor entering the wine department of the Exhibition was reported to the committee.

The second meeting of the Sub-Committee for Civil and Mechanical Engineering was held on the 5th of January, Sir John Coode in the chair. There were also present Messrs. Douglas, Moreland, and Woods, and Colonel Pasley, R.E. It was announced that Messrs. Chance, Brothers, of Birmingham, will exhibit a first-order six-sided dioptric revolving light, intended for the South Stack Lighthouse, near Holyhead.

The third meeting of the Committee for Sanitary Apparatus and Construction was held on the 6th of January, Dr. Hardwick in the chair. There were also present Messrs. W. Clode and C. Gatcliff, and Dr. George Ross.

THE CITY COMPANIES AND THEIR EARLY HISTORY.

(*Continued from p.* 117.)

All City companies were subject to City control, and the Brewers acknowledge this subjugation in a petition dated 1435; at a later date they address the City magistrate as their right worshipful and gracious lord and sovereign the Mayor of London. Still later the Mayor is styled, by virtue of his office, master of all the Companies. (See City Records Report 29, folio 182.) The Mayor could fine and imprison the wardens at pleasure. The first instance on record of such having been done bears date 30th July, 1422, when Sir Richard Whittington complained, and Robert Chichale, the mayor, sent for the master and twelve of the most worthy of the Brewers' Company to appear at Guildhall, to whom John Fray, the Recorder, objected a breach of government, for which £20 should be forfeited, for selling dear ale. The masters were ordered to be kept in prison in the chamberlain's custody until they should pay the fine, or find security for the payment thereof. It is added, Whittington having obtained his conviction, and the Mayor and Court of Aldermen "gone home to their meat," the masters who remained in custody asked the chamberlain and clerk what they should do. He bade them go home, and promised that no harm should come to them. If further evidence of the City companies being under the control of the City authorities were required, it is supplied by the fact that in 1422, when Parliament ordered all weirs or "ryddels" in the Thames between

Staines, Gravesend, and Queenswood to be destroyed, the Mayor and Common Council ordained that two men from each of the twenty-six crafts should go out with the Mayor for this business.

Liveries are not mentioned as having been worn by any of the companies before the reign of Edward I., when the fraternities rode, to the number of six hundred, in one livery of red and white, "with the connusances of their mysteries" embroidered on their sleeves. This was on the occasion of the marriage of the King to his second wife, Queen Margaret. In 1348 the livery consisted of an upper and under garment, called a "coat and surcote," the cloak, or gown and hood, being reserved for ceremonials, and completing what was termed the "full suit." There appears also to have been an undress, called "the hooding," perhaps allowed to freemen who were not esteemed full brothers, like the livery. The hood appears to have been the only covering for the head worn at this period, the square cap, subsequently worn, according to Stow, not having been introduced before the reign of Henry VII.; and Sir John White amongst the young aldermen, is sneered at as the first that wore the flat round cap, which was followed by the Spanish felt hats. In 1435 permission to wear the livery was extended to honorary members; but in the reign of Richard II., liveries, in the manner of fraternities, became a general and dangerous party badge, and by Act 20, sec. 1, of that reign, it was prescribed that no yeoman, nor none other of less estate than esquire, shall use nor bear a badge or livery. And it was further ordained by 20th Richard II., that no spiritual or temporal lord, or others of less estate, or of whatever condition he might be, should give livery of cloth either to his family or his household, his relations or kin, his stewards, council, or to the bailiffs of his manors; and also that no livery should be given under colour of a guild or fraternity, or of any other association, whether of gentry or servants, or of the commonalty, but that the whole should be abolished within ten months after the Parliament then sitting; and further, that any taking livery contrary to that ordination might be imprisoned without redemption, that the guild or fraternity offending should lose their franchise, and those having no franchise should forfeit £100; and the companies were thenceforth obliged to have the king's license to wear liveries, the nature of which appears to have been left to their own fancy. All the companies continued to vary in the colour of this habit, until it became settled, about the beginning of the seventeenth century, but the style of their dress was nearly uniform as now. The initial letter and part of an ornamented border on the Leathersellers' charter, granted by Henry VI., in 1444, has preserved to us the style and character of the full clothing or livery.

The companies observed many ceremonials, costs, and customs, at their elections, funerals, attendances on state, and civic triumphs. Their semi-religious character at the date of their foundation led them to choose their patron saints, to appoint chaplains, and found altars to such saints. The Fishmongers adopted St. Peter, the Drapers the Virgin Mary, mother of the Holy Lamb, the Goldsmiths St. Dunstan, the Merchant Taylors St. John the Baptist. In other cases, they denominated themselves fraternities of some particular saint; the Grocers called themselves the fraternity of St. Anthony, the Vintners of St. Martin. The companies, from the wealth they early accumulated, their dinners, and abundant entertainments, soon became a source of attraction to those who loved the good things of life. At the companies' feasts, not only did widows, wives, and single women who were members join the joyous throng, but it appears, from an ordinance of the Grocers, dated 1348, that the brethren could introduce their fair acquaintances on paying for their admission, not as mere spectators, but as participants.

The earliest mention of the companies possessing halls is about the time of their being first chartered, under Edward III. Some, however, had halls or places of meeting long before, as the Merchant Taylors, who had a hall at the back of the "Red Lion," in Basing-lane; the Sadlers had theirs adjoining St. Martin's-le-Grand College. Most of the halls which existed before the Reformation seem to have been formed from the deserted mansions of the great, and subsequently from religious buildings, which account for their possessing, in many instances, gardens. Draper's-hall was the mansion of Lord Cromwell; Salter's-hall a town seat of the Earl of Oxford; the Grocers built upon the site of Lord Fitz-Walter's town mansion. The minor companies, in several instances, bought and converted the halls of the dissolved religious houses into trade halls, as the Leathersellers, who fitted up the hall of the nuns of St. Helen's; the Pinners, who occupied the Austin Friars hall; the Barber-Surgeons, who built on the site of the Hermitage of St. James-in-the-Wall. In the reigns of Elizabeth and the Stuarts, besides a hall, the guilds were obliged to have a granary and an armoury; and their almshouses for decayed members, wherever possible, adjoined the hall, that the almsmen might be ready to join in processions and pageants, which they did on the occasion of a royal marriage, the coronation of the king, the celebration of important victories, and other occasions of national rejoicing, as also upon the inauguration of the mayor. At the coronation of Richard III., the example first occurs of the heads of the great livery companies being chosen by the Common Council to attend the Mayor of London to Westminster as cup-bearers. In the same reign the twelve great companies contributed with the mayor towards the repair of the City walls, each company taking its respective portion.

The effects of the Reformation upon the livery companies were severely felt. It had been customary, in making gifts and devises to them in Catholic times, to charge such gifts with annual payments for supporting chantries for the souls of the respective donors; and as scarcely an atom of property was left without being so restricted, at a period when the supposed efficacy of these religious establishments was part of the national belief, almost the whole of the companies' trust estates became liable at the Reformation to change masters with the change of religion. The Act 37 Henry VIII., chap. 4, entitled "An Act for the dissolution of colleges, chantries, and free chappelles, at the King's Majesty's pleasure," had given the whole of their estates to the King and his successors, but they do not appear to have been wholly taken possession of till the next reign, when a new Act, 1 Edward VI., chap. 14, was proposed, entitled, "An Act whereby certain chantries, colleges, free chappelles, and the possession of the same, be given to His Majesty," and vested all such as had not been before seized on (and this included "all payments by corporations, mysteries, or crafts, for priests, obits and lamps,") in the king, to whom they were thenceforth to be paid by the companies. The companies, under requisition from the king, bought off these rent charges in the 3rd Edward IV., by selling other of their lands; this cost the companies £18,700. This seizure of chantry estates was followed by a measure of emancipation, calculated to promote the general interests of trade, but inflicted another blow on the companies, as persons not free of such corporations were allowed to exercise their crafts in cities and towns corporate. The City got the latter act repealed, upon the plea of the costs and charges craftsmen were liable to, as well as corporation taxes, and the great danger of "the decaie of cunning," by driving away freemen, if foreigners were admitted amongst them. The Act of Parliament 1st Mary prohibited linendrapers, woollendrapers, haberdashers, grocers, and mercers, who lived in the open country, and were not free of any city, borough, or corporation town, from vending their wares in such, or anywhere else, except in open fairs and by retail. The custom of exacting forced loans from the companies, begun by Henry VIII.,

was carried to a most oppressive extent by Philip and Mary, and it is stated by Maitland that, in 1558, £200,000 was raised in the city by way of loan, at 12 per cent., to carry on the French war, and to which all the companies were compelled otherwise largely to contribute. From this time the extracting of money from the trading companies became a regular source of supply to the government, and was prosecuted during Elizabeth's and succeeding reigns with a greediness and injustice that scarcely left these societies time to breathe. Contributions towards setting the poor to work, towards erecting the Royal Exchange, cleansing the City ditches, projects of discovering new countries, money for furnishing military and naval armaments, for men, arms, and ammunition, to protect the city, for state and city pageants and attendances, for provisions of coal and corn, compulsory loans for government and for the prince, state lotteries, "monopolous patents," and many other expedients were among the more prominent of the engines by which that "mother of the people," Elizabeth, and afterwards James and Charles, contrived to screw from the companies their wealth. Specie in the hands of the companies had the faculty of attracting clouds of precepts, or writs, directed to the masters and wardens by the mayor, in consequence of mandates or orders from the Privy Council. These enjoined them to call their companies together, to confer on the demand made, and to yield immediate compliance, as they would answer the contrary as in the king's writ. If the companies objected, they made return of their objections, whether on the score of being over-rated, want of sufficient security, or otherwise; the general plea, however, was inability. In cases of positive refusal, which rarely took place, "the King of the City," sovereign-like, compelled by fine and imprisonment. It is stated in the records of the Grocers' Company, that Elizabeth granted her servants and courtiers patents for monopolies, and those patents they sold to others, who were thereby enabled to raise commodities to what price they pleased, and to put inconceivable restraints upon all commerce, industry, and emulation in the arts.

(*To be continued.*)

SIR F. KNOWLES ON THE MANUFACTURE OF IRON.

The following correspondence, in addition to that already quoted, has appeared in *Iron*:—

Sir,—I am much obliged to Mr. I. L. Bell for the gentlemanly manner in which he has replied to my letter which appeared in your impression of the 20th December, 1873, and, were I to consult my feelings, I would at once let the matter drop, but I find that Mr. Bell's letter renders further reply an imperative duty devolving on me.

In my present communication I do not think it would be wise to give any further extracts from Baron Gruner's report; and, in declining to pursue that course of action, I am prompted by respect to the author and a love for truth, as I am quite persuaded that no person will ever be able to form a correct idea of the report itself, or of the impressions of the author's mind, from merely reading detached and isolated extracts, such as I could give consistently in a correspondence like the present; however, I thank Mr. Bell for his kindness in directing my attention to certain portions of Baron Gruner's report, and, in doing so, state that these portions had not escaped my notice. I am well acquainted with them, having very carefully gone through the report several times, and in my perusals I trust I have been actuated by a desire to arrive at truth; and I assure Mr. Bell that the quotations which he has given, so far from either altering or correcting my previous opinions, do quite the contrary; those convictions have also been confirmed by my later communications with Baron Gruner.

Judging from Mr. Bell's remarks relative to the manufacture of steel rails at Langley Mill, he writes as if he were under an impression that they were made from piles, of puddled bars. I take this opportunity of correcting that impression; and, in doing so, I will first observe that we made three qualities of rails at Langley Mill, viz., iron rails simple, iron rails with steel tops, and steel rails. The two first kinds of rails were made from piles in the usual way; the steel rails, however, were not made from piles, the mode of manufacture being simply as follows:—The converted material was heated in a ball furnace up to a welding heat; it was then forged under a steam-hammer into a bloom; the bloom was then reheated in a mill-furnace, and rolled direct into a rail, which rail was not sold at the low price named by Mr. Bell, but at £3 per ton above the usual price of iron rails sold by us. I may here state that there are now rails in use that have been laid in a very trying situation, and have worked ever since they were laid down, and are still good, being quite round on the top. In conclusion, I may say I have every confidence in the nitrate of soda process accomplishing all that I ever claimed for it to effect, were it carried out as recommended by myself in my patents, and in my previous communications on the subject. These convictions are the result of close observation of the practical working of the process at the Langley Mill Works, imperfect as the apparatus was.—Yours truly, John Heaton.

Sir,—The vast importance of any method which would effect that which Sir Francis Knowles claims for his process, in the paper recently published by you—viz., the saving of about ten shillings on every ton of wrought iron or cast steel produced, together with absolute freedom from the heavy per-centage of loss of metal which attaches to the present system of hand-puddling and Bessemer steel making—compels its careful consideration from all interested in those manufactures of which your journal is the organ. It is therefore to be hoped that the unfavourable opinion of even so deservedly high an authority as Mr. Lowthian Bell may not hinder a fair trial being made of the new process on a large scale, as the results of such experiments, if carefully observed and recorded, would throw much light on some of the most obscure and debated points in the technology of iron. The suggested "improvements" may be fairly considered apart, according as they have for their object the production of heat and the concurrent agitation of the fluid metal by the forcible injection of gases; or as they aim at the elimination of prejudicial impurities by the use of definite reagents.

Now, the proposed use of a mixture of carbonic oxide and air (assisted by the reagents indicated) as a substitute for the unaided air-blast of the Bessemer converter, regarded in its scientific aspect, offers many advantages as a means of obviating the serious loss of metal which is in that process unavoidable; while the elaborate calculations appended seem as convincing as they are minute, as to the economy of the agent employed. It is in expecting practical results to accord with those deduced from theoretical considerations that I fear the learned author will find himself to have largely underestimated the cost of production of his gaseous mixture. There are many points, moreover, with reference to the use of carbonic oxide, on which the paper is anything but explicit. Thus, we are not told how the pressure of blast—say 1·2 atmospheres—necessary to force the mixed gases through the contents of the converter, is to be supplied. Is the gas, after passing from the retort, to be first cooled in "gasometers" or otherwise? or is it proposed to pass carbonic oxide and air at a temperature of 500 deg. through any existing blast plant? The latter alternative, I presume, may be dismissed, though the paper says that "the gas being mixed in the condenser with hot air will be blown," &c.

Again, it appears to be assumed that the coke consumed in the cupola will be entirely converted to carbonic oxide, surely this is not anything like the fact.

Another serious question to be considered in the use of carbonic oxide, is its intensely poisonous character; so poisonous, indeed, is it, that a trifling escape in any confined situation might be attended with fatal consequences to the workmen; while the considerable occlusive action on this gas of cast-iron would also have to be considered. It is doubtful, too, whether sufficient allowance has been made in the calculations for the heat absorbed during the conversion of carbon into a gaseous condition as carbonic oxide; while, finally, it remains to be seen whether the temperature produced in the converter would not be absolutely too high to effect its purpose, and whether, as Dr. Percy concludes, the pasty condition is not the one most favourable to the freeeing the metal from phosphorus and sulphur.

I may take it that the object of all attempts at the chemical purification of pig-iron is the introduction of a substance which will form a readily fusible silicate with the silica present, substituting itself for the iron which would otherwise be lost in the slag, while at the same time, by its predisposing action as a strong base, it should facilitate the oxidation of the phosphorus and sulphur, and combine with them, so as to effect their removal as slag. Both nitrate of soda and caustic soda would theoretically fulfil these requirements, and it is most desirable that it should be authoritatively settled whether they do so in practice, and, if so, the conditions most favourable to their action. Common salt might probably be substituted for one or both of these, as the chlorine evolved would materially assist in the purification; the practical failure of this agent, when added in the blast-furnace, is no argument against its utility under the different conditions which obtain in the subsequent refining operations. It has indeed been used and recommended by various patentees as a flux in the ordinary puddling furnace at intervals during the last 50 years.

The adoption of some such lining as that brought forward by Sir Francis Knowles would be quite necessary to give the alkali treatment a fair chance of success; nor can there be much doubt that the use of a pure natural oxide of iron as a means of oxidising (with a view to their removal) the silicon and superfluous carbon present in the pig, is sound both in theory and practice.

On this and other points I must not dwell, but content myself with reminding your readers that an eclectic treatment of the suggestions advanced by Sir Francis Knowles may bring us nearer the solution of a problem which, when once solved, would add some millions to the wealth of the nation, for such would be the effect of any process which would cheaply and effectively purify the impure metal of Cleveland and other of our most productive iron districts.—I am, &c.,

S. T.

SILK IN FRANCE.

Amongst other useful effects of the late exhibition, organised by the Oriental Congress in Paris, must be noted the revived attention to the supplies of silk in France. The following details, from a recent French report, may prove interesting, though much therein contained is by no means new to English readers. The war, and political difficulties which have supervened, have thrown many important subjects into the shade for a time, but the silkworm disease, which has now prevailed ever since the year 1849, and seemed to be diminishing from 1870 to 1872, has assumed serious importance again this year.

In Italy the production was reduced by the disease and its consequences, in 1864, to the extent of 53 per cent.; in 1870 the deficiency fell to 14, and in 1871 to 4 per cent., but last year it amounted to 16 per cent.

In France the crop was a fair one in 1872, and this result was attributed to the gradual adoption of Professor Pasteur's mode of selecting the seed eggs with the aid of the microscope, but this year the crop is again bad, and without contesting the advantages of M. Pasteur's system, many scientific silk producers believe it insufficient to prevent the ruin of their industry, which seems affected at its very source. The production this year of cocoons is not half what it was twenty years ago, while the demand is largely increased. The frost raised the price of mulberry leaves, and, to cap the climax of misfortune, the Japanese eggs, which had done excellent service for some years, failed almost as completely as those of the native insects. The causes of these disasters have been sought for with all the anxiety caused by the partial destruction of one of the staple industries of a country, especially when all Europe is suffering from the same, and when, consequently, imports cannot be called in to fill the void in home produce. M. Destreux declared some time since, at a special meeting of the agricultural members of the National Assembly, that the silkworm disease had not diminished in intensity, and that M. Pasteur's process had not given the promised results, and he warned the Assembly against leading silk producers into further expense. This is not surprising, for it is now clearly proved, as was asserted by M. Guérin-Menneville years ago, that of these two diseases, or two phases of the disease, one is called *pébrine*, and is recognised by the appearance in the eggs of the microscopic corpuscules described by M. Pasteur; the other, known as *flacherie*, kills the worms, but without producing the slightest corpuscle that the microscope can detect. Thus this latter disease has at present baffled all the attempts of science.

So wide-spread is the evil and so serious its results, that small proprietors are compelled to give up the rearing of silkworms, being unable to gain sufficient even to cover expenses. It was believed that the crowded state of the breeding-houses and the ignorance of the peasants respecting the value of cleanliness and ventilation fostered, if, indeed, they did not originate the disease. The subject was well studied; model magnaneries were established, with all possible improvements in the simple fittings, and many extensive breeding-houses were created where the most scientific knowledge and care presided. For a time it was thought that by these means the disease had already been diminished and would finally be extirpated; but it is unfortunately now pretty generally admitted that breeding on a large scale has actually favoured the retention of the disease.

Under this accumulated misfortune the collection of silk and silkworms at the Oriental Exhibition had special interest, and has aided in bringing out some valuable information.

For some sixteen or eighteen years M. Guérin-Menneville and others have given great attention to the oak and other silk-producing worms. There was a collection shown at the London International Exhibition of 1862, and no opportunity has since been lost in France of bringing them prominently before the world. The difficulties surrounding the subject were great, but M. Guérin-Menneville and others have persevered with the most praiseworthy obstinacy, and at last their efforts seem to be about to be crowned with success.

One great inducement to the introduction of the insects in question is that they are far less tender than the true silkworm, can be reared in the open air, and give much less trouble than the latter.

The oak worm is the *tussah* of India, and is also indigenous to North America, China, and Japan, where it is known as the *yama-maï*. M. Guérin-Menneville proposes the name of *Bombyx perny* for the Chinese variety, as having been introduced into France by the Abbe Perny. All the varieties succeed well in France and other European countries.

The Yama-mai is cultivated on a large scale ' France; its cocoon divides easily, and its silk posses the peculiar property of taking a different tint w

placed in the same dye with that of the mulberry worm, which allows of the production of a curious variety of colour by simple immersion. The introduction of this worm gives a value to the leaves of the oak, which have not heretofore been turned to any commercial account.

Speaking of the food of silk-producing insects, it should be mentioned that M. Decroix has laid facts before the Acclimatisation Society of Paris tending to prove that the leaf of the mulberry is not the only food of the silk-worm, that vine leaves serve for the rearing of the worms for a certain period, and that in this case the silk assumes a red tinge, while, if fed on cultivated lettuce, white nettle, &c., the silk becomes of a yellow, green, or violet tinge; still the mulberry leaf appears to be the chief food of the insect; and according to another authority, it is sufficient to obtain the desired tint to give the worms the other leaves mentioned about 20 days before the production of the silk.

The other worm which is largely cultivated in France is the *Bombyx cynthia* which feeds on the ailanthe (*ailanthus*), and first received in error the name of the Japan varnish tree, with which it has no relation. The *ailanthus* grows where scarcely any other tree will, its progress is most rapid, and its form remarkably elegant; it has been adopted for the decoration of one or more of the Paris Boulevards, and seems to be well adapted for town growth. The cocoon of the ailanthus worm is pierced for the exit of the moth, the worm breaking the thread for that purpose, so that at first the silk could only be spun, as it is called, not reeled, but this difficulty has now been overcome by the invention of a special apparatus; since this great step has been made, the cultivation of the ailanthus has allowed large tracts of hitherto waste ground to be made profitable, and its extension is going on rapidly. The trees yield two crops of leaves a year, and give a net profit of from 100f. to 500f. per hectare. To give a case in point, M. Usèbe, whose property is near the Château de Milly, in the department of the Seine-et-Oise, obtains from silicious land, formerly valueless, 300f. per hectare, which is equal to the profit obtained in France from the cultivation of wheat on land worth 1,000f. to 5,000f. the hectare. With such results as these the breeding of the ailanthus worm is thought certain to extend not only in France, but wherever the tree will flourish and the climate is not too rigorous for the insects.

The process of silk spinning has always been avowedly imperfect, in spite of all attempts to improve it; but at last, M. Duseigneur-Kléber seems to have accomplished the object in view. The *moulinage* of silk, to use the French term, has for its object the uniting of the threads of raw silk in such a manner that they shall not disengage themselves when plunged in boiling solution of soap to get rid of foreign matters, which, unless removed, would diminish the suppleness, whiteness, and brilliancy of the silk. Hitherto this has required five successive operations to produce what is called organzine; and while in spinning cotton and wool, which have less power of resistance than silk, the spindles revolve at the rate of more than 6,000 turns a minute, the bobines of the old silk mills never reached half that speed. M. Duseigneur-Kléber has succeeded in so modifying the machinery as to at once twist the threads two by two, thus saving an operation, and to obtain a speed of 6,500 to 6,800 revolutions per minute.

This new machinery is already at work in four silk mills, and those specially interested in the subject will find a detailed description of it, by M. Alcan, in the September number of the "Bulletin de la Société d'Encouragement" of Paris.

M. Alcan says:—"This process increases production and improves the results, while, at the same time, diminishing expense to a notable extent. Its adoption allows of the spinning silk of a fineness hitherto impracticable, and the expense is very low." He adds that old machines may, to a certain extent, be adapted to the new process.

PROGRESS OF TRADE IN AUSTRIA.

In seeking for the causes of the recent development of Austrian commerce, it is necessary to take a retrospective glance at the history of the empire, and in doing so the attention is naturally arrested at that great turning-point in the modern annals of the country—when the system of absolute government was replaced by one of constitutional monarchy, that is, the revolution of 1848. The limits of this notice do not admit of a minute allusion to the various political and social reforms which, as a natural consequence, followed that change of government; but a brief comparison of the condition of the empire prior to 1848 with that at the present time will afford a general impression of the important modifications which have taken place in the condition of the country during the past quarter of a century. Up to the year 1848 the application of the feudal system to land and labour still existed in Austria. Previous to its abolition industry was dependent upon imperial concessions, capital was locked up by usury laws and the want of banks; production was protected against competition, both at home and abroad, by high import duties and inland taxes; the home markets were isolated from each other by the deficiency of means of transport, and manufacturing industry, in the present acceptation of the term, was almost entirely unknown. The wealth of the country at that time was chiefly derived from the products of the soil, and society was almost exclusively divided into the two classes of owners and tillers of land. For many years subsequent to the revolution, however, the progress of emancipating the nation was but slowly proceeded with, owing partly, perhaps, to the prejudices of the landed proprietors, and partly to the difficulty which the government experienced in controlling the conflicting interests of the several nationalities of which the empire was composed. It was not until after the loss of Venetia, and the still further disaster which befel the Austrian arms at Sadowa, that the government and people saw the necessity of co-operation if the empire was to preserve its rank amongst the leading states of Europe. The success of Germany at Sadowa, moreover, entirely dissipated the long-cherished hope of Austria's again becoming the head of the German Empire, and thus led to the introduction of a firm and progressive policy in the place of the old vacillating policy of the empire.

If we glance at the condition of Austria at the present time, a striking contrast is presented to that above described. Government monopolies (with but one exception) have ceased, industry is free, the usury laws have been abolished and banks created, home production is no longer unnaturally protected by high customs tariffs and inland duties, transit duty has disappeared, the home as well as the foreign markets have to a great extent been connected by steam communication, and many important manufactures have been developed.

Added to this, perfect civil and religious freedom has been established, and a system of national education introduced which will bear comparison with that of any other European state. The admission of the working classes to the suffrage is but a question of time. In the midst of all these improvements it is of course difficult to say how each in particular has been instrumental in expanding the trade of the empire. It may be safe, however, to give a prominent place to the extension of steam communication and to the conclusion of treaties of commerce as the chief means whereby both national and international exchanges are effected. It may be mentioned that the length of railway communication in the empire increased from 1,374 English miles in the year 1850 to 7,530 miles in the year 1872; the latter amount giving a proportion of about one mile of railway to every thirty square miles of area. As respects the treaties of commerce, it is worthy of remark that even before the German war, during the existence of a

liberal administration, Austria evinced the desire of extending her commercial relations with foreign countries by concluding a treaty of commerce with England. Up to that date Austria had contented herself with conceding some tariff privileges to the produce of other German states in return for concessions on the part of the Zollverein. The new treaty with England was established on a wider basis; the prohibitive system was abolished, and one of moderate protection substituted in its place. The tariff attached to the treaty was to a great extent based upon the Anglo-French treaty of 1860—that is to say, the limit of the import duties to be levied was fixed at 20 per cent. *ad valorem.*

The provisions of the English treaty, however, did not come into operation until after the termination of the war—viz., on the 1st of January, 1868. Its privileges were subsequently rapidly extended to the commerce of other countries in exchange for the "most favoured nation treatment" of Austrian produce, and it is in a great measure owing to the operation of theso treaties, in connection with the improved means of transport, that the natural resources of the Empire have been developed and its commerce enlarged. Before proceeding to notice the statistics of the trade of the Empire it may be useful to give a brief account of its resources. The total area of Austria is about twice the extent of the United Kingdom, but the total area under cultivation is only equal to that of this country. The proportion of cultivated land under corn crops is larger in Austria than in the United Kingdom, being about 16 million acres to 12 million acres. A very large part of the empire, 22 million acres, is covered with woods and forests. In ordinary seasons Austria not only produces sufficient corn for internal consumption, but also supplies considerable quantities for exportation. The produce of the forests is very large, furnishing, besides timber and fire-wood, gall-nuts, potash, turpentine, resin, and tanning-bark. The export trade in timber forms an essential part of Austrian commerce; and a very large revenue results therefrom. The value of the forests will, however, be greatly enhanced as the means of communication are extended—large tracts remaining still completely isolated from the existing land and water-way. Flax, hemp, hops, and tobacco are also extensively cultivated. The production of wine is estimated at from three to five hundred million gallons per annum. Austrian beer has now a European repute, and has become a staple of export. As regards live stock, Austria possesses more horses and cattle, but fewer sheep than the United Kingdom. The last returns give about three and a-half million horses, twelve and a-half million cattle, and twenty million sheep. About two-thirds of the population are still engaged in husbandry; but the spread of manufacturing industry is rapidly attracting large numbers to the industrial centres, and their places will have to be supplied by the introduction of machinery and improved methods of farming.

The empire is rich as respects the variety of its mineral wealth, but in many instances it is deficient in quantity. The production of coal is small, being estimated at about only five million tons per annum. The most important metal produced is iron—the productions of the Styrian and Carinthian districts, as is well known, possessing a world-wide celebrity. The Austrian manufacturers also excel in the production of good qualities of silk and woollen goods, glass wares, leather wares, paper, chemicals, some descriptions of tools, wooden wares, "articles de Vienne," and other minor branches. As a rule quality is the chief aim of the Austrian producer, as contrasted with quantity on the part of the English manufacturer. The sugar refineries and tobacco manufactories are important branches of trade.

Without going into elaborate statements, it may be worth while to examine the statistics of the commerce of the empire during the last decennial period for which they have been issued:—

1.—*Total Value of Imports.*

Years.	Merchandise.	Bullion.	Total.
	£	£	£
1861.	24,384,700	2,843,100	27,227,800
1871.	54,075,000	5,938,300	60,013,300
Increase in 1871.	29,690,300	3,095,200	32,785,500

2.—*Total Value of Exports.*

Years.	Merchandise.	Bullion.	Total.
	£	£	£
1861.	27,673,400	3,192,500	30,865,900
1871.	46,758,300	5,548,800	52,307,100
Increase in 1871.	19,084,900	2,356,300	21,441,200

The subjoined table shows the nature of merchandise both imported and exported in the two years:—

Description of Articles.	IMPORTS. (Stated in Millions.)		EXPORTS. (Stated in Millions.)	
	1861.	1871.	1861.	1871.
	£	£	£	£
Food	$4\frac{3}{10}$	$6\frac{3}{10}$	$4\frac{1}{10}$	6
Raw Materials ..	$9\frac{2}{10}$	$14\frac{0}{10}$	$7\frac{3}{10}$	$10\frac{5}{10}$
Manufactured goods	$10\frac{9}{10}$	$32\frac{8}{10}$	$16\frac{2}{10}$	$30\frac{3}{10}$

It will be observed from the above figures that the greatest increase has taken place in the exchange of manufactured goods. As regards articles of food, the imports and exports in 1871 nearly balanced each other, as they did in 1861. The exports of grain vary considerably, and depend upon the character of the seasons; as a general rule, the exports of live stock appear to be pretty equally the same in amount as those of the imports. The imports of raw materials, on the other hand, have increased in greater proportion than those of the exports.

The amounts above stated are exclusive of the value of the transit trade, which has very materially increased of late years, especially since the opening of the Brenner route. The total value of merchandise conveyed through the empire in transit in the year 1861, was only £9,512,000; in 1871 it rose to £23,586,000 sterling.

The general results speak for themselves, but it may be interesting to notice the effects of the recent commercial legislation upon some of the principal branches of national industry.

Glass Wares.—The production of glass and glass wares in Bohemia has rapidly increased of late years. The coloured wares find a market chiefly in the United States and the United Kingdom. The commoner descriptions are exported to tho Danubian Principalities and Turkey. Many other glass manufactures, such as buttons, beads, and dress trimmings, are largely exported to France, the United Kingdom and Germany.

Leather Wares.—The growth of this branch of industry, owing to the increased foreign demand for Austrian leather wares, has given rise to large importations of hides and skins and of tanning and dyeing substances. The excellence and cheapness of Vienna and Prague gloves have secured for them a large sale in foreign markets. The fancy leather goods of Austria are too well known to require mention.

Paper.—The production of paper is now very considerable, especially in the lower qualities; large orders are executed for England, and several of the London newspapers are printed on Austrian paper.

Sugar.—The cheapness of home-made beet sugar has almost entirely excluded cane sugar from the Austrian markets, and owing to the rapid extension of this branch of industry large quantities are produced for exportation, some shipments even having been made to the English markets.

Beer.—The export of Viennese beer has rapidly increased since 1867; the total export increased from 96,000 centners, in 1861, to 488,000, in 1871. The progress in the culture of hops has enabled Austria to compete with other foreign producers.

Wine.—The export of Austrian wines has increased considerably, but they have not as yet obtained an extensive sale in foreign markets. This is probably due to their comparative dearness, both in quality and price, when brought into competition with the light wines of France and Germany. It cannot, however, be doubted that many of the Austrian wines would command a good sale in the English markets were they more generally known. Several of the white wines produced in the environs of Vienna are of excellent quality, and if they could be transported to this country in good condition would be highly appreciated.

Iron.—The increased importation of pig-iron is regarded as a satisfactory evidence of the progressive state of the native iron works; very large imports of rails for railways, unshaped bars, sheet-iron, and coarse castings, as well as of iron and steel wares and machinery, were received in the year 1871, as compared with the imports in 1861. As the native iron works are insufficient to supply the demands of the various branches of native industry, these increased imports are indicative of the expansion of the home trade of the empire. It should be borne in mind that Austria has very little inferior iron; the reductions in the tariff now permit the introduction of the cheaper kinds of iron wares; but, at the same time, the production of nails, screws, sickles, scythes, knives, instruments, and utensils of various kinds in Austria, can hardly meet the demand which exists for them. The manufacture of machinery in Austria has also attained a high degree of excellence.

Fancy Wares.—The celebrated fancy wares of Vienna, in part already alluded to, in their endless variety and tastefulness, especially the gilt wares, trinkets, &c., continue greatly to improve, and are sent in enormous quantities to all parts of the globe. The estimated value of these goods exported in the year 1871 was five million pounds sterling.

Lucifers.—A considerable trade is still carried on in wooden matches, but owing to the introduction of the wax vestas, the Austrian matches are not now largely used in England.

Woven Tissues.—Although exhibiting some signs of progress, both the importation of raw materials of textile fabrics, and of textile fabrics themselves, are still unimportant, when the extent of the population of the empire is taken into consideration. We have, however, already mentioned that two-thirds of the population are still engaged in husbandry, and this will account in a great measure for the small consumption of woven tissues as compared with their use in other countries where the working classes are engaged in industrial pursuits, and earning higher wages, which afford them the means of indulging in greater extravagance in dress.

The manufacture of household furniture, ornamental china and earthenware, carved wooden wares, and many other descriptions of articles which may be designated as "fine art" goods, has rapidly increased during the last few years.

It has been stated above that the Austrian producers, like the French, excel in the production of articles of good quality rather than in those of inferior quality or low price, consequently there exists in the Austrian markets a large opening for the commoner kinds of most goods, provided they are of honest make. The ordinary Austrian linens and cottons, especially sheetings and table linen, are very coarse; common earthenware heavy; window and plate glass inferior; hardware and table cutlery far behind the English; all kinds of implements of industry, wheelbarrows, carts, waggons, omnibuses, water-carts, &c., very ill adapted to the purposes for which they are intended. The employment of the superior Austrian iron for a thousand purposes for which common English or Belgian iron would suffice, annually entails great losses to the country. It is greatly to be hoped that the crowning act of the Austrian Government in the path of progress, namely, the holding of the International Exhibition in Vienna during the past summer, may be productive of good fruit, not only to Austria, but to all countries which took part in it. It matters little which nation is to be the first to benefit by it, for it has been wisely ordained that no nation can enrich itself without enriching others. There can be no doubt but that the display of western products at Vienna last year will be productive of vast expansion of trade in south-eastern Europe and in many Asiatic states.

Space does not suffice to allude to the numerous internal improvements that are taking place in Vienna, Pesth, and other centres of the empire. Suffice it to say that it appears to be the object of the Austrian Government to avail itself of the peculiar geographical situation of the empire to endeavour to make Austria one of the chief routes of communication between the eastern and western worlds. As railways are extended throughout Asia it will tend to place Austria in the most direct line of communication, and one which will, moreover, be free from the rigorous climate of the proposed northern lines *via* the Baltic and Russia.

In order to attract commerce the Austrian Government must not neglect to reduce and simplify the customs tariff and regulations, and to afford the greatest possible facilities for bonding and transit throughout the empire.

CORRESPONDENCE.

RETURN OF ADMISSIONS TO PUBLIC MUSEUMS.

Sir,—Why has the return for the British Museum been omitted for the last two months? Is it impossible to obtain the returns? If so, surely the facts ought to appear. I submit that the list should every month contain the name of every museum, and the reason why the information is withheld or omitted.—Yours, &c.,

Statist.

[The British Museum authorities declined to furnish returns, stating that their returns were made up annually, and published as a Parliamentary paper.—Ed.]

A VERY CHEAP FUEL.

Sir,—I have been interested in a discovery made by a certain peasant of Hasselt, Louis Raymaekers, of a new fuel, the details of which have been lately published.

Raymaekers' recipe is as follows:—Coal dust, one part; garden mould, three to five parts; small quantity of common soda in solution. Mix the ingredients into a stiff compound, and make into balls.

I have not, till within the last few days, had an opportunity of testing practically the value of the above compound. The results obtained are as follows:—I made a mixture thus—To 15 lbs. of mould from ground adjoining this house I added 3 lbs. of powdered coal; also one pint of a solution of common washing soda—water, one pint; soda, one ounce. The mass was worked up after

the fashion of mortar, and then made into balls about the size of a large orange. Half-a-dozen balls in the wet state were put on a coal fire, which was not burning very brightly. In a short time the moisture was driven off, and the balls in a little time became red hot, giving out a strong heat, and apparently burning slowly without falling to pieces, the soda, no doubt, acting as a flux. The balls, on being touched with the poker, broke into lumps, which burnt like cinders, yielding a fire clear at the top. I further observed that, after the moisture was driven off, the balls burnt without smoke. The combustion seemed very perfect. I next fixed a blower to the grate, and secured a good strong draught. The fuel attained a white heat, and burnt away not very rapidly, leaving a by no means bulky ash. The ash was apparently of a heavy character, altogether different to coal-ash, which, as is well known, flies about in a very troublesome manner.

I could give further details of experiments I have made during the last three or four days, but fear to trespass on your space.

I see, by a recent number of a Belgian paper, that a portrait and memoir of Raymaekers will appear in *L'Illustration Européenne.* Certainly this intelligent peasant, who must be considered, if not a second Prometheus, at all events one of the benefactors of the human race, deserves honour and recompense, not only from his countrymen, but from all who take an interest in the poor, to whom cheap fuel means life. Prejudice and ignorance, the two great obstructives to progress, should not be allowed, in this instance, to hinder a fair trial of this easily-prepared fuel, which, besides its great cheapness for manufacturing as well as domestic purposes—it is just the thing for furnaces and stoves—promises to diminish the smoke nuisance, and promote the sanitary welfare of the community by utilising decayed or decaying animal and vegetable substances. These will become available for mixing with coal-dust, another comparatively refuse article. Common soda is cheap, and as very little is used in the new fuel, the cost may be reckoned almost *nil*. This cheap fuel is under no patent restrictions. I have no interest in recommending it except as one of the public. Let experiments be made, and the results published. Here are the proportions at a glance:—

Mould	15 lbs.
Coal-dust, or "breeze"	3 lbs.
Common carbonate of soda	1 oz.
Water	1 pint.

It is worth trying to convert one ton of coal into six tons of excellent fuel.—I am, &c.,

DUNCAN C. DALLAS.

362, Gray's-inn-road, King's-cross, London,
January 6, 1874.

[M. Laronde, chemist of the hospice of Tournai, gives the following as the composition of this fuel:—Small coal, 100 lbs.; common earth, 200 lbs.; common salt, 10 lbs.; saltpetre, 1½ lbs.—ED.]

GENERAL NOTES.

Varley Testimonial.—At a preliminary meeting of the Committee, held the 20th of November, Sir William Fothergill Cooke in the chair, it was resolved to recommend that a memoir of the late Cornelius Varley, illustrated with a photographic portrait, should be prepared and issued under the superintendence of the committee, and a copy presented to his family, in token of the high estimation in which he was held; and further, that some memorial should be erected to his memory at the place of his interment. Also that this resolution should be communicated to the absent members of the committee, and to his friends generally, asking them for their approval and co-operation on the committee, and that subscriptions should be invited.

Steel Rails on the Baltimore and Ohio.—During the past year, 878 tons of steel rails were substituted for iron rails on the Washington branch of the Baltimore and Ohio Railroad. The management is making a liberal expenditure for the improvement of the system. Upon the main line no fewer than 11,012 tons of steel rails were used in the year ending September 30, 1873. In all, 351 miles of the road are now laid with this durable material, and contracts have been concluded for the delivery of 12,000 tons of similar rails in the twelve months ending with September 30, 1874. The cost of the steel rails laid down upon the system has been charged to the repair account.

Sub-Wealden Exploration.—The boring, says *Nature*, has proved far more expensive than was at first anticipated, and additional funds will be required to complete the desired depth of 1,000 feet. A third sum of £1,000 has now been promised, and this will form a basis for future operations. This amount includes £200 from the Duke of Devonshire, £100 from Lord Leconfield, £50 from the Earl of Ashburnham, £50 from the Royal Society, and £25 from the Duke of Norfolk. These sums will be collected as the work proceeds, and additional contributions are solicited. The importance attributed to the enterprise by Professor Phillips, in the Geological Section, during the last meeting of the British Association at Bradford, is an additional proof, if any were needed, of the expediency of completing the investigation.

Plasterers' Company's Prizes. — The Company of Plasterers offer the undermentioned prizes to be competed for by students in metropolitan and provincial schools of art in connection with the Science and Art Department. 1.—A model in plaster: For a group of flowers, foliage, or fruit. This is to be an original design, suitable for the centre of a panel in a wall decoration. The size of the model not to exceed 29½ inches high by 21½ wide. Any style may be chosen. For the best, £7 7s.; for the second best, £4. 2.—A design in monochrome: An original design drawn in pencil or monochrome, and capable of being executed in plaster, in low relief, for the decoration of one panel, forming a portion of the side of a room 18 feet in height. The design should show the whole decoration from floor to ceiling, but should not extend beyond the width of the panel, which is to be less than its height. The drawing to be to a scale of one inch to the foot. For the best, £8 8s.; for the second best £5 5s. These prizes are open to all students in the provincial and metropolitan schools of art, including artisan classes in those schools; but the first and second prizes in either case cannot both be taken by students of the National Art Training School at South Kensington. The models and designs will remain the property of the competitors, but the Plasterers' Company reserve the right of taking copies of them should it be thought desirable. Designs in competition must be sent to the Science and Art Department in April, 1874, with the works required by the regulations in the Art Directory. The designs will be judged by the Science and Art Department.

The Hoosac Tunnel.—This celebrated tunnel is at length finished, so far as complete penetration of the mountain is concerned. At 3.13, on Thanksgiving afternoon (Nov. 27), the last heading was blown away. The dividing wall had been reduced to eleven feet. One central hole was bored entirely through this, and around were grouped a number of eight-foot holes on each side. The latter were charged, and the electric wires of both sets of shots were connected by means of the centre hole. One turn of the electric machine and the whole charge exploded with such violence that one mass of rock, weighing fully a ton, knocked down the strong gates placed as a barrier 300 feet distant. A very perceptible little breeze, from the gasification of the nitro-glycerine, swept through the tunnel. A breach five by four feet had been made by the shots, and through this the Hon. Robert Johnson, of Boston, State senator and chairman of the legislative committee on the tunnel, passed, followed by Mr. Shanly, the contractor, through whose energy the great work has been completed. The tunnel was proposed in 1825, revived in 1845, contracted for in 1855, attempted in 1856, re-contracted for in 1858, and slowly continued till 1862. In 1868 Mr. Shanly took it in hand, and promised to complete it in less than seven years, for less than 5,000,000 dols., but the whole cost has been about 10,145,000 dols., and it will cost before fit for running trains at least 2,000,000, dols more. The length is nearly four and three-quarter miles.

Incomes in Berlin.—The *Zoelwische Zeitung* gives the following particulars of the incomes of the population of Berlin:—52 per cent., 104,000 families have only an income of £45; 30 per cent., 60,000 families, between £45 and £60; 5 per cent., 10,000 families, £75; 4½ per cent., 9,000 families, £97 10s.; 3 per cent., 6,000 families, £120; 2 per cent., 4,000 families, £135; 2 per cent., 4,000 families, £150; and 1½ per cent., 3,000 families, over £150 per annum.

NOTICES.

JUVENILE LECTURES.

The second of a course of two lectures will be given by Mr. Frank Buckland, M.A., her Majesty's Inspector of Salmon Fisheries, on "The Structure and Habits of Beasts, Birds, and Fishes, as showing Beauty and Design," this evening (Friday), January 9th. For the lectures special tickets are required, and these have already been issued to members up to the full extent of the space at the disposal of the Society.

ORDINARY MEETINGS.

The following arrangements have been made for the month of January:—

January 14.—"On Museums for Technical Instruction in the Industrial Arts and Manufactures of the United Kingdom, and the Appropriation of the Surplus of the Inventors' Fee Fund for that purpose." By Thomas Webster, Esq., Q.C., F.R.S. On this evening, Thomas Hughes, Esq., Q.C., M.P., will preside.

January 21.—"On German Music, with Especial Reference to the Works of Richard Wagner." By Ferdinand Praeger, Esq.

January 28.—"Account of a Recent Visit to the Coal and Iron Fields of Virginia, United States of America." By Professor D. T. Ansted, F.R.S.

February 4.—"On Eastern Art, and its influence on European taste." By Dr. Christopher Dresser.

February 11.—"On Type Printing Machinery, with suggestions thereon." By the Rev. Arthur Rigg, M.A.

February 18.—"On Thrift as the Outdoor Relief Test." By G. C. T. Bartley, Esq. On this evening the Right Hon. the Earl of Derby will preside.

February 25.—"On the Channel Tunnel." By William Hawes, Esq., F.G.S.

March 4.—"On Bells, and Modern Improvements for Chiming and Carillons." By George Lund, Esq.

INDIA COMMITTEE.

A conference will be held on Friday, 23rd inst., at eight p.m., when a paper by Dr. Archibald Campbell will be read, on "Indian Teas, and the Desirability of Extending their Use in the Home Market." Members are entitled to attend these conferences and to admit two friends to them.

THE LIBRARY.

The following works have been presented to the Library:—

Transactions of the Society of Engineers for 1871. Presented by the Society.

Patents and Patentees (Victoria), Indexes for 1854 to 1871. Abstracts of Specifications of Patents from 1854 to 1866, Ac to Bu, and Metals, Part 1., by W. H. Archer, Registrar-General of Victoria. Presented by B. Woodcroft,

Abstracts of English and Colonial Patent Specifications, relating to the Preservation of Food, etc., by W. H. Archer. Presented by B. Woodcroft.

Statistical Tables of the Colony of Victoria. Presented by B. Woodcroft.

Parliamentary Buff Book for 1873, by T. N. Roberts.

The following works, by Don Carlos Nebreda y Lopez, have been presented by His Excellency José Merino Ballesteros:—

Tratado teórico-práctico para la Enseñanza de la Pronunciacion de los Sordo-mudos.

Tablero Arithmético-Geométrico, para la Enseñanza de los Ciegos.

Método de Escritura Usual, para la Enseñanza de los Ciegos.

Informe de la Sociedad Económica Matritense sobre los aparatos inventados.

El Colegio Nacional de Sordo-mudos y de Ciegos de Madrid, en la Exposicion Universal de Viena.

Memoria correspondiente al Curso Académico de 1870 á 1872.

Memoria relativa a las Enseñanzas especiales de los Sordo-mudos y de los Ciegos, premiada con Medalla de Platta, en la Exposicion Aragonesa de 1868.

The following have also been presented by his Excellency José Merino Ballesteros:—

El Colegio Nacional de Sordo-mudos y de Ciegos en la Exposicion Nacional de 1873.

Programa de los Ejercicos que han de Practicar en la Exposicion Nacional de 1873, los Alumnos del Colegio Nacional de Sordo-mudos y de Ciegos.

The following has been purchased for the Library:—

Society for the Promotion of Scientific Industry. Artisans' Reports on the Vienna Exhibition.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Royal Geographical, 8½. 1. Letter from Mr. T. Douglas Forsyth, "On the Progress of the Yarkand Mission." 2. Prof. Leone Levi, "Geography and Resources of Paraguay."
British Architects, 8.
Medical, 8.

Tues. ...Royal Institution, 3. Prof. Rutherford, "On Respiration."
Anthropological, 8.
Royal Medical and Chirurgical, 8½.
Civil Engineers, 8. President's Inaugural Address.
Photographic, 8.

Wed....**SOCIETY OF ARTS, 8.** Mr. Thomas Webster, "On Museums for Technical Instruction in the Industrial Arts and Manufactures of the United Kingdom, and the Appropriation of the Surplus of the Inventors' Fee Fund for that purpose."
Graphic, 8.
Literary Fund, 3.
Archæological Association, 8.

Thur....Royal, 8½.
Antiquaries, 8½.
Linnæan, 8. 1. Mr. J. G. Jeffreys, "On Japanese Marine Shells and Fishes which Inhabit also the North Atlantic." 2. Mr. Thos. Davidson, "On a New Japanese Brachiopod."
Chemical, 8. 1. Dr. Gladstone and Mr. A. Tribe, "Researches on the Action of the Copper Zinc Couple on Organic Bodies." (No. 5, on Ethyl Bromides.) 2. Dr. M. D. Tommasi and Mr. R. Meldola, "On the Action of Trichloracetyl Chloride upon Amines." (No. 1, Action upon Aniline.)
Numismatic, 7.
Royal Society Club, 6.
Royal Institution, 3. Prof. P. M. Duncan, "On Palæontology, with Reference to Extinct Animals and the Physical Geography of their Time."

Fri ......Philological, 8.
Royal Institution, 8. Weekly Evening Meeting. At 9, Professor Tyndall, "The Acoustic Transparency and Opacity of the Atmosphere."

Sat......Royal Institution, 3. Prof. G. Croom Robertson, "On Kant."

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,104. Vol. XXII.

FRIDAY, JANUARY 16, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

SWINEY BEQUEST.

A meeting of the judges appointed under the will of the late Dr. Swiney is hereby summoned to be held on Tuesday, the 20th of January inst. (being the anniversary of his death), when the bequest under the said will, in favour of the "author of the best published Treatise on Jurisprudence," will be adjudged. The meeting will take place at the House of the Society of Arts, at four o'clock, p.m.

(By order) P. Le Neve Foster, *Secretary.*

15th January, 1874.

ECONOMICAL USE OF FUEL.

On Tuesday last, the 13th inst., a visit was paid by the Committee for this subject to the houses of the Rev. W. G. Wrightson and Captain R. A. E. Scott, R.N., which have been fitted with fireplaces on Captain Galton's principle. Present—Major-Gen. F. Eardley-Wilmot, R.A., F.R.S, (Chairman of Council), Mr. S. W. Davies, Captain Douglas Galton, C.B., F.R.S., Dr. R. J. Mann, Mr. Robert Rawlinson, C.B., Rev. A. Rigg, Mr. H. T. Wood, with Mr. P. Le Neve Foster, Secretary. The Committee inspected Mr. Wrightson's arrangements, and heard a report of their effect from him. His house is fitted throughout with Capt. Galton's grates, and has been built specially with a view to them. Captain Scott's house was next visited. In this case the house was not specially built for the purpose, but the existing arrangements had been modified in order to admit of the introduction of the Galton system, and the application of gas to that purpose. A detailed account of Mr. Wrightson's experiments will be found in another part of the *Journal.*

MEETINGS.

The Council wish to draw special attention to the list of meetings on the last page of the *Journal.* It will be seen that an entirely new series of meetings have been arranged for the discussion of the more recent application of Chemistry to Arts and Manufactures. The list of ordinary meetings, and of meetings of the Indian section is also very complete.

NATIONAL MUSEUMS AND GALLERIES AND PUBLIC EDUCATION.

A meeting of the Committee was held on Saturday, January 10th, at the Patent-office Museum. Present—Major-General F. Eardley-Wilmot, R.A., F.R.S., Mr. Henry Cole, C.B., Mr. E. Thomas, F.R.S., Mr. Andrew Cassels, Mr. Hyde Clarke, and Mr. Thomas Webster, Q.C., F.R.S.

The Committee inspected the Museum, and afterwards proceeded to view some collections in the South Kensington Museum, in the possession of the Lords of the Committee of Council of Education. These had reference to (1) military weapons and projectiles, (2) naval armaments, (3) education. It was determined that application should be made to the Lord Chancellor, that he would appoint an early day on which to receive a deputation from the Society on this subject. To-morrow (Saturday), the 17th, has since been appointed by his lordship for the purpose.

The list of the Executive Committee is as follows:—

Abel, F. A., F.R.S.
Bennett, Sir John
Bourne, Col. J., M.P.
Brady, Sir Antonio
Brock, E. Loftus
Cassels, Andrew
Charley, Wm. T., D.C.L., M.P.
Clarke, Hyde
Cochrane, A. D. W. R. B., M.P.
Cole, Henry, C.B.
Croll, Colonel A. Angus
De la Rue, W., F.R.S.
Dresser, Christopher, Ph.D.
Eardley-Wilmot, Major-General F., R.A., F.R.S.
Elcho, Lord, M.P.
Gerstenberg, I.
Goldney, Gabriel, M.P.
Gower, Lord Ronald Leveson, M.P.
Hambro, Charles J. T., M.P.
Henry, J. Snowden, M.P.
Holland, Samuel, M.P.
Hughes, Thomas, Q.C., M.P.
Kay-Shuttleworth, U. J., M.P.
Kinnaird, Lord
Lichfield, Earl of
McLagan, Peter, M.P.
Morley, Samuel, M.P.
Müller, Prof. Max, F.R.S.
Mundella, Anthony, J., M.P.
Paget, Admiral the Right Hon. Lord Clarence, K.C.B.
Palmer, John Hinde, Q.C., M.P.
Parry, Love Jones-, M.P.
Playfair, Right Hon. Lyon, LL.D., C.B., M.P., F.R.S.
Powerscourt, Viscount
Reed, Charles, M.P.
Rothschild, Nathaniel M. de, M.P.
Samuelson, B., M.P.
Sandhurst, Lord
Sclater, Dr. P. L., F.R.S.
Siemens, C. W., D.C.L., F.R.S.
Straight, Douglas, M.P.
Strange, Lieut.-Col., A., F.R.S.
Thomas, E., F.R.S.
Tufnell, E. Carleton
Verney, Sir Harry, Bart., M.P.
Ward, G. W.
Webster, Thomas, Q.C., F.R.S.
Whitwell, John, M.P.

PROCEEDINGS OF THE SOCIETY.

SIXTH ORDINARY MEETING.

Wednesday, January 14th, 1874; J. Hinde Palmer, Esq., M.P., Q.C., in the chair.

The following candidates were proposed for election as members of the Society:—

Ashby, Morris, Colne-house, Staines.
Batley, John, 7, Kensington-park-gardens, W.
Beale, Joseph, Ash-mount, Abbey-wood, Lessness-heath.
Budenberg, Arnold, 23, Lower King-street, Manchester.
Burgess, Arthur W., 107, Strand, W.C., and 2, Thames-villas, Bray, Berks.
Burton, Walter Hally, 8, Mill-street, Hanover-square, W
Carr, Ellis, Heath-view, Clapham-common, S.W.
Chavasse, W., 505, Oxford-street, W., and Athlone-house, Shernhall-street, Walthamstow, E.
Cheney, Frank W., Messrs. Cheney, Bros., Hartford, Connecticut, U.S. America.
Cubitt, Leonard W., 12, Newgate-street, E.C.
Dann, Miss, 11, Chester-place, Hyde-park, W.
Drury, Mrs., 13, Radnor-place, Hyde-park, W.
Fowke, John C., Ann-street, Birmingham.
Frewer, Charles, 34, Nicholas-lane, Lombard-street, E.C.
Garland, Richard Wheen, Wharncliffe-works, Sheffield.
Hadland, John Henry, Wallington, Surrey.
Hurst, Thomas W., 8, Portsdown-road, Maida-vale, W.
Israel, Samuel, 1, Crescent, America-square, E.
Johnston, A. R. Campbell, F.R.S., Heatherley, near Wokingham.
Jones, Rev. John, F.R.G.S., 1, Crowland-terrace, Church-road, Islington, N.
Kempson, Mr. Alderman W., Mayor of Liecester.
Lambert, Thomas John, 59, Bishopsgate-street Within, E.C.
Lazarus, Abraham, 55, Euston-square, N.W.
Lazarus, Simeon, 38, Tavistock-square, W.C.
Leonard, Alfred Selfe, Ebley court, Gloucestershire.
Lindsay, Alexander, Bridgeton, Montrose, Scotland.
McFarlane, D. H., 62, Portland-place, W.
Nightingale, B. E., Albert Embankment, S.E.
Norris, Richard Stewart, C.E., Kenyon, near Manchester.
Norton, George, 19, Abchurch-lane, E.C.
Paget, Frederick Arthur, C.E., 1, Seymour-chambers, Adelphi, W.
Pasley, Lieut.-Col. Charles, R.E., Director of Works Department, Admiralty, Spring-gardens-terrace, S.W.
Postlethwaite, Alfred Perry, Royal School of Mines, Jermyn-street, S.W.
Pott, Robert, Bridge-street, Southwark, S.E.
Power, Edward, Oriental Club, W., and 45, Belsize-park, N.W.
Pratt, F. M., 18, Clifton-gardens, Maida-hill, W.
Prouse, Charles, jun., Melford-house, Upper Clapton, E.
Rivington, Septimus, 8, Kensington-gardens-square, W.
Robertson, R. A., 45, Scotland-street, Glasgow.
Sacré, Alfred L., 1, Mornington-crescent, N.W.
Scanlan, William Robert, 5, Grove-terrace, Walsall.
Selby, George Thomas, 1, Eaton-square, S.W.
Simpson, James Barron, 30, Baker-street, Portman-square, W.
Smith, Valentine, Thames-bank, Grosvenor-road, Pimlico, S.W.
Smith, W. J. Boase, Manaccan, Helston, Cornwall.
Steel, Harry J., Wharncliffe-works, Sheffield.
Steer, A., 83, Upper Thames-street, E.C.
Stephens, Henry Robert, 3, Cornwall-road, W., and 3, King Edward-street, Lambeth-road, S.E.
Taylor, Henry, 2, York-gate, Regent's-park, N.W.
Taylor, John Leigh, Oakleigh, Bolton-le-Moors.
Taylor, William, Westbourne, Chorley New-road, Bolton-le-Moors.
Tomkins, Alfred Savill, 29, Ladbroke-square, Notting-hill, W.
Webber, Major C., R.E., 101, Cannon-street, E.C.
Wight, James F., Gatcombe-villa, Croxted-road, West Dulwich, S.E.
Williams, Henry, Warwick-house, Warwick-lane, E.C.

AND AS HONORARY CORRESPONDING MEMBERS.

Ortolano, Don Juan de Tro y, D.C.L., K.C.I.C., Calle de San Miguel, No. 27, Madrid.
Satterlee, F. Le Roy, M.D., Ph.D., 42, West 21st street, New York, U.S. America.

The following candidates were balloted for and duly elected members of the Society:—

Barker, Albert, 41, Edwardes-square, Kensington, W.
Barker, William, 164, New Bond-street, W.
Bevis, Restel R., Birkenhead Iron Works, Birkenhead.
Billing, Charles Eardley, 14, Neville-terrace, South Kensington, S.W., and 90, Hatton-garden, E.C.
Chubb, John Charles, 57, St. Paul's Church-yard, E.C., and Teddington.
Clapham, R. Calvert, Earsdon, near Newcastle-on-Tyne.
Coulson, Frank, 34, Elm Bank-crescent, Glasgow.
Cumming, Simon Fraser, 51, Prince's-square, Bayswater, W.
Draper, George, 66, Old Broad-street, E.C.
Eldridge, James, Richmond Gas Company, Richmond, Surrey.
Faulconer, Robert Stephen, Clarence-road, Clapham, S.W.
Fawcett, Joseph, 16, St. James's-row, Sheffield.
Hewett, Henry North, Larkhall Brewery, Larkhall-lane, Clapham, S.W.
Hill, Hamilton Andrews, M.A., 11, Lee-park, Blackheath, S.E., and 13, Queen Victoria-street, E.C.
Holmes, Mrs., 21, Holland-villas-road, Kensington, W.
Hughes, Jabez, 49, Camden-square, N.W.
Jobson, John, Derwent Foundry, Derby.
Kirtley, William, Midland Railway (Locomotive Department), Derby.
McMaster, James S., Mitcham, Surrey.
Penton, George, London and Burton Brewery, Ratcliff, E.
Ray, Richard, Brewery, Camberwell-park, S.E.
Renshaw, Arthur Dallison, Lovell's-court, Paternoster-row, E.C., and 11, Cedars-road, Clapham, S.W.
Reynolds, W. P., London and Southwark Insurance Corporation (Limited), 73 and 74, King William-street, E.C.
Rhodes, Jehoida A., Britain Works, Howard-street, Sheffield.
Routh, Leonce, Moss-hall-grove, Finchley, N.
Stanbridge, Sidney, Hutton-lodge, 62, Wiltshire-road, Brixton, S.W.
Ward, Edwin, York-house, 69, Avenue-road, N.W.
Westhorp, Theophilus, Holmhurst, Loughton, Essex.
Whitehead, Dr., 54, Hamilton-square, Birkenhead.
Wittmann, Sidney A., 42, Great Marlborough-street, W.

The paper read was—

ON MUSEUMS FOR TECHNICAL INSTRUCTION IN THE INDUSTRIAL ARTS AND MANUFACTURES OF THE UNITED KINGDOM, AND THE SURPLUS OF THE INVENTORS' FEE FUND.

By Thomas Webster, M.A., F.R.S.
(One of Her Majesty's Counsel.)

The communication now submitted to the Society for the Encouragement of Arts, Manufactures, and Commerce has two specific objects, the one, the establishment, maintenance, and utilisation of museums for the technical instruction of the people; the other, the application, appropriation, and utilisation of the Inventors' Fee Fund to and for such purposes.

The term *technical instruction* is adopted in preference to *technical education*, in order to express the more limited object of the present communication, as compared with others which have been heretofore discussed at, and occupied the attention of, meetings in this room and elsewhere, and for several reasons. First, instruction is only part of education; it is, in the arts and manufactures, for a special class, what reading and numeration are for mankind generally. The fiat has just gone forth that no child among us shall be

left without the latter; so I hope that, by the exertions of this ancient and energetic Society, something may be done towards the former. There are other reasons why it is desirable that the subject should be specially limited. This Society has taken steps, and is pursuing active measures, as to "National Museums and Galleries and Public Education," with the view of bringing under direct Parliamentary responsibility the national museums and galleries, so as to extend their benefits to local museums, and to make them bear on public education. The objects in view for effecting this purpose are the following:—

1. All museums and galleries supported or subsidised by Parliament to be made conducive to the advancement of education and technical instruction to the fullest extent, and be made to extend their advantages to the promotion of original investigations and works in science and art.

2. To extend the benefits of national museums and galleries to local museums of science and art which may desire to be in connection, and to assist them with loans of objects.

3. To induce Parliament to grant sufficient funds to enable such objects to be systematically collected, especially in view of making such loans.

4. For carrying out these objects most efficiently, to cause all national museums and galleries to be placed under the authority of a Minister of the Crown, being a member of the Cabinet, with direct responsibility to Parliament; thereby rendering unnecessary, for the purposes of executive administration, all unpaid and irresponsible trustees, except those who are trustees under bequests or deeds, who might continue to have the full powers of their trusts, but should not be charged with the expenditure of Parliamentary votes.

5. To enter into correspondence with all existing local museums and the numerous schools of science and art, including music, now formed throughout the United Kingdom, and to publish suggestions for the establishment of local museums.

6. Also to cause the Public Libraries and Museums Act (18 and 19 Vict. c. lxx.) to be enlarged, in order to give local authorities increased powers of acting.

This great and comprehensive plan, which must commend itself to all earnest reformers of the education of the people, is worthy of the exertions of this Society, which has inaugurated and helped forward so many other noble undertakings.

The distinction between decorative and industrial art was recognised by the founder of South Kensington; it was always intended to have "at least two large establishments, one for practical science in all its developments, and the other for what may be called decorative art."* This distinction is well founded in principle, and important to be observed in practice. The same mind seldom has a natural bent or inclination for both; the instruction and the training are essentially different. But, although the cultivation of the fine arts and science, as applied to the industrial arts and manufactures of the country, have no necessary connection with each other; however fitting it may be that some one person should be made responsible and accountable to Parliament and the country for the administration of the funds applied to the general administration of the system; museums for technical instruction in the industrial arts and manufactures form one part of this great whole, but a part of pressing and urgent necessity, a part comparatively easy of accomplishment, and for which large funds already exist, contributed by the persons who owe everything to, and will be specially benefited by, such instruction.

* See evidence of Mr. Henry Cole before Select Committee of House of Commons," on "The Patent Office Library and Museum," 1st July, 1864 (2,353).

It is about 25 years since the advent of the Great Exhibition (1851) aroused the attention of this Society to the reform of the Patent-laws, and to the recognition of the claims of inventors to some more rational system than then existed for creating rights in their own property, the result of their intellectual labour.

The efforts of this Society, seconded by a large body of inventors and patentees, resulted in the reform of the session of 1852, due mainly to the statesman-like proceeding of Earl Granville, who, not concealing or disguising his objections to the system of patents, declared in the House of Lords, on introducing the Bill of the preceding session, that a system which the nation was not prepared to give up should be reformed. The measure then advocated having been lost for want of time in the session of 1851, it was matured into the Act of 1852, under the Government which succeeded to office at the commencement of that session.

The "Inventors' Fee Fund," as to which those who know most are disposed to say least, was created by, or has sprung up out of, the system then established.

Under the system existing prior to the 1st October, 1852, the fees on a patent and the specifications, amounting to nearly £300, from the three patents for England, Scotland, and Ireland, were appropriated at about two-thirds to public and one-third to private objects, the former being supposed to find its way, as stamp duties and otherwise, into the general accounts of the nation—the latter into the pockets of certain high officers of state, their clerks, and a great host of officials.

The Chancellor of the Exchequer, in 1851 (Sir Charles Wood, now Lord Halifax), being unwilling to allow the property in inventions to escape wholly from taxation or contribution to the public purse, agreed that one-fifth of the charge should go to the public, and the remaining four-fifths for the administration of the system. Accordingly, the Bill adopted by both Houses of Parliament in 1851 (but lost in that session for want of time) contained a schedule in which, of the total of the payments made at various stages of the periodical payments, one-fifth, or £20 per cent., was a stamp duty, and the remaining four-fifths, or £80 per cent., a payment in cash for the costs and charges of the administration of the patent system, the former being by the Act placed under the care and management of the Commissioners of Inland Revenue, the latter being ultimately paid into the receipt of the Exchequer, and carried to and made part of the Consolidated Fund of the United Kingdom, a vote being taken each year in Parliament for the costs, charges, and expenses of the administration of the system.

At the commencement of a new system, under which the cost of the patent and of the specification were to be reduced from £300 to £25, or to 1-16th of the cost, subject to further payments of £50 and £100 respectively, before the expiration of the third and seventh years, and the expenses of administration of which were uncertain, no complaint could be made then, even if some such complaint can now be made, as to the first cost of a patent. Some misconception exists on this point. The promoters of the Patent Law Reform of 1852 insisted that the taxation of property in inventions, and the repression of the creation of such property

by high charges, were essentially vicious, and contrary to all sound principles of taxation and political economy; and that if the creation and maintenance of such property was for the public weal, it should be encouraged and not obstructed. They conceded, however, that any such system might reasonably bear its own expenses; and that, assuming no more to be charged for the patent than the expenses of the system, the periodical payments might be regarded as a taxation on property after it had become valuable, in contrast to taxation when everything about its value was uncertain, it being assumed that such further payments would not be made unless the property had some value. The distinction and proportion already stated of 4-5ths and 1-5th was preserved by the Chancellor of the Exchequer as to such further payments. It may be further observed that the payment of the stamp-duty, or the revenue charge proper, does not take place until just before the sealing of the patent on the warrant of the law officer.

It should be further observed, that the applicant obtains protection on a species of inchoate property for six months for a payment of £5 only, and need not incur any further payment until the expiration of four months after the date of his application. The applicant, it is considered, in all cases receives an equivalent for this payment; and considering the circumstances under which it is made in some cases, and the advantages which might result from it, if the recommendations of the Select Committee of the House of Commons are carried out, much may be said in favour of its maintenance at that amount. The growth of the Inventors' Fee Fund is curious. During one year only (the second, in consequence of the cost of printing the old specifications) was there any deficiency. There has been a gradually increasing surplus, which, during the year ending the 31st of December, 1872, was £85,611 1s. 9d.; the total receipts during twenty years being £2,073,420 10s. 4d.; and the total expenditure, £1,060,500 2s. 11d.; showing a surplus of £1,012,920 7s. 5d., from the payments by inventors beyond what they have received in return, or what has been expended on objects in which they have a direct interest.

The statistics of the system present other curious results; out of, say 4,000 applications, on each of which £5 is paid, not more than 3,000 are prosecuted to a patent; the payment before the end of the third year, that is the first periodical payment of £50, is made in respect of not more than about 600; and the payment before the end of the seventh year of £100 is made in respect of not more than 300, or one-tenth of the patents originally granted.* These facts, coupled with the evidence before the Select Committee of the House of Commons during the sessions of 1871 and 1872, suggest many curious considerations, on which it would be foreign to our present purposes to enter, beyond remarking that the contributions to the "Inventors' Fee Fund" from the two periodical payments is inconsiderable, as compared with the amount arising from the payment for the patent.

The claim to be made on the Chancellor of the Exchequer is for the application of this million of accumulated surplus, and of this annual surplus of eighty thousand pounds, to inventors' purposes.

Four objects have been suggested as presenting special claims for the utilisation of this surplus, viz:—

1. The publication of a history of inventions.
2. Pecuniary rewards to inventors who may have received no adequate remuneration for their labours, and the benefits thereby conferred on mankind.
3. Purchase for the public, pending the term of the patent, of the use of inventions affecting important branches of national industry.
4. Museums and lectures for technical instruction in the industrial arts and manufactures of the United Kingdom.

The first of the above-mentioned objects was partially carried out by the "Abridgments of Specifications," issued under the superintendence of Mr. Bennet Woodcroft, and by the authority of the Commissioners of Patents, the proceeding with which has been suspended. It may be hoped, however, that the recommendation of the Select Committee of the House of Commons may lead to the appropriation of sufficient funds out of the surplus for this most important purpose.

The second and third of the above objects would require further legislation.

The last, which is within the powers of the Act of 1852, and of "The Elementary Education Act, 1870," as to establishing, building, and maintaining of industrial schools (33 and 34 Vict., c. 75, s. 28), is, as appears to me, the most pressing, and of the greatest national moment.

An eminent statesman, the Right Honourable Sir John Pakington, one of the Vice-Presidents of this Society, whose zeal in the cause of the education of the people has been surpassed by none, in his opening address at the Leeds Congress of the Social Science Association (A.D. 1871), said:—

> "Technical instruction will not wait. The enemy is at the gate, not in the shape of fleets or armies, but of a rivalry in manufactures and trade, in which, if we fail to maintain the position hitherto held, our national prosperity will be undermined, and England's wealth, power, and greatness will be a story of the past. Let us, then, be wise, ere it is too late."

The Right Hon. Baronet had been an attentive observer of the progress and development of that knowledge of which the Great Exhibition of 1851 was the pioneer. That great exposition of the industry of the world aroused the suspicions of Englishmen; the Universal Exhibitions at Paris, of 1855 and 1867 realised these suspicions, and gave them a definite form and expression. To this, nothing contributed more than the reports of the Special Commission, and, above all, the series of reports by working men, due to this Society, which are replete with information of the deepest interest. The suspicions before adverted to, as to the relative position and progress of England and other countries in the industrial arts and manufactures, created by the Great Exhibition of 1851, and the Paris Exhibitions of previous and subsequent years, aroused the attention of the Schools Commissioners, and led them (July, 1867) to request authoritative and authentic information as to the "inferior rate of progress in manufacturing and mechanical industry

* The actual number, on the average of ten years, ending with 1865, were 3,222, 2,065, 580, and 220 respectively.

in England compared with other European countries." Amongst the persons applied to, and who expressed their opinions, the following may be specially noticed. The present Postmaster-General, Mr. Lyon Playfair, states:—

"A singular accordance of opinion prevailed that our country had shown little inventiveness and made little progress in the peaceful arts of industry since 1862. Out of 90 classes, there are scarcely a dozen in which a pre-eminence is unhesitatingly awarded to us. The one cause upon which there was most unanimity of conviction is, that France, Prussia, Austria, Belgium, and Switzerland possess good systems of industrial education for the masters and managers of manufactories and workshops, and that England possesses none."

Professor Tyndall says:—

"I have long entertained the opinion that, in virtue of the better education provided by Continental nations, England must one day, and that no distant one, find herself outstripped by those nations, both in the arts of peace and war."

Mr. Huth writes:—

"I am sorry to say that, although we may still be unsurpassed in many of our productions, we no longer hold that pre-eminence which was accorded to us in 1851. The enormous strides that have of late been made by our Continental rivals in France, Belgium, Prussia, and Austria will make it daily more difficult for our woollen manufactories to hold, not only their former prominent position, but even to maintain their present one. I found that it is the want of industrial education in this country which prevents our manufacturers from making that progress which other nations are making. I found both masters and foremen of other countries much more scientifically educated than our own. The workmen of other countries have a far superior education to ours, many of whom have none whatever. Their productions show clearly that there it is not a machine working a machine, but that brains sit at the loom, and intelligence stands at the spinning-wheel."

Mr. M'Connell says:—

"In the class for which I was juror for England I made a very careful examination and comparison of our locomotive engines, carriages, railway machinery, apparatus, and materials, with those exhibited by France, Germany, and Belgium. I am firmly convinced that our former superiority, either in material or workmanship, no longer exists. Unless we adopt a system of technical education for our workmen in this country, we shall soon not even hold our own in cheapness. It appears to me Government should take the matter in hand. There should be mining schools in South Wales, Staffordshire, and Durham; and machinery and engine schools in Manchester, Glasgow, &c."

Professor Frankland says:—

"As a juror in Class 44 of the Paris Exhibition I was not only forcibly struck by the want of evidence of progress in the different branches of chemical manufactures carried on in Great Britain, but still more so by the great advances made by other nations—especially Germany, France, and Switzerland—in respect of such manufactures since 1862, when, as a juror in the corresponding class, I had also an opportunity of comparing the chemical manufactures of different nations. In the Polytechnic schools of Germany and Switzerland the future manufacturer and manager is made familiar with those laws and applications of the great national forces which must always form the basis of every intelligent and progressive industry. It seems that at length this superiority in previous training is more than counterbalancing the undoubted advantages which this country possesses in raw material."

Mr. Mallet says:—

"I fully agree that a better system of technical education for all classes connected with industrial pursuits has become a pressing necessity in Great Britain, and that immediate steps ought to be taken for organising and procuring legislatively such a system.'"

He has been long convinced that—

"Unless checked by a vast improvement in our own educational system, general and technical, the pre-eminence of England must decline with a rapidly accelerated pace."

Dr. David Price says:—

"What is really wanted for this country, and is of vital consequence to our future prosperity, is a higher scientific culture of those who are likely, in the natural course of events, to be master manufacturers; so that when discoveries are made, they may fructify, and not stagnate or decay, as has too often been the case, for want of intelligence, on the part of those who command capital and books, to see their merits."

The evidence given by other jurors is not less strong, especially that of Mr. Mundella, who said:—

"The branch of industry with which I have been connected for 30 years, is the manufacture of hosiery. I am the managing partner, employing 5,000 work-people; with the establishments in Nottinghamshire, Derby, and Loughborough, employing 4,000; with branches at Chemnitz and Pausa, in Saxony, employing about 700 persons. I have, for four or five years past, been increasingly alarmed for our industrial supremacy, and my experience of the Paris Exhibition has only confirmed and strengthened my fears. I am of opinion that Englishmen possess more energy, enterprise, and inventiveness than any other European nation. The best machines now at work in France and Germany are the inventions of Englishmen, but are there constructed and improved by men who have had the advantage of a superior industrial education.

"At the largest establishment in Paris these machines are constructed and improved, on thoroughly scientific principles, under the superintendence of a young man who, I was informed, took high honours at the school of the government in Paris. Precisely the same thing is taking place in Saxony; but the Saxons are, in respect of education, both primary and industrial, much in advance of the French, and in my branch they are our most formidable rivals. The contrast betwixt the workpeople of Saxony and England, engaged in the same trade, is most humiliating. I have had statistics taken of various workshops and rooms in factories in this district, and the frightful ignorance they reveal is disheartening and appalling. In Saxony, our manager, an Englishman of superior intelligence, and greatly interested in education, during a residence of seven years, has never met with a workman who cannot read and write, not merely in the limited and imperfect manner in which the majority and English artisans are said to read and write, but with a freedom and familiarity that enables them to enjoy reading and to conduct their correspondence in a creditable and often superior style. Some of the sons of our poorest workmen in Saxony are receiving a technical education at the Polytechnic schools, such as the sons of our manufacturers cannot hope to obtain. I am of opinion that the English workman is gradually losing the race, through the superior intelligence which foreign governments are carefully developing in their artisans. The education of Germany is the result of a national organisation, which compels every parent to send his children to school, and afterwards affords the opportunity of acquiring such technical knowledge as may be useful in the department of industry to which they are destined."

His concluding sentence ought to carry great weight:—

"If we are to maintain our position in industrial competition, we must oppose to this national organisation one equally effective and complete; if we continue the fight with our present voluntary system, we shall be defeated; generations hence we shall be struggling with ignorance, squalor, pauperism, and crime; but, with a system of national education made compulsory and supplemented with art and industrial education, I believe within twenty years, England would possess the most intelligent and inventive artisans in the world."

The evidence of most experienced men, of which the following is an imperfect summary, led to further inquiries, and to a communication from Mr. B. Samuelson, M.P., to the following effect:—

"I have attempted to show by examples what is the con-

dition of some of the leading industries in these countries (France, Switzerland, and Germany). I do not think it possible to estimate precisely what has been the influence of Continental education on Continental manufactures. That the rapid progress of many trades abroad has been greatly facilitated by the superior technical knowledge of the directors of works everywhere, and by the comparatively advanced elementary instruction of the workers in some departments of industry, can admit of but little doubt; meanwhile we know that our manufacturing artisans are imperfectly taught, our agricultural labourers illiterate, neither one nor the other can put forth with effect the splendid qualities with which Providence has endowed our people. Our foremen, chosen from the lower industrial ranks, have no sufficient opportunities of correcting the deficiencies of their early education; our managers are too apt in every case of novelty to proceed by trial and error, without scientific principles to guide them; and the sons of our great manufacturers too often either despise the pursuits of their fathers as mere handicrafts, unworthy of men of wealth and education, or else, overlooking the beautiful examples which they afford of the application of natural laws to the wants of men, follow them solely as a means of heaping up more wealth, or, at the best, for want of other occupations. To the evils of such a condition not only our statesman but also our people are rapidly awakening, and, the disease being once acknowledged, I believe the remedy will soon be applied."

To the opinions of the men eminent in position, already quoted, may be added the testimony of workmen, who from their circumstances are entitled to the highest credit, as in most instances self-educated men, speaking from actual experience.

On the subject of early technical training, one experienced in chairmaking, Mr. Lucraft, says:—

"Seeing some lads at work with the men in the carvers' shop, I went to the bench of one about 14. He was carving a chairback of a mediæval form, from a working drawing. I expressed my surprise that one so young was found capable of carving so well, and was informed that boys at school are specially prepared for the trade they fancy; so that a boy about to be apprenticed to learn carving, is instructed in ornamental drawing, modelling, and designing. Further, I am bound to repeat that in the race we are nowhere. Without the least doubt or hesitation, yet with the most profound regret, I say that our defeat is ignominious, and I fear as disastrous, as it is possible to conceive. We have not only made no progress since 1862, but it seems to me we have retrograded."

To the foregoing may be added that of Mr. Aitken:—

"Industry, formerly unaffected by foreign rivalry, contended only with small producers of its own nation, and then the competition was small. But free trade has thrown down the barriers, and the world is now one mighty universal market. To be successful in this competition, our nation must therefore put forward all its energies to educate, in technical and other schools, the present and coming generations. This was anticipated, and was clearly seen. Humboldt, many years ago, foresaw and predicted, 'That the time was not far distant when science and manipulative skill must be wedded together; that national wealth, and the increasing prosperity of nations, must be based on an enlightened employment of natural products and forces.' Justus Liebig said, 'The nation most quickly promoting the intellectual development of its industrial population must advance, as surely as the country neglecting it must inevitably retrograde.' Peel saw this, and uttered the memorable words—'If we are inferior in skill, knowledge, and intelligence to the manufacturers of other countries, the increased facilities of intercourse will result in transferring the demand from us to others.' And England's noblest Prince foresaw in international exhibitions (which he was the first to inaugurate), the coming activity in things industrial; and in order to provide for the coming competition he inaugurated, ere his lamented death, a system of industrial education. In France, Prussia, Saxony, and the small State of Wurtemburg, &c., trade schools, in addition to others of a higher class, are in existence, and furnish the connecting link between the man of science who discovers, and the superintendent who is the medium, and who, educated in these schools, aids, by his instruction and advice, the workman in bringing into visible shape the discovery of the man of science, rendering practically usful that which existed as an idea only. If, then, industrial and technical training has benefited other countries and states in their industrial progress (which no doubt it has), it becomes the duty of every Englishman to see to this important point."

A perusal of the reports of the eighty-eight artisans of this country, formed on a personal visit and inspection of the Paris Exhibition, which this Society was the means of securing, can hardly fail to lead to the conviction—1st, of the critical position of this country in regard to its manufacturing pre-eminence; 2nd, of the great neglect of technical instruction in this country, as compared with other countries; 3rd, that the rapid progress of other countries in the industrial arts and manufactures is due mainly to the complete instruction in trade craft which is provided equally for the lowest order of mechanical and the highest order of professional skill.

The subject now under consideration has been treated by Mr. Thomas Brassey, M.P., in the following striking manner. In his work on "Work and Wages" attention is called to the contrast of results of individual personal labour in the staple manufacture of spinning in this and foreign countries, as to which he states the average number of spindles attended by one person to be—

In France	one person	for	14	spindles.
Russia	,,	,,	28	,,
Prussia	,,	,,	57	,,
England	,,	,,	74	,,

This extraordinary discrepancy is due to two causes—one, superior skill in the artisan; the other, superior machinery. The physical power of the attendants, for the most part women and children, can hardly affect the question.

It must be borne in mind that during the last century domestic manufacture has been succeeded and superseded by larger establishments, formed on, or created by, capital and machinery. This change may be regarded in two aspects—first, as regards the artisan; second, as regards the public, in the diminished cost of production and the consequent increased consumption.

The further consideration of these questions would be foreign to our present object, except in connection with the means by which these objects can be promoted, and the warning that the difference presented by this comparison may and in all probability will be rapidly noticed.

Too much stress cannot be laid on the observations of Mr. Brassey, at p. 15 of "Work and Wages," to the following effect:—

"English workmen but imperfectly realise the serious odds against which our industrial establishments have to contend from the difference in the rate of wages in this country and on the Continent. It requires much skill in the employer, much energy in the workman, to compensate for the difference in the wages."

This lower rate of wages may be due partly to the cheapness of provisions, but other causes are in operation. The tendency towards the unity of mankind will gradually repair these distinctions; and the question of the superior technical knowledge of the artisan must be fairly met and grappled with. Other causes in operation ought not to be disregarded, as to which Mr. Samuelson, M.P., says:—

"I think that the importance of the question of foreign competition, as affecting the policy of a patent law, has been somewhat underrated by some of the witnesses examined before this Committee. I think it is a very serious matter that specifications should be published in the handy form in which they are published in this country, in those little blue books, costing from 3d. to 2s., and that they should at once be disseminated all over the world, so that any persons interested in the subject in the countries in which there happens, from any cause, not to be a patent for the same invention, should be able to avail themselves of the information as against manufacturers generally in this country. In many cases those descriptions are not sufficient to enable a person to carry on the manufacture successfully; but there are many other cases in which they are quite sufficient; for instance, where they relate simply to some new mechanical combination not of a very complex character. Now, in the year 1867, I visited Switzerland, and I was surprised to find how successfully our inventions in spinning machinery are immediately copied there; the result being that our trade in spinning machinery, so far as certain neutral markets are concerned, more especially the South of Germany and the North of Italy, has been transferred almost entirely to the Swiss. And they have this advantage, that they are able to avail themselves of a combination of English patented inventions, each of which is a monopoly, or something approaching to a monopoly, in this country, and in that way it happens that they may be able actually to produce a better spinning machine occasionally than any single manufacturer can do in this country. Now, it appears to me, that some remedy ought to be sought, at all events to diminish this evil to the English manufacturer, and for my part I can see no other remedy than that it should be made a condition of patents that the patentee should grant licenses, and that in the terms of those licenses regard should be had to the exigencies arising out of foreign competition."

Various remedies of the admitted evil may be suggested, amongst others, technical instruction by means of museums of, and lectures on, the industrial arts and manufactures.* The difficulty of obtaining suitable teachers has been much insisted on; that difficulty I believe to be purely imaginary. It cannot be denied that suitable teachers of the highest class, such as our old universities may produce and sanction, may be found with difficulty, but, as remarked on a former occasion, experts in particular branches could be found, whose character in the locality would ensure an attentive audience.†

We are now face to face with the real difficulty as to places, the plant, and the apparatus necessary for such instruction.

A Select Committee of the House of Commons, presided over by Mr. Dillwyn (1864), entered fully into the question of museums. It may be well to call attention to the evidence then given before, and to the report of, that Committee, which, after referring to the various suggestions as to the nature of such museums, states:—

"That it appears that the chief purpose of a general museum is to illustrate and explain the commencement, progress, and present position of the most important branches of mechanical inventions, to show the chief steps by which the most remarkable machines have reached their present degrees of excellence; to convey interesting and useful information, and to stimulate invention."

This recommendation of Mr. Dillwyn's Committee has been wholly disregarded; the Museum of Inventions at South Kensington is starved in the most extraordinary manner. A sum of money, £120, recently solicited by a peer of the realm, when Law Officer, for the carriage of a unique machine—an original Smeaton steam-engine, presented by the Carron Company—having been refused, notwithstanding the accumulated million of surplus unspent on the objects entrusted to the Commissioners of Patents.

The inability of the high functionaries acting on that Commission to obtain the adoption of their recommendations is most remarkable. For years past the Commissioners, in their annual report to Parliament, have set forth the necessities of the office, have pointed out suitable sites, amongst others Fife-house, on the Embankment. Other convenient and available sites may be found; but so long as the Chancellor of the Exchequer regards inventors and inventions as legitimate objects of taxation, no effective steps will be taken.

But the establishment of such museums is specially called for at the seats of our respective industries. Certain localities have become, so to speak, dedicated to particular industries; they follow after, and do not resist, natural causes. An obvious step would be to provide, in our great seats of industry, museums specially illustrative of the arts and manufactures of the locality or district, with lectures on the practical matters in which the workmen and their families are engaged.

At the recent meeting of the British Association at Bradford, this subject was brought before a meeting presided over by Mr. Samuel Cunliffe Lister, and an address presented to the Bradford Chamber of Commerce, with the view of obtaining the application of some portion of the accumulated and annual surplus to a museum of the industry of that locality. The following practical proceeding for attaining this object is suggested.

Let the inventors of each locality constitute local committees, and let the amount assigned to each locality be assessed by or have reference to the number of patents in each district.

There will be found in the first number of the Commissioners of Patents *Journal*, a table of the number of patents issued to inventors having residences in Middlesex, Lancashire, Yorkshire, and the Midland and Southern counties, Ireland, and Scotland; thus the surplus could be applied in some proportion to the amounts contributed from the inventors, the skilled artisans of the district. The taxation should either not be levied, or if levied, applied to purposes in which the contributors have an interest.

The present Earl Derby, in 1866 (as Lord Stanley), writes as follows, in reference to this question:—

"The fact that a considerable surplus does exist, the certainty that it will largely increase, are both admitted. Equally indisputable is it, that the taxing of inventions is an experiment never contemplated by the framers of the Act of 1852, and unjustifiable even in the utmost pressure of financial distress. The latter point, indeed, requires no argument. Inventors, therefore, demand that this tax should cease, and that Patent-office fees should henceforth be applicable only for Patent-office purposes. When once the Treasury ceases to have an interest in the amount of fees collected, the question what those fees should be, and under what limitations it may be expedient to levy them, will present fewer difficulties. The scale of fees, as fixed by the Act of 1852, was a compromise with the Chancellor of the Exchequer, Sir Charles Wood, in the uncertainty of the number of patents that would issue; now that experience has shown the amount which these fees may reasonably be expected to yield, the amendment of legislation which caution dictated, and the appropriation of the surplus to inventors' purposes, would be only to carry out the principles of that first instalment of reform in the patent system."

* See Paper on Technical Education, 27th November, 1872, *Journal of the Society of Arts*, vol. xxi, p. 21.

† *Ibid.*

Other evidence to the same effect was given before the Select Committee of the House of Commons, by other persons of experience, and especially in the Sessions of 1871 and 1872, by Mr. James Howard, M.P., advocating a museum, such as those at Washington and elsewhere, as a great educational establishment; and by Dr. Siemens and others on the application of the surplus of the Inventors' Fee Fund.

There exists already in this country, at South Kensington, a museum in its original design and intention such as is now advocated, under the designation of the Patent Museum, that name having been assigned to it from the circumstance of its connection with the Commissioners of Patents, under whose authority it was established. This museum, however, relates to inventions generally, and contains many inventions that are not, and never were, the subject of patents.

In addition to the contents of the foregoing museums under the immediate control of the Commissioners of Patents, there exist in several rooms or portions of the South Kensington establishment, entirely apart from the Patent-office Museum, numerous other models of the highest interest. Other collections also of models exist but partially utilised. No catalogues exist of these valuable collections; indeed, the ownership of many of the models and machines is doubtful, some belonging and some lent to the Commissioners, some belonging or lent to Mr. Woodcroft, and some belonging or lent to the Exhibition Commissioners.

These, if collected in one building and properly classified, would form a valuable nucleus of a National Museum of Industry, and by a proper distribution of duplicates, material assistance might be rendered to local museums.

Reference has from time to time been made to the subject of models illustrative of patented inventions, but the experience of the United States' Patent-office and the evidence before the Select Committee of the House of Commons in 1864, on the Patent-office and Museum, presided over by Mr. Dillwyn, shows such a collection to be of little value, and points to the conclusion that such a museum should consist of select models illustrative of the progress and actual state of the industrial arts and manufactures of the country.*

A cause supported by such authority, and presenting such claims, can hardly fail of ultimate success, and may be commended to the sense of justice of the nation and to the support of this Society.

* See Report of Select Committee of House of Commons on the "Patent-office Museum and Library," 1864.

DISCUSSION.

The Chairman read the following letter from Mr. Cole :—

"Dear Sir,—I had intended to be present this evening at the reading of Mr. Webster's paper, but I fear to venture out with my cold, I therefore send a few words as my substitute, which I hope the Chairman will allow to be read to the meeting.

"The point for this evening's discussion is not the principle of a patent-law, but the policy of placing a tax upon invention. Thirty years ago the Society of Arts caused the Patent-laws to be reformed, chiefly on the ground that there should be no more tax on invention than was necessary to support the Patent-office. Unexpectedly the tax has yielded about £70,000 a year beyond expenses, which the Treasury has got between its teeth, and starves the administration of the Patent-office almost to the point of death. I trust that the Society will again buckle on its armour, and raise the war-cry of "No taxes on invention," and cause an Act of Parliament to be passed to prohibit the Treasury from misapplying any surplus fees to general taxation. General taxation at the present time ought to disgorge at least a million of pounds, to wipe out the discredit of the nation for the present chaotic state of what is called the Patent Museum. Such a state of beggarly confusion could only have resulted from the incompetence of Board management, which, I trust, will be led to execution in the next session of Parliament.

"Yours faithfully,

"Henry Cole.

"33, Thurloe-square (opposite the Museum),
"South Kensington, S.W., January 14, 1874."

Mr. Campin said the letter just read from Mr. Cole put very forcibly before the meeting the points that he himself was going to introduce. He thought taxes upon inventions were objectionable, because at the present time business could not be carried on without having resort to improvers in manufactures. It seemed to him a very grave question whether they could enter into a consideration of the question of applying the revenues already derived by taxing inventors in the way proposed, because, the Chancellor of the Exchequer having once got the money, it would be very difficult to get it back, and it was, therefore, only the surplus of future years which could be looked to as available for museums of technical education. That such institutions were desirable he was willing to admit—it was a necessity of the present day; but there were other means of getting the money besides taking it out of the pockets of inventors. A reduction in the cost of patents would be, in his view, a more legitimate application of these moneys. A great many inventors paid the first £5, but there was really no protection until they got the Great Seal, costing £25, which a great number could not pay, and consequently they were left in the hands of their employers, or other capitalists, who could give them what they pleased. The first thing required was to reduce the cost of patents, then to provide a proper office, and improve the publications which the commissioners issued; this would take some money to accomplish. When that was done, they might talk about applying the money of inventors to what was a great public object, viz., technical education. He thought the various guilds in London ought to look after that point; he had been constantly mooting the subject at Guildhall, and should still continue to do so. The general feeling of the working men was that at present they could not go into any scheme for appropriating the existing surplus without first taking care to make a reduction in the cost of patents, and putting the Patent office into proper trim.

Mr. H. T. Wood begged to draw attention to two slight inaccuracies in Mr. Webster's otherwise valuable paper. The useful abridgments of specifications to which Mr. Webster had referred were still being continued, several volumes having been published within the last six months; and whereas it had been stated that there was no existing catalogue of the exhibits in the Patent Museum, South Kensington, on the contrary there was an excellent descriptive catalogue, which had been prepared by Mr. Michell, a senior clerk in the Patent Office. Of this several editions had been published, though he believed it had not been brought down to a period within the last few years. Up to the time when it was last issued it was as accurate and exhaustive as could be wished. He could not say whether it was out of print or not.

Mr. G. B. Galloway, as an inventor, considered the subject of the paper one of vital importance. It carried his

memory back to the year 1865, when for the first time he spoke upon it, at the meeting of the British Association at Birmingham, when Lord Stanley occupied the chair. Professor Rogers had prepared a very elaborate paper on the Patent laws, which evoked a very important discussion. He then spoke somewhat feelingly, as an inventor who knew the practical working of the laws in question, their imperfections, and deficiencies, and at the same time their value and importance to the nation. He then stated what he now repeated, that England's greatness was based upon the inventive skill of Englishmen, and that it would increase in proportion as genius and talent of this kind was fostered. In 1866 also he had read a paper on the same subject at Nottingham, when he held that the surplus of the fee fund belonged not to the Government and not to the country, but to inventors, and that it ought to be devoted to the development of inventions and of practical science—to the encouragement of inventors. This surplus from the fee fund should be devoted to a fund which scientific societies, by representation, should have the management of, and which would be aided by the contributions of those who desired to encourage art and science. This might then be so utilised that it need be no longer said that English workmen were losing the race, and that other nations were taking the lead and displacing England in the markets of the world. He trusted that the Society, having taken up this subject, would never lose sight of it until justice was done to inventors.

Mr. Christian Mast said that as far as he understood the paper, it was proposed to make use of some money now in the hands of the Government, and this being a somewhat difficult process, the war cry of industrial education was to be raised, and no doubt this was a very wise step. A large sum had been taken from inventors, and no doubt this ought to be returned to them in some way; but it was a well-known fact that it was extremely difficult to get money out of the hands of Government, so that anything which would aid in the effort should be welcomed. At the same time he thought Mr. Webster's proposal that museums should be established and lectures delivered, rather premature, because he considered the first requisite in England was a good basis of elementary education. In Germany, technical education only followed on a good, sound, primary education. It was no use making a golden head to an image of clay. Experiments, however desirable, if not made at the right time, did not succeed, as was shown by Mechanics' Institutes, which were not so successful as they ought to be, simply because the youth of this country had not the necessary elementary instruction.

Mr. P. L. Simmonds said this subject was very important, not only to the Society, but to the country at large. A great deal had been done, and he hoped more would yet be done, in the direction indicated by Mr. Webster, who had divided his subject into two principal heads—one, the establishment and maintenance of museums for technical instruction; and the other, the appropriation of a certain fund for this purpose. On the second point he was not so well entitled to speak as some other gentlemen, but as a juror and official at various international exhibitions he had had the importance of museums continually pressed upon his attention. There could be no doubt there were many deficiencies in English industry as compared with other countries, as was proved by our large imports of paper, glass, and many other articles. It was obvious to every one who thought upon the subject how beneficial it would be to establish in large industrial centres museums devoted to the exhibition of such articles and materials as were the staple of the district. Having been a good deal connected with museums, both at home and abroad, he naturally felt the importance of the subject, and only a week ago, when reading a paper in that very room on the progress of the colonies, he had occasion to refer to the benefits derived from museums of this class. He had recently dispatched large illustrative collections to the Melbourne Technological Museum, but he was sorry to say that for some time past England seemed to be standing still in this matter. After the Exhibition of 1851 a nucleus was formed of an animal products collection, which, after being located at South Kensington, had recently been transferred to Bethnal-green; but no attempt seemed to be made to complete it. Recent returns proved that our imports now reached the value of a million sterling per day, and this showed, amongst other things, that we were mainly dependent on other countries for raw materials. Hitherto, however, England had been supreme in the markets of the world as a manufacturer, not only of iron, of steam engines, and machinery, but of all the principal products of industry; but it would be a sad day for her when other countries were allowed to wrest this position from her. The value of these proposed museums was that they conveyed a great deal even to the eye, but this was vastly assisted by instructive lectures. Not very long ago he had had occasion to form for Dr. Gray, of the British Museum, a collection illustrating the industrial uses of shells, and trivial as some of these things might appear, they were instructive, as showing the numerous uses to which simple natural products were applicable. Fortunes had not unfrequently been made by persons who had chosen the right moment for introducing certain raw materials into notice for manufacturers' purposes, as was shown at the time of the Russian war, when several vegetable fibres were first made use of in place of bristles by brush manufacturers. The alpaca manufacture of Sir Titus Salt was another illustration of the same thing, and india-rubber and gutta percha, both of which had been introduced in great measure by the Society of Arts, were further examples of the same thing. Where would submarine telegraphy have been without them? If, therefore, these museums were not established by corporations and city guilds, some other bodies should set about it, and he should much rejoice if the funds described by Mr. Webster could be applied in this direction.

Mr. Murdoch would have been glad if a little more stress had been laid upon the benefits which might arise to inventors from museums, and from one great central museum, such as they had in America, which might serve as a beacon to warn inventors and others that it was of no use going on in a track which had already been trodden. Having had occasion to go through America, he had seen the advantage which inventors and investors had from this plan being adopted. He was not an inventor himself, but he knew the danger there was from their not having something to guide them as to whether a certain path had been trodden before or not. Investors were very necessary to inventors, but, though hard-headed men, they were often carried away by the sanguine expectations of the latter, simply for want of a little more knowledge; and then they often put their money into what turned out to be only a sieve with very large holes. Something more than a valid patent was required; for instance, sometime ago a great demand arose for paper-making stuffs, and inventors came upon the field by hundreds, many of them going into the same fields of actions for utilising all kinds of fibres mechanically and chemically. If there had been museums such as that at Washington, a number of these men would have found it was no use going on paying their money when they were all working in the same channel. This fact was proved by the figures stated by Mr. Webster, that out of 3,000 who paid the first £5, not more than 30 really made the final payment. As to technical education, he was sure they were all agreed as to its value.

Mr. E. Hall said he should have liked to have heard more from Mr. Webster on the subject of museums, and rather less upon matters with which they were perfectly well acquainted, viz., the evidence which had been given as

to the deficiency of technical education. With regard to the importance of museums, Mr. Simmonds had forestalled him in his remarks, but with regard to the utilisation of museums, considerable difficulty presented itself to his mind. It seemed to him that the importance of museums had not been quite sufficiently appreciated by one of the speakers, for so far from it being absolutely necessary that they should begin education by elementtary instruction, he thought the conferences held in that room had erred greatly in that respect, and that the conclusion had been arrived at somewhat too hastily that it was impossible for adults to do anything, and that therefore they must deal only with the rising generation. Museums had this great value, that they addressed themselves not only to the rising generation but to adults, and thus furnished a means of elementary education. He thoroughly agreed with the view that the state of the Patent Museum was abominably bad; but if he were asked what should be done, he should feel himself in very great difficulty. In order that there might be a proper utilisation of museums, they must begin by arranging the plan and construction of the buildings, which must be built and lighted in a very different manner from that which at present existed. With regard to lighting, the South Kensington Museum was not unfrequently pointed to as a model, but to him it appeared that while there was plenty of light overhead, very little was thrown on the objects below. The peculiarity of these museums was that in many instances the most important objects were those of the smallest dimensions, and therefore it was necessary that the museums should be opened at such times that they could be visited by those whom it was important to teach, not so much at night as at the most convenient times for seeing them by daylight. Every opportunity therefore should be afforded of seeing the objects on Saturday afternoons. There could be no doubt that the proper way to study such subjects was by visiting museums, and those who were familiar with the British Museum, and even South Kensington, must greatly regret the manner in which some of the specimens were inspected. A great number who went did not go for the purposes of study, but were mere idlers, who derived no benefit whatever, but were even in some degree injured by the careless way in which they examined the specimens. With regard to the subject of lectures in museums, he had taken a great interest in that matter, having many years ago instituted a system of visits and lectures with good results. There was the greatest possible difficulty in utilising museums in this manner, because they were arranged for the individual examination of the specimens, but not for a number of people to inspect a particular object at the same time, so that if there were ten or twelve persons accompanying the lecturer, they could not all hear and see. He did not wish to discourage the system adopted of conducting visits, but would throw out a suggestion as to the great desideratum in managing lectures, viz., to bring the objects referred to out of the cases into the lecture-room. He thought he would be doing wrong if he did not urge upon the Society the intense difficulty they had to encounter in this respect, and hoped they would devise some means for remedying it.

The Chairman said the question which had been submitted to the meeting by Mr. Webster was one of the most important subjects which could engage the attention of anyone who desired the welfare of his country. They had heard extracts from the evidence of gentlemen quite competent to give their testimony upon the subject, that it was absolutely essential to the maintenance of the position which this country had hitherto held in the general commerce of the world that instruction in technical education should be much more promoted than it was at present. Such men as Mr. Mundella stated their fears that England would lose the export trade to foreign countries. And why? Because foreign countries were going far ahead of them in the general knowledge and improvement in industrial pursuits in which England formerly excelled. He found in the Board of Trade returns for the year ending in December last that the exports had diminished to the extent of about a million sterling. Whether that was to be attributed to the competition of foreign countries, to a depreciation in the industrial arts in England, or to any other cause, it was a matter of regret; but he was inclined to think it was to be attributed to what was predicted and prophesied by gentlemen like Mr. Mundella and others, namely, that artisans were losing the pre-eminence which they formerly possessed in the industrial arts of this country. One way of endeavouring to counteract the depreciation was by promoting (and that was the object of the paper), technical education throughout the manufacturing districts of England. Then came the question —How was that to be done? That was a subject which for many years had been agitated, not only by the Society of Arts, but by various other societies; but, unfortunately, up to the present it had never been carried into real practical effect. The difficulty was to find, first of all, the funds to promote it, and, in the next place, efficient teachers. With reference to the funds, Mr. Webster had certainly made a valuable suggestion. They had a large annual surplus, arising from the payments made by inventors—upwards of £80,000—and they had the accumulation of upwards of a million, arising from the payments from the year 1852 down to the present time. With reference to that accumulation, he thought it was quite true that, when once that became absorbed by the general finances of the country, it would be a very difficult thing to get it out of the hands of the Chancellor of the Exchequer. But there was not so much difficulty in getting the application of the surplus funds which annually arise from inventors' payments; and he thought it was a practical suggestion to be made to the Government that that sum should be paid for the purpose of promoting technical education. That would amount to a very considerable sum, and, although they might not be able to induce the Government to give back the million, yet they had a very fair claim upon them to grant something like interest upon that money for the future—£30,000 or £40,000. That was a more practical way of dealing with it than asking them to return the *corpus* of the fund, so to speak. From his experience in the House of Commons he thought they would find the greatest difficulty in getting the Government to accede to that, and he was afraid if they did some one would immediately propose to strike off from the Civil Service estimates the sum devoted to the South Kensington Museum, so that in the end they would not get the advantage they ought to from these funds. He did not think it was safe or advisable to rely upon these grants of public money for the purpose in view, but that they should be promoted in a great degree by local efforts. The museums would not be of any public utility to attain the objects in view, unless they were all, or the great majority of them, localised. For that purpose, he thought it would be perfectly right and fair that a certain small fee should be paid by those who were in the habit of attending these establishments. This fund, if they could get it, should be applied to supplement and aid local efforts, and by that means they might be able to accomplish what they desired. In the Elementary Education Act there was a provision that a subsidy, if thought right by the School Board, should be applied to industrial schools, and he thought that might very well be extended to the application of a portion of the fund to schools for such technical education as they were now desiring to promote. There was another source which, he thought, was available. They were all aware there was an Endowed Schools Commission existing in this country, whose object was to apply to various educational purposes large endowments which had been granted from time to time by private benevolence to purposes of public utility, and it would be a very proper application of some por-

tion of that fund, under the control of the Commissioners, to purposes of technical education. He was glad to say that was not only his own view, but the view of the Endowed Schools Commissioners themselves, because in the report published a few years ago they held out a hope that in the course of settling some of the schemes they might be able to apply a portion of the fund to this purpose. The paper read by Mr. Webster more particularly referred to museums for the purpose of public instruction in technical education. That was a subject of very great importance, and the Society of Arts, being generally the pioneer of great public improvements, had lately taken up the question of dealing with national museums for the purpose of making them more available for the general education of the people. Mr. Cole, who had been the life and soul to a very considerable extent of that valuable institution at South Kensington, having resigned his appointment, there had been a proposition made in the House of Commons to transfer that institution to the management of the trustees of the British Museum, or somebody of that description, which he thought would not by any means be a desirablo course to pursue; but this had opened the door for a discussion as to whether these important national institutions should not be vested in some responsible public body, who should be answerable to Parliament for their management. He thought it most desirable, therefore, that the Society of Arts, which had considerable influence upon subjects of this description, should, if it thought it right, press upom the government the advantage which might now be taken of the opportunity to make all these national museums available, through some public body, and not through any private trustees, for the general instruction of the people of the country. With referenee to that subject, he thought it right to say that South Kensington had already done a great deal in promoting the objects in view, because they had a correspondence with various localities throughout the country, and he found that during the year 1872, the payment to teachers on results of instruction of the artisan classes amounted to £27,000, whereas for the year 1871 it only amounted to £19,000. There was also another branch of that subject which was very interesting. In the report of the committee of the Privy Council he found it stated that the latest returns made showed that the grants had increased in number from 948 to 1,238, the number of classes from 2,800 to 3,800, and the number of students under instruction from 36,700 to 44,000. Therefore, so far as the South Kensington Museum had been able, they had promoted the view of the paper. The report also stated that "the recent large increase in the number under instruction shows that the system is now on a satisfactory footing, and we trust that it will in future obtain a larger amount of local support." These were grants made in aid of local effort, and they would see how they had increased. One important thing connected with the suggestion in the paper was, that models and various valuable specimens in the national museums should be lent to local museums for the purpose of promoting instruction; and it was stated in the report of the Privy Council that with reference to the lace manufacture at Nottingham, a museum had been established, and the authorities had lent them models. The Privy Council had, by means of the South Kensington Museum, promoted Mr. Webster's views in that respect, but it was done on too limited a scale; what was desired was that all these national establishments should be rendered more available for the purposes of local administration. It had been said that museums of themselves were not so advantageous as they should be for public instruction, but he thought they were very useful, especially for adults. With reference to the Patent Museum at South Kensington, he (the Chairman) had never let an opportunity pass in the House of Commons without protesting against the disgraceful condition in which it was. There were most valuable examples of models and inventions in this country, if they could be made available for the artisans, not only of London but elsewhere, but at present they were almost unavailable. In 1859 the Commissioners of Patents stated that it was intended to make the Patent-office Museum an historical and educational institution, for the benefit and instruction of skilled workmen employed in the various factories in the kingdom, a class which largely contributed to the surplus funds of the Patent-office, and down to 1872 the same thing had been stated every year in the report, and yet nothing was done. He thought it was most desirable that something should be done by the Society of Arts to press upon the Government the absolute necessity of some change being now accomplished. It seemed to him that the question was one of paramount importance, as affecting the manfacture and industry, and, therefore, the commercial pre-eminence of this country; and if the Society took it up by means of their Council, and urged it most strongly upon the Government, the public at large would be greatly indebted to them. He concluded by moving a vote of thanks to Mr. Webster for his valuable and interesting paper.

The motion was carried unanimously.

Mr. Webster, in returning thanks, briefly referred to the remarks which had been made. He did not think a reduction in the cost of obtaining patents was a very material question; the Act of 1852 was a compromise, and until it had been thoroughly and properly tried, it would not be wise to attempt further alteration. When there was an admission that the cost was higher than necessary it might be reduced, but it was now only £5 for protection, and if, when that step had been taken, the invention was really worth anything, it was very rare indeed that somebody could not be found to advance the other £20. He quite agreed with the remarks of Mr. Galloway and some of the other speakers, but did not quite concur with Mr. Hall's view as to museums. He believed that if they had museums properly classified and arranged, for instance, showing the origin and progress of the steam engine, and lecturers who gave real scientfic instruction at stated times to those who chose to attend, very good results would be attained. The Chairman, who had been a consistent advocate throughout of this great reform, would not, he was certain, lose any opportunity of pressing it forward; but, with regard to his suggestion about the Endowed Schools Commission, he certainly thought any funds at their disposal would be properly absorbed by primary or general education, which was quite distinct from what he advocated under the name of technical instruction. What he wished to impress on the public and on the House of Commons was this—that the funds to which he had referred were really the produce of the brains and mechanical skill of inventors, and ought to be applied to some purpose in which they had an interest. Whether one great central museum should be established in London, or a number in local industrial centres was merely a question of detail, but he hoped the principle would be maintained, that money contributed by inventors should be applied to some purpose in which they had a distinct interest. There was a broad distinction between fine art or decorative art, and industrial art, as had always been maintained by Mr. Cole, but though a good deal had been done for the former, little or nothing had as yet been done for the latter, though it was of equal importance.

JUVENILE LECTURES.

The second of a course of two lectures, under the title of "Birds, Beasts, and Fishes," was delivered on Friday evening last, to an audience consisting mainly of young people, by Frank Buckland,

Esq., M.A., Her Majesty's Inspector of Salmon Fisheries.

Mr. Buckland, after stating that as he found it totally impossible to crowd into two lectures anything like what he had intended to say, he proposed to give an additional lecture at the Fish Museum, South Kensington, on the ensuing Friday, at two o'clock, and another during Easter week at the Brighton Aquarium, to as many as liked to take advantage of the special railway facilities which would be offered. He commenced his remarks by a description of various kinds of snakes, illustrating, by means of skeletons and drawings, the wonderful construction of the back-bone, by which they were enabled to move along the ground, although not furnished with feet, being, in fact, as he described, simply a head and tail joined together. He also exhibited some snake skins, amongst others one of a boa constrictor 16 feet long, and the rattle of a rattlesnake, which, when shaken, produced quite a loud sound, but, on being placed a short time in water, lost its resonant property. Some preparations of snake's venom, crystallised upon plates of glass, were also handed round, and a very fine collection of plates, illustrating Dr. Fayrer's work on the poisonous snakes of India, coloured by native artists, was also shown. It was stated by this gentleman that in 1869, 11,416 persons were killed by snake bites in India. Even in this country snakes were by no means uncommon, and their eggs might frequently be found, in the months of August and September, by those who knew where to look for them. He had succeeded in hatching some lately. There were also snakes in the sea, particularly at the mouths of the rivers in India, and they were sometimes known to climb up the anchor chains of vessels; but as for the sea serpent, which had been talked about for 300 years, he was so sceptical of its existence, that he had no hesitation in offering fifty guineas a foot for the first one that was caught. The octopus next came under review, and the habits of this curious creature were fully narrated. Although composed principally of a kind of jelly, he was a somewhat formidable antagonist when of large size, each of his eight feet being furnished with powerful suckers, by which he grasped his prey. Only the previous week some gigantic arms of this fish had been sent to the Board of Trade, which he hoped soon to examine carefully; they were said to be about six feet long, and there could be no doubt that a creature of such a size would easily kill a man if he once got him in his clutches. He begged to offer a suggestion, that this creature was the original of the famed hydra which Hercules was said to have destroyed with so much difficulty. The various kinds of seals were next described. It was somewhat remarkable that the seal, which required sometimes to remain a considerable time under water, was furnished with a sort of valve under its nose, to prevent the entrance of the water into the nasal passage, the only other animal with a similar provision being the camel, which sometimes, in crossing the desert, had to encounter tremendous sand storms. Seals were very intelligent animals, having large brains, and the formation of the throat enabled them to make somewhat awkward attempts at speech, as was shown by the talking fish some time ago exhibited, and he had even heard young seals cry very much like babies. Unfortunately they had very valuable fur coats, with oil underneath their skins; this oil was used for dressing jute, which in its turn was applied to adulterate silk, and this was sometimes the cause why ladies' dresses did not wear so well as they ought to. There were two kinds of seals, the hairy seal and the fur seal, but even the latter had long hair, which had to be removed before the beautiful velvety fur underneath was displayed. Naturally it was of a light colour, and was dyed before being made up into ladies' jackets, &c. Several specimens were exhibited, showing the different stages of the manufacture. In connection with the otters, which were next described, two beautiful pictures by Mr. Rolf were exhibited, one being entitled "The First Lesson," showing an otter bringing home a fish to its young, and the other "Homeward Bound," an osprey with a salmon in its claws. Whales came next on the programme, and the preparation of the fins were displayed, showing that beneath the skin they possessed five fingers; also some very large pieces of whalebone, which were placed in the mouth of the whale to act as a kind of sieve. The whale took in some tons of water at a gulp, blew it out again through his blowing holes, and by means of the whalebone collected the infusoria which served him as food. Owing to the immense destruction of whales they were getting very scarce, and whalebone was now worth £400 a ton. He was informed by Captain Gray that the use of steam vessels rather tended to their preservation, because they could hear them such a long distance off and get out of the way, for which he did not know that they were to be blamed. The various kinds of fishes' teeth were next dwelt upon, beginning with the sword and saw fishes, both of which were exhibited. It was pretty certain that the use of the sword was to rake up the sand and gravel at the bottom of the sea, in order to get at the small insects on which the fish subsisted, and the structure of the sword showed pretty plainly that it possessed nerves of sensation. A very fine specimen of the horn of the narwhal was also exhibited. The lecturer said he could not say positively what this was designed for, but, from the male fish only being furnished with them; it was probably a weapon of attack; at any rate, they were known to fight very tremendously sometimes. These creatures were sometimes found to interfere with submarine cables, for the tooth from the saw of a sword fish had been found imbedded in a piece of cable, and, in other cases, the sword had been known to have pierced through a considerable thickness of a ship's side. Fish were divided into carnivorous and herbivorous; the great torment of the ocean, representing the former class, being the shark. These creatures were furnished with several rows of very sharp teeth, one above the other, so that if any were lost there were others ready to take their place. Their English prototype was the jack, also very voracious, and in his museum he had a preparation, showing where two jack had charged at the same roach, and missing it had seized each other, and finally perished in the combat. The *Lophius piscatorius* was a very curious fish, which was furnished with a kind of fishing rod at the top of his head, and this he waved about to attract the attention of the small fish on which he preyed, and when they approached he suddenly rose from the bottom, and swallowed them wholesale in his capacious mouth. The torpedo, or electric ray, and the electric eel were next described, and these creatures, in the lecturer's opinion, sufficed to disprove the Darwinian theory, for it was simply ridiculous that these creatures could furnish themselves with the wonderful electric battery which they possessed, and which was connected by nerves with all parts of their bodies. After describing with considerable minuteness and exhibiting specimens of the various kinds of teeth possessed by fishes, Mr. Buckland proceeded to describe the habits and structure of the salmon, saying that if ever he was perfectly happy it was when he was performing his duties as Salmon Fishery Inspector. He was glad to say that some good results had already attended the efforts which had been made, for last autumn salmon might be obtained from 6d. to 10d. per lb., and he hoped it would yet come down to 4d., when some more rivers were opened. He dwelt at some length on the necessity of purifying all our streams, both for the sake of the public health, and also in order to encourage the breeding of salmon and other fish. The female salmon ascended the rivers with the autumn floods, when it was able to pass the weirs, and get into the mountain streams, where the eggs were laid. Each salmon contained about 1,000 eggs per lb. weight, so that a salmon of 32 lbs. weight would produce about 32,000 eggs.

These eggs lay under the gravel during the cold winter months, and were hatched in the spring, when there was a plentiful supply of gnats and insect larvæ for the little fishes to feed upon. When one year old the young salmon descended the rivers to the sea, in order that they might not eat all the food required for their smaller brothers, and when they arrived in the salt water they fed most abundantly on the prey of all kinds of small fish. At this time of the year there were tons of whitebait, which was really a mixture of all kinds of fry, herrings, soles, mackerel, and so on. Here the young salmon remained till the autumn, getting very fat; and, indeed, this fat laid up during the summer had to last them during the winter months, which they spent in the rivers—for it was a curious fact that during that time they eat little or nothing. The male salmon sometimes fought very viciously on the spawning grounds, being furnished with a very sharp beak to their underjaw; but after another summer in the sea they returned so wonderfully filled out that it was almost impossible to recognise them as the same fish, the sharp beak having entirely disappeared. It had, however, been proved, by marking individual fish, that they did undergo this change; and it was not at all unfrequent for a fish weighing thirty pounds when it descended the rivers in spring, to return in the autumn weighing fifty or sixty. The lecture was concluded by a brief description of the oyster, a hint being thrown out that if anyone could discover the secret for hatching and rearing young oysters, as was done with salmon, there was an enormous fortune to be made. Each oyster gave birth to from half a million to a million of young, though what became of them all was as yet a mystery. Therefore, if anyone could get, say, a dozen oysters, and, rearing the spat from them all, dispose of them at 3s. a dozen, he need hardly say that the business would be very profitable. In bringing his remarks to a close, the lecturer said his desire was to found a new school of natural history, to support the arguments brought forward by the "Bridgwater Treatises," for the existence of a Creator as shown by His works. In this effort he was certain he would be heartily supported by all the clergy of England, as well as by all educated men and women, and he did not despair of eventually seeing natural history taught in all schools, both national and private.

A cordial vote of thanks to Mr. Buckland was carried by acclamation, on the motion of **Mr. P. Le Neve Foster**.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

The fourth meeting of the Sub-Committee for Architecture, Building Contrivances and Materials, was held on the 14th of January, at Gore Lodge. There were present Messrs. George Godwin, John Bird, John Elger, John Grant, D. Kirkaldy, T. Roger Smith, and Col. Wray, R.E. A memorandum by Mr. Kirkaldy, on experiments on building materials, was taken into consideration. Proposed by Mr. Godwin, seconded by Mr. Roger Smith, and carried. 1. That this Committee consider it desirable that steps should be taken to obtain the means of carying out the scheme of experiments submitted by Mr. Kirkaldy, or such portions of it as may be found attainable, at a cost not exceeding £500. 2. That it be suggested to the Committee to apply to the Royal Institute of British Architects, the Institution of Civil Engineers, and the Society of Arts, to learn if these bodies are disposed to assist with funds the object in view.

The Board of Management propose to devote a space in the Fine Art Galleries to the exhibition of works of industrial art, designed or executed by those who have been, or are now, students of the Art Schools in the United Kingdom, with the view of bringing prominently before the public the beneficial influence of the schools on the production of fine art manufactures.

The works may be executed in any material, and may have been executed at any period, but they must not have been exhibited before.

They must be accompanied by the names of the producer, designer, or art-workman.

Manufacturers, designers, and art-workmen desirous of exhibiting works, are requested to send in applications for space on or before the 2nd February, 1874.

The following are the rules for the reception of British goods:—

1. The entrances for the reception of goods will be as follows:—1, East entrance in Exhibition-road; 2, west entrance in Prince Albert's-road.

2. All objects must be delivered at the building at the entrances specified, and on the days named below:—

Monday, 16th February.—Class 10 (Heating)—West entrance.
Monday, 23rd February.—Class 1 (Paintings in Oil)—West entrance.
Tuesday, 24th February.—Water Colours, Drawings, &c.—East entrance.
Wednesday, 25th, and Thursday, 26th February.—Class 2 (Sculpture)—West entrance.
Friday, 27th February.—Classes 2 and 7 (Fine Art Furniture and Decorative Works, Reproductions)—West entrance.
Friday, 27th February.—Class 1 (Stained Glass)—West entrance.
Saturday, 28th February.—Classes 2 and 4.—(Fine Art Furniture and Decorative Works, Architectural Designs)—West entrance.
Monday, 2nd March.—Classes 3 and 5 (Engravings, Photographs, and Tapestries)—East entrance.
Tuesday, 3rd March.—Class 6 (Designs for Decorative Manufactures)—East entrance.
Wednesday, 4th March.—Machinery of all Classes—West entrance.
Thursday, 5th March.—Class 9 (Civil Engineering)—East entrance.
Friday, 6th March.—Class 11 (Leather, Saddlery, and Harness)—East entrance.
Saturday, 7th March.—Class 12 (Bookbinding)—East entrance.
Wednesday, 11th March.—Class 14 (Scientific Inventions)—West entrance.
Tuesday, 17th March.—Class 8 (Lace)—East entrance.

3. All objects must be delivered to the officers appointed to receive them, unpacked and ready for immediate inspection, and free from all charges for carriage, &c. Packing cases cannot be taken charge of by the officers of the Exhibition. Machinery may be sent in cases, but must be unpacked by exhibitors, and the cases must be removed as soon as the goods are unpacked.

4. To every object a label, Form No. 19 (for Fine Art, Form No. 19a), must be securely attached. The number on this label must correspond with the number of the object in first column of delivery order (see Rule 5). A small label, bearing the name of the exhibitor, must also be pasted or gummed to every object.

5. Delivery orders (Form No. 31), duly filled in, must be sent in with the exhibits. These forms must contain a complete list in duplicate of all objects sent, and the numbers in the first column must correspond with the numbers on the labels (see Rule 4).

6. The doors will be opened at 8 a.m. daily, and will

remain open until 4 p.m., except for one hour, viz., from 12 to 1 o'clock.

[Note.—Exhibitors of Pictures and Sculpture need not conform to these rules so far as they relate to forms of labels and delivery orders. A written label must, however, be attached to each Picture or work of Sculpture, and the name of the exhibitor must be pasted or gummed to the back of each Picture or other Work of Art. A note, giving list in duplicate of works sent in, must accompany them.]

The distribution of space in the Exhibition is proposed to be as follows:—

Room 1.—Lace, Leather, and Bookbinding Machinery.
" 2, 3, and 4.—Machinery in Class 9. Civil Engineering.
" 5.—Machinery in Class 9. Civil Engineering and Scientific Inventions.
" 6.—Oil Paintings by deceased artists.
" 7.—Miscellaneous Art.
" 8.—Water Colours by deceased artists.
" 9.—Foreign Paintings.
" 10.—British Paintings.
" 11 and 12.—Saddlery and Harness.
" 13.—Bookbinding.
" 14 and 15.—Lace.
" 16 and 17.—Belgian and Foreign Fine Art.
" 18*a*.—British and Foreign Water Colours.
" 18*b*.—Army and Navy Sketches.
" 19 and 20.—French Fine Arts.
" 21 and 22.—Civil Engineering.
" 23.—East End.—Civil Engineering.
" 23.—West End.—Scientific Inventions.
" 26.—Heating.
East Arcade.—Leather.
" Crush Rooms.—Photographs.
West " Engravings, Lithographs, Designs.
Gallery.—Ethnological Exhibition.
Cellars.—Foreign Wines.
Iron Annexe.

Her Majesty's Commissioners for the Exhibition of 1851, having determined to appropriate annually a portion of the galleries of the International Exhibition at South Kensington to the exhibition of pictures, sketches, sculpture, photographs, &c., executed by officers of the Army and Navy, have requested the following Committee to undertake the duty of making the collection for the Exhibition of 1874:—

Committee.—Captain H.R.H. the Duke of Edinburgh, K.G., R.N.; Captain H.R.H. the Prince Arthur, K.G., Rifle Brigade; Field-Marshal H.R.H. the Duke of Cambridge, K.G.; Captain H.S.H. Count Gleichen, R.N.; Brigadier-General J. M. Adye, C.B., R.A.; Major-General H. R. Benson, C.B., late 17th Lancers; Colonel R. Biddulph, R.A.; Dr. F. Blake, R.N.; Colonel Hon. H. H. Clifford, C.B., V.C.; Colonel Hon. W. J. Colville; Lieut.-Colonel Sir J. C. Cowell, R.E., C.B.; Colonel H. Crealock, C.B.; Major J. F. D. Donnelly, R.E.; Vice-Admiral Hon. J. R. Drummond, C.B., R.N.; Colonel Alexander Elliott; Colonel A. E. Ellis; Lieut.-Colonel Sir H. Elphinstone, K.C.B., C.M.G., V.C. R.E.; Rear-Admiral Ewart, C.B., R.N.; Colonel T. Gallwey, R.E.; Captain R. C. Goff, Coldstream Guards; Rear-Admiral E. A. Inglefield, C.B., R.N.; Rear-Admiral Oliver, R.N.

Her Majesty's Commissioners have undertaken to frame, temporarily, pictures sent from abroad if they are accepted for exhibition.

1. The Exhibition will include paintings, sketches, and drawings; sculpture in all materials; and photographs, executed by officers who are in, or have retired from, the army or navy. Works sent for exhibition must be original, and must not have been exhibited at last year's Exhibition. Copies cannot be exhibited.

2. The works sent in will be submitted to a Committee of Selection, composed of an officer of the navy, an officer of the army, and a member of the Royal Academy.

3. The Committee of Selection will be instructed to admit works both on the grounds of artistic merit and also of the interest of the subject portrayed. Under this latter head photographs will be admitted if of exceptional interest.

4. The Committee of Selection will necessarily have to limit the number of works admitted by the amount of space placed at their disposal by her Majesty's Commissioners. This consists of one room in the General Picture Gallery. Not more than six works can be received from any one exhibitor.

5. Paintings and drawings must be framed. Care must be taken that the framing and mounts are not too large. Drawings and paintings, unless they be very small, should not be framed together.

6. The works for exhibition must be delivered, free of cost, at the Exhibition building on the 20th March. It will be necessary to remove works which are not accepted. The Exhibition will close on the 31st of October, when all works will have to be removed by the exhibitors. Officers who are not in London are, therefore, advised to employ an agent.

7. Intending exhibitors should apply, before the 20th February, 1874, to the Secretary, Annual International Exhibitions, Upper Kensington-gore, London, S.W., for the special labels for this Exhibition (No. 19*c*), stating at the same time the number and nature of the works they propose to send.

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1. Under the class of bookbinding, to be represented at the London International Exhibition of 1874, it is the desire of Her Majesty's Commissioners to secure collections of both ancient and modern workmanship, in order that the public, as well as those professionally interested in the subject, may have the means of studying the history of the art.

2. The formation of the collections will be dealt with under the advice of a committee of the following gentlemen:—The Duke of Devonshire, K.G.; Lord Houghton; Lord Acton; Right Hon. Sir D. Dundas; Sir William Stirling Maxwell, Bart.; the Vice-Chancellor of Oxford; the Dean of Durham; W. T. Bone, Esq.; T. Gibson Craig, Esq.; Henry Cunliffe, Esq.; Augustus W. Franks, Esq.; Lieutenant-Colonel Hibbert; J. Winter Jones, Esq.; J. W. Maskell, Esq.; F. H. Rivington, Esq.; A. Suttabby, Esq.; Charles Tennant, Esq.; J. Toovey, Esq.; R. S. Turner, Esq.; and W. Watson, Esq. This Committee will also act as a Committee of Selection.

3. For the selection of specimens of ancient bookbinding, the following gentlemen, forming the Committee for the general representation of Ancient Objects, will assist:—Sir William Drake; Sir M. Digby Wyatt; Dr. Hugh Diamond; Henry Durlacher, Esq.; T. Dyer Edwards, Esq.; J. Evans, Esq.; A. W. Franks, Esq.; F. W. Moody, Esq.; R. H. Soden Smith, Esq.; R. A. Thompson, Esq.; H. Vaughan, Esq.; and T. M. Whitehead, Esq.

4. The class of bookbinding is held to comprise binding in cloth, vellum, leather, velvet, wood, *papier maché*, or metal, ivory, and all material; also albums, scrap-books, portfolios, music-books, manuscript-books, memorandum-books, ledgers, and account-books.

5. Her Majesty's Commissioners will grant space, and afford facilities for the exhibition of the different kinds of processes worked either by hand or by machinery in the galleries of the Exhibition.

6. Information as to the course to be followed by intending exhibitors will be found in the general and special rules for 1874 (forms Nos. 1 and 3, and forms of application Nos. 10 and 10*a*), which may be obtained on application to the secretary for the London International Exhibitions.

1. Under the class of lace to be represented at the London International Exhibition of 1874, it is the desire of her Majesty's Commissioners to secure collections of both modern and ancient workmanship, in order that the public, as well as those professionally interested in the subject, may have the means of studying the history of the art. The formation of the modern collection, and especially those illustrating manufactures, will be dealt with under the advice of a Committee of the following gentlemen, with power to recommend additions to their number:—A. C. Biddle, Esq.; R. Birkin, Esq.; John Brown, Esq.; John Hunt Gosling, Esq.; J. Hartshorn, Esq.; W. Osborne, Esq.; Alderman Stone.

2. The class of lace is held to comprise—

(1.) Pillow lace, the article or fabric being wholly made by hand (known as Valenciennes, Mechlin, Honiton, Buckingham); or guipure, made by the crochet needle; and silk lace, called "Blonde" when white, and Chantilly, Puy, Grammont, and Black Buckingham, when black.

(2.) Lace, the ground being machine-wrought, the ornamentation made on the pillow, and afterwards applied to the ground (known as Brussels, Honiton, or Appliquée lace).

(3.) Machine-made nets and quillings, wholly plain, whether warp or bobbin (known as bobbin net, Tulles, Blondes, Cambric, Mechlins, Malines, Brussels, Alençons, &c.).

(4.) Lace, the ground being wholly made by machine, partly ornamented by machine and partly by hand, or wholly ornamented by hand, whether tamboured, needle-embroidered, or darned.

(5.) Lace, actually wrought and ornamented by machinery, comprising trimming, laces of every description, veils, falls, scarfs, shawls, lappets, curtains, &c.

3. Her Majesty's Commissioners will grant space, and afford facilities for the exhibition of the different kinds of processes worked either by hand or by machinery in the galleries of the Exhibition.

4. Information as to the course to be followed by intending exhibitors will be found in the General and Special Rules for the year 1874 (Forms Nos. 1 and 3, and Forms of Application Nos. 10 and 10*a*), which may be obtained on application to the Secretary for the London International Exhibitions.

5. The Committee for Lace above-mentioned will act also as a Committee of Selection; but, as regards specimens of ancient lace, the following Committee of Ladies will decide as to the admissibility of the specimens offered on loan to the Exhibition:—H.R.H. the Princess Christian, H.R.H. the Princess Louise, Marchioness of Lorne. H.R.H. the Princess Mary Adelaide, Duchess of Teck, the Princess Teano, the Duchess of Marlborough, the Duchess of Northumberland, the Marchioness of Bute, Louisa, Marchioness of Waterford, the Marchioness of Exeter, the Marchioness of Bristol, the Countess of Shrewsbury, the Countess De-la-Warr, the Countess of Carnarvon, the Countess of Warwick, the Countess of Kenmare, the Countess of Bradford, the Countess Somers, the Countess of Cawdor, the Countess Brownlow, the Lady Cornelia Guest, the Lady Marian Alford, the Lady Charlotte Schreiber, the Lady Susan Melville, the Lady Dorothy Nevill, the Lady Louisa Egerton, the Lady Wharncliffe, the Lady Chesham, the Lady Fitzhardinge, the Lady Hamilton Gordon, the Hon. Mrs. Percy Wyndham, the Hon. Mrs. Welby, Lady Lindsay, Lady Anthony de Rothschild, Lady Wyatt, Lady Drake, Mrs. Hailstone, Mrs. Holford, Mrs. Maccallum, Mrs. Alfred Morrison, and Mrs. Bury Palliser.

The Board of Management desire to have the various processes of making lace, by hand (on the pillow, by the needle, &c.), shown in the Exhibition of 1874, and to receive applications for space from producers, agents, wholesale and retail dealers, interested in hand-made lace, who may desire to promote the interests of the public in such manufacture. Applications for space should be addressed to the Secretary to the Executive, Annual Internation Exhibitions, Upper Kensington-gore, London, S.W.

OBSERVATIONS AND EXPERIMENTS IN THE WORKING OF CAPT. GALTON'S FIRE-PLACES, MADE DURING JANUARY, 1874.

By Rev. W. G. Wrightson,
The Grange, New Beckenham.

The first series of observations was made in a dining-room, containing 4,850 cubic feet, in which the fire-place is erected against an outer wall. The temperature of the air outside the house, in the centre of the room, and at the valve where the fresh warm air enters the room, were taken simultaneously. Two calm days were selected for the experiments, and a moderate fire was used on each occasion. The observations are registered in degrees and decimals, Fahrenheit:—

	Time of observation, 11 a.m.	Time of observation, 10 p.m.
Valve	80·5	70·5
Room	54·0	58·5
Outer air	39·5	30·5
Diff. between outer air and valve	41·0	40·0
Diff. between outer air and room	14·5	28·0
Diff. between room and valve	26·5	12·0

Further experiments confirmed the fact of this fire-place, when filled with a moderate fire, raising the air 40° while passing through the air chamber.

The second series of observations was made in a drawing-room, containing 5,300 cubic feet, in which the fire-place is constructed against an inside wall. In other respects the experiments were made under similar conditions with those previously given. The results were as follows:—

	At 11 a.m.	At 11 p.m.
Valve	85·5	94·0
Room	53·0	57·0
Outer air	35·0	42·0
Diff. between air and valve	50·5	52·0
Diff. between air and room	18·0	15·0
Diff. between valve and room	32·5	37·0

The difference of temperature between outer air and valve is about 50 degrees, as against 40 degrees in the dining room. This difference of 10 degrees must be accounted for by the different position of the fire-places, one being against an "outer," and the other against an "inner" wall.

Two further experiments were made in the drawing-room, with a view to ascertaining the fall of the temperature in the air chamber after the fire had been out for several hours:—

	Fire out for 8 hours.	Fire out 11 hours.
Valve	50·5	50·5
Room	47·5	49·5
Air	37·5	41·5
Difference between air and valve	13·0	9·0
Difference between air and room	10·0	8·0
Difference between valve and room	3·0	1·0

Thus after eleven hours the fire lumps and air chambers retained sufficient heat to raise the outer air one degree above the temperature of the room.

The third series of experiments was made in a smaller size of Capt. Galton's fire-place, in a bedroom containing about 3,500 cubic feet. The object was to ascertain if the valve could be left open all night without the cold air entering after the fire had died out. The experiment

was tried when a high wind was driving the air at a great speed through the air chambers and valve. The fire was lighted at 6 p.m. At 11 p.m. it was "made up" for the night, and must have finally died out about 5 a.m. the next morning.

	Fire made up at 11 p.m.	Fire been dead out for some hours at 9 a.m.
Valve	75·0	61·0
Room	54·0	50·5
Air	44·0	45·0
Difference between air and valve	31·0	16·0
Difference between air and room	10·0	5·5
Differenco between valve and room	21·0	10·5

This experiment proved that the valve might be left open all night with perfect safety, as at 9 a.m. the air entering by it was still 10·5 degrees higher than the temperature of the room.

Ventilation.—The ventilation is perfect. A person was laid up ill in the above bedroom, which is without any other ventilation, except by the fireplace, for three weeks, without door or window being left open, and the air was always warm and delicious. Of course fire was used.

Economy of Fuel is considerable, as the heat is obtained from the back as well as the front of the fire.

STOVE PRIZES.

The following remarks on the stoves submitted for the Society's prizes are extracted from *Iron* :—

The stoves naturally divide themselves into three classes—cooking stoves and warming stoves. With regard to the former, the first thing that strikes an observer is that the majority of them hardly fulfil the conditions of the prizes. The object of the Society evidently was to discover a suitable domestic fireplace, available at once for general use and cooking, in fact, to get hold of a good cottage fireplace. Now, among the most prominent objects in the collection are some large kitchen ranges. Many of these, sent by well-known makers, are certainly admirable examples of the latest improved ranges, but it strikes us that they are somewhat out of place in the present competition. Some, however, are very compact and ingenious.

Among the domestic fireplaces there are two ideas which occur over and over again. One is that of having a fire-basket pivotted on a central axis, either horizontal or slanting. The fresh fuel is added at top, and the basket reversed, so as to bring the incandescent fuel on the top of that which has just been added, and so cause the gases, &c., from it to pass through a layer of burning coal. The other plan is that of carrying air tubes through or near the fire-grate, and causing them to discharge into the room. When the pipes are led actually through or close to the fire, the cold air must simply abstract heat therefrom, and there can be no saving whatever. When the pipes are placed so as to utilise the waste heat of the chimney, they certainly do cause economy, but in any case it must be remembered that the use of hot metal must, in a greater or less degree, affect the air. The metal naturally oxidises, and the result is that the effluent air is deprived of its oxygen. In some instances this defect is remedied by lining the tubes with fire-clay, and the result of this improved system will, we fancy, be found beneficial.

There are also a considerable number of hopelessly impracticable contrivances, and not a few utterly and entirely unintelligible to any one but their inventors. One competitor has sent in what appears to be a confused mass of old bricks and queer-shaped tiles, which defies the keenest ingenuity to construct out of it anything like a tangible shape. Several other specimens are mere jumbles of old iron, neither ornamental nor, we fear, very useful. That such would be the case was, of course, certain. Inventors are a crotchety race in the main, and where, as in the present case, full liberty is given them, some curious results may well be expected. But, on the other hand, the common-place as well as the eccentric is well represented; there are several specimens which it would puzzle the keenest inspection to discriminate from the ordinary household stove. The same objection applies to many of the ranges, which, though excellent, and admirably suited to their purpose, seem, on a cursory inspection, to lack the all-important eleme t of novelty.

Looking at the whole exhibition, it is difficult to pick out any apparatus which can be said at once to solve the question required. There are many which show immense improvement upon the ordinary household grate, and many which are admirable examples of the best grates and stoves our best makers can turn out. That these are an immense improvement on the wasteful fireplaces of a few years back is very certain, but none of them are worthy of a prize for novelty.

Such is the first impression, though, as we said above, it may require considerable modification when the results of the testing are made known. For this practical testing a temporary house of concrete has been built, containing six rooms, on the waste ground adjoining the machinery annexe of the International Exhibition. Each exhibitor will have a room given to him for a certain time, and he will be required to fit up his stove therein for experiments. What are the actual tests proposed we do not yet know, but it is to be hoped that the committee will aim at practical results, and not at theoretical and ultra-scientific measurements. What we want to know is, how to make a scuttle-full of coals last longest, not how many units of heat a certain apparatus will, under certain artificial conditions, be persuaded to evoke.

TRADE IN 1873.

If the disturbing causes which existed in the home trade during the past eighteen months be taken into consideration, the general results of the foreign exchanges of the nation during the year just elapsed must be regarded on the whole as highly satisfactory. The industry of the country had not only to contend against the effects of deficient harvests, but also against very materially enhanced prices in the two principal materials of production, viz., coal and iron, as well as against high rates of wages in many other branches of trade. It was generally anticipated that these causes, so adverse to production, would tell in a very marked manner upon our export trade; but, although in several of the leading branches of British exports there was a falling off in the quantities, the total money value of the export trade in 1873 was not less than that of the previous year, and was still 32 millions sterling more than that of the exports in 1871.

On the other hand, the register of the import trade presents a brighter view, the total value having increased by 16 millions sterling over that of 1872, and by 39 millions over that of 1871.

As regards the detail of the export trade, the following articles show an increase in quantity in 1873, as compared with the exports in the previous year, viz.: alkali, bags and sacks, beer, copper, cotton yarn, herrings, glass, jute manufactures, seed oil, paper, salt, sugar (refined), and tin (unwrought); whilst candles, coals, cotton piece goods, haberdashery, hardware and cutlery, iron and steel, lead, leather, linen yarn and manufactures, silks, spirits, wool, woollen yarns, and woollen and worsted stuffs, exhibit a decrease. As respects machinery (entered at value), there was an increase of one million and three-quarters sterling, but this may in a great measure have been due to increased prices.

The import account shows, with very few exceptions, an augmented receipt of the necessaries and luxuries of life, in addition to a more extensive supply of the raw materials of industry. The principal articles of which the imports were less in 1873 than in the previous year were currants, hops, preserved meats, raisins, rice, silk (raw), iron, and ironwares. The decrease in the supply of currants is no doubt partly owing to the unsatisfactory manner of levying the export duty in Greece, now practised by the Greek government; that of preserved meats to the prejudice of the working and domestic classes to partake of other than the first quality of fresh meat; whilst the decline in the import of foreign iron plainly indicates that in spite of the high prices of native iron, foreign iron-masters are as yet unable successfully to compete in the British markets. The apprehensions in this respect, which at one time prevailed to some extent, have therefore proved groundless. The increase in the other articles is owing to exceptional causes.

The following table exhibits the comparative imports of articles of food, &c., and of raw materials of industry in each of the years 1872 and 1873 :—

	1872.	1873.
Live stock :—		
Oxen, bulls, cows, &c.	173,000	201,000
Sheep and lambs	810,000	851,000
Swine	16,000	81,000

		1872.	1873.
Bacon	cwts.	1,841,000	2,773,000
Beef (salted)	„	193,000	218,000
Butter	„	1,188,000	1,278,000
Cheese	„	1,060,000	1,355,000
Wheat	„	41,990,000	43,751,000
„ flour	„	4,396,000	6,204,000
Eggs	Great hundreds	4,429,000	5,500,000
Hams	cwts.	155,000	200,000
Lard	„	578,000	644,000
Pork (salted)	„	212,000	266,000
Potatoes	„	6,029,000	7,473,000
Poultry	£	217,000	257,000
Cocoa*	lbs.	7,853,000	8,311,000
Coffee*	„	282,000	288,000
Spirits*	galls	9,029,000	10,223,000
Sugar (refined)*	cwts.	1,765,000	2,197,000
„ raw*	„	12,540,000	13,523,000
Tea*	lbs.	127,729.000	132,022,000
Tobacco (unmanufactured)*	„	42,915,000	44,719,000
Wine*	galls.	16,878,000	18,027,000
Cotton	cwts.	12,641,000	13,693,000
Hemp	„	1,103,000	1,251,000
Flax	„	2,022,000	2,194,000
Jute	„	4,047,000	4,643,000
Leather (tanned, &c.)	lbs.	27,558,000	31,178,000
Tallow and stearine	cwts.	1,326,000	1,521,000

The general totals of imports and of British exports during the last three years are given below :—

	Imports.	Exports.
1871	£330,788,000	£223,066,000
1872	354,120,000	256,257,000†
1873	370,380,000	255,073,000

The movement of the precious metals in 1873 contrasts favourably with that of 1872, the amounts received having exceeded those shipped, as will be seen by the subjoined figures :—

Gold.

	Imports.	Exports.
1872	£18,337,000	£19,748,000
1873	20,462,000	19,071,000

Silver.

1872	£11,167,000	£10,586,000
1873	12,992,000	9,828,000

The shipping returns, in a general way, bear out those relating to imports and exports. The total tonnage entered with cargoes in 1873 was in excess of that similarly employed in the preceding year, and the tonnage cleared with cargoes was less. It is, however, satisfactory to notice that the decline in the carrying trade was not felt by British shipowners, as the following figures will show :—

Total Tonnage.

	1872. Tons.	1873. Tons.
Entered	17,905,000	18,792,000
Cleared	19,248,000	19,142,000

British Tonnage.

Entered	12,139,000	12,474,000
Cleared	13,574,000	13,656,000

The general conclusion to be drawn from the statistics for the year is, that, whilst in consequence of advanced prices the export trade experienced some degree of contraction, the home demand must have been well maintained ; and further, that, from the increased importations of the raw materials of most of our staple industries, the prospects of the present year may be regarded as more hopeful than those of 1873. The diminished exports of merchandise, and the more economical use of coal at home, during the past year, have already led to a decline in the price of fuel, which it is hoped may still further recede as the year advances.

* Quantities entered for consumption.

† It appears from a note appended to these figures that the values, and, to some extent, the quantities of worsted stuffs were overstated in 1872; consequently the total value of British exports in 1873 was quite equal to, if not in excess of that of 1872.

CORRESPONDENCE.

RETURN OF ADMISSIONS TO PUBLIC MUSEUMS.

Sir,—" Statist" calls attention to the imperfection of the monthly return of admissions, and the editor says the British Museum authorities " decline to furnish the returns." I agree with " Statist," that the refusal should be stated every month until the trustees are shamed into supplying this public information. Surely the refusal should be brought to the notice of the Standing Committee, as an illustration of the obstructiveness of Boards, and a formal remonstrance made to the trustees. Of late years we have had even weekly returns of the public revenue, involving millions of pounds, and yet the trustees of the British Museum cannot tell weekly how many visits are made to it—say about 10,000 a week. Little as this matter is, it shows how backward the management of that institution is. It "makes up" its counting only once a year.—I am, &c.,

A Member of the Society.

FLORID GOTHIC ARCHITECTURE.

Sir,—In the discussion on Mr. Whitburn's paper on the 10th ult., I must have expressed myself imperfectly with respect to Gothic architecture. I do not think its time has gone by as a style, but only that feature termed florid—such as the Houses of Parliament—and this only because it is a waste of money and of labour to shape and carve stone in such manner as on exposure to a London atmosphere shall lead to its destruction in a few years. I do not, however, know any British stone which can be cut and carved in the florid style, and be exposed to the weather action of the British climate, which can have a life of ordinary endurance ; the play will not be worth the candle. The rapid decay of the Houses of Parliament is no doubt in some respects exceptional ; the stone, however, is in fault, of this there need be no doubt. If ever a ship was spoiled for want of one half-penny worth of tar, those unfortunate houses may, for illustration of the proverb, be considered that ship. Government spent a very large sum in selecting the quarry, but declined to spend a very small sum in selecting the stone, the results being great cost and inevitable failure. If there had been a stipulation that each stone quarried should endure on the ground not less than two years' exposure to the weather, and that then only sound and selected stones should be used in the buildings, the whole would have been in the condition of the best, and the life of the work would have been, so far, prolonged ; but carved and undercut as the stone is, to suit the style, the life would not even then have been long.

In the days of cathedral and abbey building there were neither roads, as now, canals, nor railways ; so that the stones to be used would get a good weathering before they reached the mason, and every particle of bed-sap would have crumbled by exposure to frost, rain, and sunshine.—I am, &c., Robert Rawlinson.

THE MOULD-AND-COAL FUEL.

Sir,—Will you allow me to make known the results of my experience in the matter of the above fuel ? The first necessity appears to be suitable mould, and in so far as I have observed, that which constitutes our good meadow and garden mould seems the most suitable. Clayey or poor earth does not undergo combustion

satisfactorily, but remains in the fire to be converted into bits of brick, which, I fear, rather absorb than increase the desired heat.

That the mould should be free from stones, and well mixed with the coal-dross and soda solution will appear obvious to every one, but that the mass should be made into balls I have not found so important, as it speedily "cakes" of itself when the heat of the fire has acted upon it. I find also that it is better to place a lump or a few lumps of coal beneath the mass, when placing it upon the fire. I am the more eager to mention the above facts, because I have seen already instances of hasty conclusion against the fuel where unsuitable mould has been used. All the remarks respecting smallness of waste, and dust, and reduction of smoke, I am entirely able to verify.—I am, &c.,

A. W. Cuttall.

GENERAL NOTES.

Tonic-Sol-Fa Teachers' Association.—This association (in union with the Society of Arts) will hold a meeting at the Literary Institute, 165, Aldersgate-street, E.C., on Saturday evening, January 24th, to hear a lecture (illustrated) on "The Faculty and Sense of Hearing," to be delivered by T. P. Pennefather, Esq., M.R.C.S., &c., surgeon-dentist. The President (W. Hepworth-Dixon, F.S.A.) will take the chair at 7.30. Members of the Society of Arts will be admitted on presentation of private card or by ticket, to be obtained of Mr. Edward G. Hammond, hon. sec., at the Office of the Association, 1*a*, University-street, W.C.

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

ORDINARY MEETINGS.

The following arrangements have been made:—

January 21.—"On German Music, with Especial Reference to the Works of Richard Wagner." By Ferdinand Praeger, Esq.

January 28.—"Account of a Recent Visit to the Coal and Iron Fields of Virginia, United States of America." By Professor D. T. Ansted, F.R.S.

February 4.—"On Eastern Art, and its influence on European taste." By Dr. Christopher Dresser.

February 11.—"On Type Printing Machinery, with suggestions thereon." By the Rev. Arthur Rigg, M.A.

February 18.—"On Thrift as the Outdoor Relief Test." By G. C. T. Bartley, Esq. On this evening the Right Hon. the Earl of Derby will preside.

February 25.—"On the Channel Tunnel." By William Hawes, Esq., F.G.S.

March 4.—"On Bells, and Modern Improvements for Chiming and Carillons." By George Lund, Esq.

INDIAN SECTION.

The following arrangements have been made for Friday evenings during January and February:—

January 23.—"On Indian Teas, and the Desirableness of Increasing the Use of them in the Home Market." By Dr. A. Campbell, late Superintendent of Darjeeling. On this evening Sir Louis Mallet, C.B., Member of the Council of India, will preside.

February 6.—"On Indian Art." By Dr. Zerffi.

February 27.—"On our Relations with the Hill Aborigines of Northern India. By Dr. Leitner.

AFRICAN SECTION.

The following Friday evening meeting has been arranged:—

January 30.—Inaugural meeting.

CHEMICAL SECTION.

The dates for the various papers are not yet fixed. The meetings will be held on the following Friday evenings, at 8 o'clock:—February 20th, March 6th and 20th, April 10th and 24th, and May 8th. The following subjects have already been arranged:—

"On the Production of Anthracene and Alizarine from Pitch."

"On the Manufacture of Chlorine."

"On the Utilisation of the Waste Products of Gas Manufacture."

"On some Recent Improvements in the Production of Carbonate of Soda."

"On Sugar Refining, with special reference to Fingel's Sugar Crystals."

THE LIBRARY.

The following works have been presented to the Library:—

The Ninth Census of the United States, 1870, 3 vols. Presented by the Department of the Interior.

Lancashire Worthies, by F. Espinasse. Presented by the Author.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Medical, 8. 1. Captain Shortland, R.N., "Economy of Coal, as viewed by the Commander of a Steamer." 2. Mr. Marsham Adams, "Adams' Patent Mensurator and Cœlometer."
Asiatic, 3.
Victoria Institute, 8. (At the House of the Society of Arts.) The Right Rev. Bishop Piers C. Claughton, "On Buddhism."

Tues. ...Civil Engineers, 8. Mr. Alex. C. Kirk, "On the Mechanical Production of Cold."
Statistical, 7¾.
Pathological, 8.
Zoological, 8½. 1. Dr. Otto Finsch, "On *Psittacula, andicola*, an apparently new species of parrot from Eastern Peru." (Received 29th November, 1873.) 2. Major O. B. C. St. John, "Note on *Oryx beatrix*." (Received 3rd December, 1873.) 3. Mr. Edward R. Alston, "On a new species of *Pteropus* from Samoa." (Received 4th December, 1873.)
Anthropological Society, 8. Annual Meeting.
Royal Institution, 3. Prof. Rutherford, "On Respiration."

Wed....Society of Arts, 8. Mr. F. Praeger, "On German Music, with Especial Reference to the Works of Richard Wagner."
Meteorological, 7. Annual Meeting.
Geological, 8. 1. Mr. J. W. Judd, "The Secondary Rocks of Scotland (Second Paper)—On the Ancient Volcanoes of the Highlands and their Relations to the Mesozoic Strata." 2. Mr. A. W. Waters, "Remarks on Fossils from Oberburg, Styria."
Royal Society of Literature, 8.
Royal Horticultural, 8.

Thur....Royal, 8½.
Antiquaries, 8½.
Royal Society Club, 6.
Royal Institution, 3. Prof. P. M. Duncan, "On Palæontology, with Reference to Extinct Animals and the Physical Geography of their Time."

Fri......Royal Institution, 8. Weekly Evening Meeting. 9. Prof. Sylvester, "Recent Discoveries in Mechanical Conversion of Motion."
Quekett Club, 8.
Clinical, 8½.

Sat......Royal Institution, 3. Prof. G. Croom Robertson, "On Kant's Critical Philosophy."
Royal Botanic, 3¾.

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FRIDAY, JANUARY 23, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

SWINEY PRIZE.

A Meeting of the Adjudicators of this prize, appointed by the will of the late Dr. Swiney, was held on January 20th, 1874, at the rooms of the Society of Arts, Major-Gen. F. Eardley Wilmot, R.A., F.R.S., in the chair.

The Secretary read the advertisement convening the meeting.

Read the following minute of the Joint Committee of the Society of Arts and the College of Physicians:—

A meeting of the Joint Committee of the Society of Arts and the Royal College of Physicians was held at the Rooms of the Society of Arts.

There were present—

Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman of the Council of the Society of Arts, in the chair The Lord Hatherley, F.R.S. Sir Daniel Cooper, Bart. Mr. Hyde Clarke Mr. Edwin Lawrence, LL.B. Mr. Seymour Teulon	On the part of the Society of Arts.
George Burrows, M.D., President of the Royal College of Physicians James Risdon Bennett, M.D. William Munk, M.D. Henry A. Pitman, M.D.	On the part of the Royal College of Physicians.

Read the clause in the will of the late Dr. Swiney referring to this bequest.

It was moved by Lord Hatherley, seconded by Mr. Seymour Teulon, and resolved unanimously, to recommend that the award of the prize be this year made in favour of the Right Honourable Sir Robert Joseph Phillimore, D.C.L., One of her Majesty's Most Honourable Privy Council and Judge of the High Court of Admiralty, the author of a published work on Jurisprudence, entitled, "Commentaries on International Law."

By order of the Committee,
P. Le Neve Foster, Secretary.

It was thereupon moved by the Chairman, seconded by Mr. Philip Palmer, and resolved, "That the Prize, a Silver Goblet, value £100, containing gold coin to the same amount, be adjudged, and the same is hereby presented, to the Right Hon. Sir Robert Joseph Phillimore, D.C.L., the author of a published work on jurisprudence, entitled, "Commentaries on International Law."

The cup has been executed by Messrs. Garrard, from a design made expressly for the Society by the late Daniel Maclise, R.A.

ECONOMICAL USE OF FUEL.

The Committee appointed to take charge of this subject have paid several visits to inspect the articles sent to the International Exhibition buildings in competition for the prizes offered under this head by the Society, and in particular visited the collection on Wednesday, the 21st inst., when there were present: Major-General F. Eardley-Wilmot, R.A., F.R.S. (Chairman of Council), Captain Douglas Galton, C.B., Dr. David Price, Rev. A. Rigg, Captain Robert Scott, R.N., Major Webber, R.E., attended by Mr. P. Le Neve Foster, Secretary, and Mr. S. W. Davies, who has charge of the testing. The Committee proceeded with the classification and selection of the articles for testing.

REVOLUTION INDICATOR FOR SHIPS.

The Gold Medal of the Society, or £20, is offered for the best "Revolution Indicator" which shall accurately inform the officer on deck, and the engineer in charge of the engine, what are the number of revolutions of the paddles or screw per minute without the necessity of counting them. The following are the conditions:—

1. Simple in construction.
2. Not easily disarranged, and easily refitted in case of accident.
3. Accuracy not depending upon the heel or steadiness of the ship.
4. To indicate to the officer on deck in charge of the ship, and to the engineer in the engine-room, the revolutions per minute at all times, by night and day, immediately by simple inspection, without the necessity of counting, or the use of a watch.
5. It is desirable that the error should not exceed two per cent.
6. Moderate in first cost and expense of fitting. Cost to be stated.
7. Drawings or working models to be sent to the Society not later than the 1st of June, 1874.

The "Patent Log," the "Berthon Speed Indicator," and the "Counter," have been in use on board ship, but fulfil offices distinct from the required "Revolution Indicator."

PATENT-OFFICE MUSEUM.

On Saturday morning, the 17th instant, a deputation from the Society waited upon the Lord Chancellor, at his residence, Portland-place to urge upon him the necessity of some improved arrangements in connection with the

Patent-office Museum. The deputation consisted of the following gentlemen:—Major-General F. Eardley-Wilmot, R.A., F.R.S. (Chairman of the Council); Sir Antonio Brady, Mr. E. Loftus Brock, Mr. A. Cassels, Mr. Hyde Clarke, Mr. Henry Cole, C.B., Dr. Christopher Dresser, Mr. I. Gerstenberg, Mr. Thomas Hughes, Q.C., M.P.; Dr. Mouat, Mr. A. J. Mundella, M.P.; Mr. J. Hinde Palmer, Q.C., M.P.; Mr. C. W. Siemens, F.R.S.; Col. A. Strange, F.R.S.; Mr. E. Thomas, F.R.S.; Mr. E. Carleton Tufnell, Mr. Thomas Webster, Q.C., F.R.S.; with Mr. P. Le Neve Foster, Secretary. The Lord Chancellor was attended by Mr. Bennet Woodcroft, F.R.S., Clerk to the Commissioners of Patents.

Major-General Eardley-Wilmot, in introducing the deputation, said the immediate object of waiting upon his Lordship was only part of a large question in which the Society of Arts had been for a long time much interested, viz., the question of the administration of our National Museums and Galleries, and their connection with the education of the people. They desired to address his Lordship, as Chief Commissioner of Patents, upon the subject.

Mr. A. J. Mundella, M.P., said the committee was formed with the view of utilising all the national museums for the purpose of education. Attention had been directed to the British and other museums, and in due course they had arrived at the Patent Museum. This was one of the most interesting in the world, in fact, quite unique, containing, as it did, some of the first specimens of inventions which had revolutionised modern industry, modern travelling, and the whole character of civilisation. There might be found Kay's machine for making cards, three of Arkwright's first looms, Stephenson's "Rocket," and many other original machines and models of great value. But these were housed in a dirty shed of corrugated iron, so crowded and dark that they could not be seen or classified. Then there was indeed a reading-room, but it was not warmed, and frequently, in winter time, the thermometer stood at 30°, while when crowded, as it sometimes was, it reeked like a stable. It was unworthy of the country that the museum should be in such a condition; when they possessed such advantages, they ought to be utilised for the technical instruction of the artisans throughout the kingdom. Only a short time since one of the most unique specimens of machinery in the world—the first steam-engine put up at the Carron Iron Works—had been offered as a gift, but the cost of its carriage was not forthcoming from the Treasury, nor was there any place, if it had come, in which properly to put it. He was sure his lordship was not responsible for this state of things.

The Lord Chancellor said the Chancellor of the Exchequer was responsible for the expenditure.

Mr. Mundella said he admitted that was unfortunately the case, but he desired to point out that there was a surplus of more than £80,000 a-year derived from inventors in the shape of fees on patents.

The Lord Chancellor said he had no control over that. It was entirely in the hands of the Treasury.

Mr. Mundella said that was no doubt so, but it was understood that the Patent Museum was under the control of the Commissioners of Patents, of whom his lordship was the head, and he was quite sure his lordship was not personally responsible for the condition of that which probably he had never even seen. They (the Committee) were desirous that the management by trustees and irresponsible bodies should cease, and that one responsible Minister should be appointed to the control over the whole, so that these museums in the metropolis might be the centre and the receptacle for all the best specimens of every kind, and that they should be the means of improvement throughout the whole country. He represented an industrial constituency of a quarter of a million; and what was there for those working men to see? Nothing at all; there was no object of beauty of any kind for their eyes to rest upon; nothing but the blackness and darkness of their work. He was anxious to see museums erected throughout the country, which should receive loans from the central establishments in London, the latter being under the management of a Minister, who should be responsible to the House of Commons for their administration and the use of the funds voted for their maintenance.

Mr. Henry Cole, C.B., said he understood the condition of matters to be this, that inventors were taxed to the extent of about £80,000 a year more than was ever intended when the Acts of 1852 were brought forward, the principle then enunciated being that there should be no more fees paid than were necessary to meet the expenses of administration. Instead of that, however, there was the large surplus which he had mentioned; but, of course, the Treasury cared nothing about the patents, or anything but the balance-sheet, and did not see the indecency of allowing the Patent Museum to continue in its present state. He believed Parliament would remedy this state of things when its attention was drawn to the matter, but it was the moral duty of everyone who looked into the question to see that this surplus was properly applied. The French could not be compared with the English in respect of mechanical invention, but in Paris they had a splendid Conservatoire or Museum of Mechanical Inventions, which was worthy of the nation. This was also made a receptacle for patents, though the objects coming under that description made but a very poor show indeed. It was not every patented article which was worth preserving, but he thought the museum should include not merely patented inventions, but mechanical inventions of all kinds. He would not enter on the question of Patent-laws, on which anyone might well be excused for changing his opinion, but he ventured to say that the Pyramids had never done anything for the world like Watt's first engine, and this was in our museum, as well as numerous other early contrivances. Indeed, it had been said that if there were any part of the world where one could look for the origin of species, it was in this Patent Museum. He trusted that the Lord Chancellor would bring his influence to bear, and say that he would no longer be a party to the miserable treatment this Museum was receiving. He had no faith in Boards, which Bentham had long ago called "screens;" and others had said that if there was salvation in anything it was in individual responsibility. They could not expect Lord Chancellors to be constantly visiting patent museums, and he did not know whether his lordship had ever been there—(his Lordship shook his head)—but if he had, he was sure he would desire to wash his hands of it.

Mr. Mundella desired to add that during the last three years he had spent several days in the Patent Museum at Washington, one of the finest buildings in the United States, built of white marble, and so complete a contrast to anything in England that it made him quite ashamed of his country. Yet the specimens and models themselves were not to be compared in value to those existing in England.

Colonel Strange, who said that, though he attended as a member of the Council, he desired to speak only in his individual capacity, in order to justify his taking part in the proceedings, referred to the steps he had taken at the British Association in 1868, which led to the formation of a committee of that body, and ultimately to the appointment of a Royal Commission, to consider the subject of systematising the national scientific adminis-

tration of the country. He had given evidence at great length before this commission, and, after correspondence with scientific men of all countries, had laid before the commission a complete system for administering scientific matters. It had been well said by Mr. Mundella that this Museum was only part of a much larger question, but it was a very important part, and might be looked upon as a typical example. Responsibility was so divided as to be quite nugatory in all scientific departments. The nation, in its wisdom, left a good deal to individuals, but still it did something itself, and he found, on investigation, that there were about fifteen or sixteen public Scientific Institutions under no less than seven different Government departments. This evidently showed that what was called a system was no system at all; it was without unity and without a head. No one would think of conducting matters in that way in his individual capacity, either as head of a household or of an industrial concern. The most important recommendation which he made to the Royal Commission was that there should be at the head of these matters a responsible minister of State. But it was necessary to go one step further, because ministers, though men of great eminence in various walks of life, were often totally ignorant of the departments of which they had charge. This might answer very well in some cases, but it did not do in science; and, therefore, he also recommended that the minister should have the assistance of a permanent scientific council, to advise him when necessary. The Patent Museum was an example of the way in which the most important interests were left to take care of themselves, and he could assure his Lordship that the description which had been given of the Museum was by no means a picturesque one—it was the plain, unvarnished truth; it would really be a disgrace to the most uncivilised community on the face of the globe. Mr. Cole had advocated combining with the Patent Museum a collection of mechanical inventions in general, but this was a matter of detail, which required consideration. His own idea was that the two institutions had different objects. The granting of patents was one thing, the general collection of inventions was another; but it was desirable that such articles should be easily accessible to those engaged in patent litigation. He thought that the one great department should be practically subdivided into two branches. At the same time he quite agreed that they should be connected, and he should also like to see established a system of instruction under which public lecturers should be appointed to explain the progress of invention and the principles upon which it must proceed. He believed an institution of that kind would give an impulse to invention, and a support to our material resources, of which at present we had no conception.

Mr. Hinde Palmer, Q.C., M.P., said he had taken great interest in this question, and had again and again brought it before the House of Commons. The last time he did so was on Lord Elcho's motion with reference to the Natural History Museum, when he was informed that there was ample space there which might be used for the purpose of a Patent Museum, but nothing ever seemed to come of it. He agreed with Col. Strange, that whatever museums were established, there would still be a speciality connected with patent inventions which should in some way be kept distinct, so that resort might be made to them by those interested. This was a large question, and would take a considerable time before it could be satisfactorily settled; but in the meantime he desired to press upon his lordship that something should be done to render more available the valuable collection connected with the Patent-office, especially as he believed there were means within reach by which this could be accomplished.

The Lord Chancellor asked if there were any existing buildings which could be used.

Mr. Hinde Palmer believed there were buildings which could be made available at South Kensington. He was not quite sure on that point; at all events, there were buildings in contemplation, such as the Natural History Museum, and there was a large space of ground, amply sufficent to provide what was required, belonging to the Commissioners, at South Kensington. He then called attention to a document under his Lordship's own signature, namely, the Report of the Commissioners of Patents, from which he read one or two passages, referring to the desirability of exhibiting the valuable models belonging to the Commissioners, which were still remaining in cases because there was no proper place in which to exhibit them. This question had been continually under consideration since 1859. Numerous memorials had been sent in, signed by legal, scientific, and literary men, pointing out the deficiencies of the building now occupied, and urging that suitable premises should be erected. The Patent-office and Library in Southampton-buildings had been much improved during the time of the late Sir William Bovill, and were now in a very satisfactory condition; but for thirteen years nothing substantial had been done to the museum at South Kensington. He could not help thinking that, if not only the Lord Chancellor, the Master of the Rolls, and the two Law Officers, had been appointed as Commissioners, but also additional members of the Commission had been appointed, as was originally contemplated when the Act of 1852 was passed, who would have given more attention to the subject, the museum would not have remained in the state in which it now was. This was one practical point in which he thought his Lordship had the means, as he was sure he had the inclination, to help them, the surplus fees being now about £80,000 per annum.

Sir Antonio Brady, after referring to the Patent Museum at Washington, urged the importance of technical instruction to artisans throughout the country, if the English nation were to retain its pre-eminence in commerce. In order to promote that object, he, with several others, took the initiative in the establishment of the Bethnal-green Museum, the condition on which the land was given being that there should be an educational establishment provided in the broadest sense of the word. Unfortunately, he did not think that even that had received as much encouragement from the Government as it ought to; for at the present time the vacant ground, which was covenanted to be planted with trees, was still a receptacle for refuse building materials; and so little interest seemed to be taken in the matter that only very recently the First Commissioner of Works did not even know that four acres of ground still vacant belonged to the Government. At the same time, he was happy to bear his testimony to the great improvement in the whole tone of society in the neighbourhood which had followed the establishment of that museum. He also referred to museums in America and on the Continent, and considered it a disgrace to England, a country of the greatest wealth, that these matters were left to take care of themselves. England had already lost her preeminence in many staples, and he feared, if they did not look to it, that the Chancellor of the Exchequer would rue the day when he applied these surplus patent fees to other purposes.

Mr. Cole said he had no authority to speak in the name of the Commissioners, but he believed there were buildings at South Kensington which could be utilised; and if the Commissioners of Patents thought fit to communicate with her Majesty's Commissioners, he thought accommodation might be afforded for about five times the amount of specimens to be found in that wretched shed which was now used.

Mr. Mundella said there were specimens all over the country ready to be given, but there was no place to put them in.

Mr. Hyde Clarke desired to call attention to the fact that this collection had chiefly been made by the officers of the Patent Museum. They were much indebted to Mr. Woodcroft and Sir Francis Petitt Smith, who had not only brought together the collection which had been so well described, but had vindicated the character of English inventors, and made known to the world the merits of many men who had been neglected in their life-time, and even after their death. It was of great importance that the museum should be put in a proper condition, considering what was being done in foreign countries. In visiting French or American museums, for instance, it could be seen at a glance who were the inventors of the models displayed, whereas in this country no information of the kind was communicated.

The Lord Chancellor, in reply, spoke as follows:—I am obliged to you, gentlemen, for the interesting and important statements which have been made, and which have been undoubtedly made with very great ability, and with very great knowledge of the subject. I entirely concur in your views of the importance of the matter. I do not propose at all to refer to the larger scheme which the Society has in view, with regard to other modes in which the interests of education, in connection with science and art, may be capable of being promoted in this country; but, with respect to the Patent Museum in particular, I cannot but think, although I have not been there myself, that there is only too much justification for all that has been now said, and for statements which have been made as to the very great value of the collection and the number of specimens for which there is no house-room at present. You have certainly convinced me—if I needed convincing, which was not the case—that we ought to have much better accommodation provided for the collection, and much greater facilities for access to it for the public in general, and the artisans throughout the country in particular. With respect to the present state of things, I rather think that the matter has not altogether been lost sight of, because when I was Law-officer of the Crown, the matter was considered by the Commissioners of Patents, who were very much dissatisfied with the condition in which things were, but they really could not find anything better to do than to make the arrangements, which have since been continued, as to the temporary custody, for it has always been considered a temporary arrangement of this collection, which, I think, comprehends many things on loan to the nation, as well as articles which belong to it.

Mr. Woodcroft said there were very few loans.

The Lord Chancellor continued—In point of fact, at the present moment, subject to what Mr. Cole has said, which ought to be looked into, as to the possibility of any available buildings being found at South Kensington, I am not aware of the existence of any actual buildings in which the collection could properly be housed. Unfortunately, we all know that with respect to the erection of new public buildings on a large scale in the first place, many years are taken in bringing people to agree as to what ought to be done, and then, when they have agreed, new schemes are started, and a great deal of delay occurs in executing what has been determined upon, in consequence of the changes recommended, and even when all that is over they make but slow progress. I need not refer to the new Courts of Law, as to which I feel a very great deal of interest; and I am sure there is a great loss to the public from the delay which has taken place, and which, I am afraid, is not being got rid of very rapidly at the present time. However, those are difficulties which may be cured in course of time. In my judgment, it would be well for the matter to be carefully looked into, and for the attention of the Government to be directed to the steps which might possibly be taken for the purpose of supplying, as soon as may be, a proper building for the reception of this valuable collection. As to the money, I apprehend the Chancellor of the Exchequer, if he were here, and I wish he were—probably he would have received us at his official residence, if it had been proposed to make this a general deputation to him and to myself—but if he were here, he probably would say, and with truth, in a certain sense, that Parliament has not specially dedicated the surplus revenue resulting from the granting of patents to this particular purpose, although I believe something may have been said in Parliament as to the intention of the Government of that day to provide suitable accommodation for the Museum if such a surplus should exist. It has been stated here, and, although I do not pretend to recollect exactly what did pass, I have no doubt that any gentleman who has made such a statement had good authority for what he said. Still, as a matter of law, and constitutionally speaking, it is only part of the general revenue of the country; and I am not prepared myself to say that the proposition could be defended, that the class of the community on whom a particular tax is levied has a special lien upon it, to be laid out for its particular benefit. I think it a much more safe ground to take that the public have an interest in having a proper museum provided for this collection. I quite agree with Mr. Cole, that the subject ought to be regarded on larger grounds than that which relates particularly to patents. As to the Patent Laws, there may be various questions about them, which, I agree, are quite foreign to the present matter, for, whatever Patent Laws we have, or are to have, still a collection of this sort would have its value. I do not think there will be the least difficulty in making it larger than would be necessary if it had exclusive reference to patents, and at the same time sufficiently distinguishing those objects which are patented, with the dates of the patents, for any one at once to see what is the history of the patented articles as represented in the museums, and also the names of the patentees. As to the administration, you will not expect me to go into that question. I do not think, however, I need hesitate to say that I entirely agree in thinking that a board of legal functionaries, whose time does not enable them even to indulge themselves as they would certainly wish, in visiting interesting collections of this kind, are the best possible guardians of any kind of museum, certainly not of a museum for the purpose of science and art, and I shall be glad to see the museum dissociated from the legal gentlemen, and placed under a proper administration, and properly arranged for use; and what I may venture to promise as to the result of this meeting, is to arrange with Mr. Woodcroft for an early meeting of the Patent Commissioners, to whom I will communicate what has passed here, and they will consider what representation may be made to the Government upon the subject.

Major-General Eardley Wilmot having thanked his lordship for his kind reception, the deputation withdrew.

It should be mentioned that the name of Mr. A. J. Mundella, M.P., was accidentally omitted from the list in last week's *Journal* of those who visited the Patent-office Museum on January 10th.

DRILL IN SCHOOLS.

The following letter, addressed to the Secretary of State for War, has been transmitted from the War Department to the Council;—

To the Right Hon. Secretary of State for War.

St. Leonard's Rectory, Exeter, October 27th, 1873.

Right Hon. Sir,—In the *Times* paper, dated August 25th, 1873, there appeared an article, which I beg to enclose, relating to the difficulty likely to occur before long in filling the ranks of the army.

Permit me to suggest the adoption of elementary drill in our national schools as a ready and inexpensive method of stimulating recruiting, the drilling to be carried on principally by the present staff of schoolmasters. The Society of Arts have lately urged its adoption, probably with a view to the development of the frame. I now urge it on account of its use in furthering the moral development of the boys, and on account of the benefit that will accrue therefrom to the State.

My first experiments in drilling the boys of one of our national schools took place in the year 1851, at Lympstone, near Exeter, of which place I was the rector. The boys of the school were then very rough, disorderly, and untidy in appearance, and most difficult to control. Noticing the good effect of the drill sergeant on the roughs who are enlisted, I determined to try on the boys of the national schools of that village the effect of the goose step, the attention drill, the extensive motions, with the left-about and right-about facings, &c.

The first class, viz., the eldest boys, were kept on this drill for twenty minutes daily during two months, commencing at 9 a.m., so as to have it over before lessons. I drilled the boys myself, and very frequently, in subsequent years, I drilled my own children with them. After that, I made the most advanced boys drill the younger classes. On the conclusion of drill, I always addressed the boys *vivâ voce* for a few minutes, giving them short lectures on history, together with advice as to conduct, &c.

The result of this drilling as to the appearance of the boys was, they became set up, more cleanly; they dressed better, kept their hair close; in fact, they became tidy and respectable, but above all obedient.

As to the effect of drill on their application to the lessons, it seemed to act very favourably, causing them to acquire more power of concentrating their attention on the subject to be learnt.

In short, the school, which was formerly notorious for disorderly boys, was afterwards highly commended for order, cleanliness, &c., and the change must be attributed entirely to the drilling.

As regards the ultimate effects of the drilling on the per-centage of the boys who subsequently enlisted from the school, this cannot be ascertained, but many of them are known to have ultimately joined the Volunteers. Of this I am quite certain, that if even the services of a pensioner were engaged at a small fee, to drill occasionally the elder boys of our national schools, and give them an account of all the countries which he had visited, it would engender a love of adventure and a love of the service in a large proportion of the boys.

The beneficial results of drilling were not confined to Lympstone, where I resided eight years, but I noticed the same results of drilling at the school of Rackenford, North Devon, of which place I was likewise rector for a period of eight years.

Extensive motions, &c., or "modified drilling," are now recommended in that excellent training college for mistresses, the Home and Colonial Society, London, from whom I obtained a mistress, who introduced the system even in an infant school in Middlesex.

In fine, elementary drilling, besides being a powerful aid in promoting discipline in a school, is a healthy and beneficial exercise, and gives boys a taste for military life.

If adopted in the national schools it would cause many in our population to have a taste for soldiering, would stimulate recruiting, and would, moreover, render the subsequent training of recruits comparatively easy.

Even in the case of those that might settle down to civil life, the drilling at an early age would go far to give them habits of self-control, and render them more respectable members of society.

I venture to suggest that drilling should be introduced by degrees into the national schools, commencing with those in the agricultural districts.

I consider that a master may exercise his authority over boys by being himself the drill instructor, besides, the drilling, not being beyond extensive motions, facings and marching, would be too elementary to necessitate the employment of a regular drill sergeant, except under peculiar circumstances. Although I am aware that its adoption depends on the view that the Lord President of the Council may take of it, yet I trust that the subject will meet with your approval and recommendation, on account of prospective benefit to the army, and that, if established, you will advance it by furnishing qualified inspectors, who may, from time to time, test the progress made in drilling at the various national schools.—
I am, &c., George Porter,
Rector of St. Leonard's, Exeter.

To the Right Hon. the Secretary of State for War.

Extract from the "Times," August 25, 1873.

A comparison of the political literature of twenty years since with that of our own time would reveal one notable fact. A great national difficulty has been so completely surmounted that it has passed from the category of public questions. Nobody now-a-days thinks or talks about "Manning the Navy," and yet in the days of Lord Aberdeen and Sir James Graham that was the topic uppermost in the public mind, whenever, as happened very frequently, our national defences were pressed upon popular consideration. Pressgangs, it was understood, were things of the past, aud though there were many volunteers from the mercantile marine, men were not always to be had either in sufficient numbers or of the quality desirable. Every now and then a frigate ordered on foreign service would be detained in harbour for months together owing to a want of men, and if a large and sudden demand had arisen, our difficulties, it is clear, might have been very serious. All this trouble is now at an end. We vote every year some 60,000 men—marines included—for the use of the fleet; but they are all forthcoming so surely that not a thought is given to the matter. Now, as that is really a remarkable fact, and as it may have its bearing on a similar question of equal importance and a still pending difficulty, it is worth while to look into the case and see how the relief has been obtained. The results are due almost entirely to the introduction or development of a new system of action. Instead of going into the open market for made sailors, we now manufacture the article for ourselves. Training-ships have been established for the reception and education of boys, where they are taught their future profession, and in due course turned into excellent sailors. Every one of these vessels, in fact, may be regarded as a government factory for seamen. The raw material is to be had in such abundance that we have only to pick and choose, and, indeed, we might fill the ships by competitive examination, if we thought fit. Last year's estimates provided for the maintenance of 7,500 of these boys, of whom 3,000 were still in training. Now, as the whole number of seamen in active service with the fleet is but some 30,000, it follows that a tenth of that force is always growing up to replace casualties, and ready to come forward as vacancies occur. As regards quality, these young sailors are all that could be desired. Last Friday the Prince of Wales reviewed 1,800 of them at Plymouth, and a more satisfactory or agreeable spectacle could not have been witnessed.

The reader will have anticipated, no doubt, that we propose to apply the moral of this story to the system of recruiting for the army. We are not insensible to the wide difference between the two cases. The number of soldiers required for the public service is three times as great as the number of sailors, while the training required and the service expected present strong points of contrast. As a rule, a good seaman learns his profession while young, improves himself in it till he is a proficient, and then follows it with exclusive devotion till his age or strength begins to fail him. In the army, on the contrary, we take the recruit at 18 or thereabouts, teach him his drill in a few months, and then, according to our present system, return him to the ranks of civil life after three or six years' service. It is obvious, therefore, that a scheme of rearing soldiers for the army, as we now train sailors for the navy, could not be carried out to the same extent or with such absolute success. It would not answer our purpose to maintain unlimited numbers of boys at vast military seminaries, up to the age of 18, in order that we might get the benefit of their services in the ranks of the army up to the age of 24. The education would be unnecessarily long, and the recompense unprofitably short. Nevertheless, we think the principle might be adopted to a greater extent than at present. We do not make the suggestion with any particular misgivings, for we were assured in the latest debates on the subject that recruits were freely obtainable, and Mr. Cardwell gave a very good account of his reserves. But there is an impression abroad, and not without some reason, that, as wages rise and labour becomes dear, we may find it difficult before long to fill the ranks of the army. Short service, be it remembered, means large requirements, seeing that a soldier has to be replaced at least every six years instead of every twelve. No doubt, we have always the option of re-enlisting the most eligible men, and so keeping the best of our bargains, but this would amount to cutting off the supplies of our reserves in the same proportion. Still it is always understood that the service of some soldiers must be prolonged, and none would be so likely to qualify for these new

engagements as men who had been trained to arms from childhood, and taught to look to the army as their sole profession. It appears to us that we might thus not only provide ourselves with a very useful resource, but introduce an element of no slight value into the composition of the army.

We maintain now more soldiers than formerly, and they retire at an earlier period from the service. This creates a larger demand for recruits, but at the same time there is an increased demand for men in the various departments of civil industry. It is part of Mr. Cardwell's scheme, no doubt, to reconcile these two things, and to make it worth the while of a civilian to turn soldier for a time. By the terms offered he would begin the work of civil life at 24 instead of 18—no very advanced age. Against the start which his neighbour might have got, he would be able to place an excellent training, not only in serviceable habits, but in such branches of industry as he might have fancied, and he would be in possession of a small but certain pay, on the condition only of returning to the colours in the event of emergency. It is not at all improbable that before long a preferential title to certain civil employments may be added to these advantages, so that, upon the whole, a young lad might well decide to take a short term with the army before settling down to his trade or calling. These are the expectations on which the much-abused system of short service has been founded, and to us they certainly appear rational. We should have thought that for one man who deliberately enlisted for life, or the best part of a life, at least a score would be ready to try a six years' venture, with the certainty of an early retreat in case of dissatisfaction. Nor can we allow that the presumption has yet been disproved, though it is possible enough that the recruits who present themselves on these conditions may be younger than before. Youth, however, is a complaint only too certain to be cured, and if it is desired to provide a counterpoise to these juvenile levies, we do not see how it could be more effectually or suitably done than by such training establishments as we have suggested. Suppose, for instance, that the army estimates, like those for the navy, included an annual provision for boys in training, and suppose that the numbers were 5,000 instead of 3,000, would not the supply of such amount and quality prove a great benefit to the service? We might safely add that it would have its advantages in other respects. A considerable proportion of the boys trained for the navy would, except for such training, fall only too surely into courses neither reputable nor safe. Not only does the State gain by their services, but society gains by their transfer to a respectable calling. Only those personally conversant with the subject know how very large is that class which, according to its youthful training, may become either useful or dangerous to the community. In numbers, we fear, it may be regarded as practically inexhaustible, and if the supply could be turned to account for the good of all concerned, it would be a piece of very wise and judicous policy.

The Council directed the following reply to be sent:—

Society of Arts, London, January 19th, 1874.

SIR,—I am directed to return the thanks of the Council for communicating to them the letter from the Rev. George Porter, and to state that the Council view it as valuable experience in rural districts, strongly corroborative of the information given by others, and especially cleygymen in urban and manufacturing districts. They all in effect call upon the War Department for aid in their work, for the mental and intellectual advancement, as well as the physical and military training of the population.

The Council request that the following instances may be brought under the notice of her Majesty's Secretary of State for War, and also of H.R.H. the Commander-in-Chief:—

The Rev. Mr. Nassau William Molesworth, the rector of Spotland, near Rochdale, has stated to a member of our Council:—

That the introduction of military drill would be a great help to the school discipline and instruction, as well as a great advantage to the boy in after life, whatever may be the nature of his occupation. Allow me to add my own strong testimony on this point. In all our large national schools the masters have found it absolutely necessary to introduce certain evolutions, which the children regularly go through, but the idea of teaching the full military drill was quite new to me when you first broached it. The more, however, I reflect on the matter, the more strongly am I convinced that even you yourself underrate the value and importance of the suggestion.

No one who has not known the people of those districts as long and as fully as I have, can, I conceive, thoroughly appreciate all the advantages which would arise from it.

The contrast between Hyperion and a satyr is scarcely more striking than that which exists between the loutish bearing of the Lancashire lad and the firm, erect, respectful and self-respecting carriage and behaviour of the same person after he has been thoroughly disciplined and polished by the military drill. I am satisfied, too, that the advantage would not be confined to the exterior man. In virtue of that mysterious co-relation which exists between the body and the mind, the erect person would betoken, and to a certain extent produce, intellectual rectitude and moral uprightness. Nothing, I am convinced, would more strongly tend to make our operatives good and useful members of society, or to foster in them attachment to the laws and institutions of our country, and loyalty towards the sovereign.

The Rev. Isaac Holmes, connected with a large industrial school belonging to Liverpool, states that he finds that—

Military drill tends considerably to sharpen the intellect, to promote habits of attention and obedience, as well as to improve the condition of the children, and that it has a beneficial effect upon them in civil life, as well as to prepare them for the service of the country.

It may be mentioned, in illustration of the effect of the early military training in imparting habits of discipline, that on the outbreak of a fire at night, lately, at the Central District School of London, where the children have a military training, it was noted that the boys, instead of flying about in wild terror, were attentive and well collected; and that the manager, on going into one of the wards to rouse them, found that they had been already roused by their little officer, and that they had been put in rank, and were waiting for orders.

The following testimonies indicate the demands for aid (of which, as the Council submit, there is an increasing need) to promote exercises for civil as well as for military training:—

The Rev. Andrew Johnson, the Head Master of the Queen Elizabeth's Free Grammar School of Southwark, after bearing testimony to such general beneficial effects of the exercises as above cited, has represented that—

To make it effective and popular with boys, drill should be treated like any other recognised branch of study, examiners should be appointed, and prizes given to the most deserving. A military referee would also be very valuable to advise with the head master on matters with regard to which the latter, from want of training, is incompetent to decide, and therefore obliged to rely too much on the judgment of his inferior, the drill master.

The Rev. J. G. Fussell, one of Her Majesty's School Inspectors for the Metropolitan division of Finsbury, states that—

Drill is gradually being introduced into the schools in my district, and as the operations of the School Board are extended, its adoption will proceed more rapidly. I earnestly hope that schools will not be allowed to 'play at it.' Its advantages as an element in education are great, but it should be taught heartily, if taught at all. The schools of the Royal Caledonian Asylum have a resident sergeant-instructor; those of St. Philip, Arlington-square, and of Old-street-road (St Mark's), the former under the instruction of a sergeant in the army, the latter under that of the incumbent, formerly an officer of volunteers, may also be specially mentioned as making good and steady progress. The girls, as well as the boys, are instructed. usually at different hours; the interest they evinced, and the effect upon their 'setting-up,' led me to wish that the practice of drill may receive recognition in girls' schools. Few things are calculated to be of greater advantage to their health and spirits, or to the promotion of their bodily and (indirectly) of their mental activity.

Other and similar testimonies may be adduced from clergymen, earnest labourers for the moral improvement of the population, in support of the representations which the Council desire to submit, as to the extending perception of the need of systematised arrangements for the general introduction of military exercises in all the State-aided elementary schools throughout the country.

I have the honour to be, &c.,
P. LE NEVE FOSTER, Secretary.

JUVENILE LECTURES.

In accordance with his previous announcement, Mr. Buckland delivered a third lecture to a juvenile audience on Friday last, January 16th, at the Museum of Fish Culture, Kensington. Mr. Buckland gave notice that he would offer prizes for the best essays on his lectures. It is proposed to arrange for a visit to the Brighton Aquarium during the Easter vacation, particulars of which will be duly announced.

PROCEEDINGS OF THE SOCIETY.

SEVENTH ORDINARY MEETING.

Wednesday, January 21st, 1874; ANDREW CASSELS, Esq., Member of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Branson, William Powell, 155, Fenchurch-street, E.C.
Brook, William B., New-inn, Strand, W.C.
Dagg, Thomas William, C.E., 72, Wilson-street, Derby.
Kearsley, Robert, Highfield, Ripon.
Leeman, George, M.P., York, and Dean's-yard, Westminster, S.W.
Leigh, Joseph, Marple, Cheshire.
Moses, G. B., Greystone, Dalton-in-Furness.
Perks, Benjamin, 10, Markham-square, Chelsea, S.W.
Ross, John, Stockton-on-Tees.

The following candidates were balloted for and duly elected members of the Society:—

Barker, Robert Wilkinson, 7, Warnford-court, E.C.
Bramwell, Frederick J., 37, Great George-street, S.W.
Burwash, Thomas Seabrook, Woodlands, Streatham, S.W.
Carfrae, John, F.R.G.S., 31, St. Swithin's-lane, E.C.
Fallon, James Thomas, 114, Collins-street West, Melbourne, Australia.
Graham, Dr., University College, W.C.
Hughes, Walter Watson, 48, Porchester-terrace, Bayswater, W.
Humphrys, Robert H., Deptford-pier, S.E.
Jackson, E. P., 14, Orsett-terrace, Hyde-park, W.
Millar, R., Milerevan Works, Lambeth, S.E.
Pagden, J. C., Little Heath, Potter's Bar.
Robinson, Robert, C.E., Darlington.
Shillington, D. F., 2, Great Tower-street, E.C.
Spencer, George, Tressillian-villa, Upper Lewisham-road, New-cross, S.E., and 77, Cannon-street, E.C.
Thompson, Henry, Summerhill, Colchester.
Tucker, Charles, Mayor of Bridport.

The paper read was—

ON THE FUSION OF THE ROMANTIC AND CLASSICAL SCHOOLS OF MUSIC, CULMINATING IN THE WORKS OF RICHARD WAGNER.

By Ferdinand Praeger.

Our music is purely a Christian art, that is to say, it dates its existence from the earliest days of Christianity. Greek art was especially plastic, and left all the sister arts, poetry, painting, sculpture, and architecture, in a high state of perfection, but nothing in music that has come to us, notwithstanding the anxious researches of all learned men, musicians or otherwise, could be deduced from those confused systems. Every province had a different system; the starting-point was to assume the 3rd and 6th as dissonances, and the 4th and 5th as consonances; this fallacious basis would never have produced any music akin to ours; and to make my assertion still stronger, especially for those who do not know anything of 4th, 5th, 3rd, and 6th in music, I simply refer them to all non-Christian nations, whose music, lacking our basis, has remained the same wild incoherent gibberish, more in unison with the antediluvian world than anything else. Before, however, beginning to speak more of music, it might not be inexpedient to inquire into the other arts, all intimately connected. Poetry is lofty ideas in lofty language. Painting, form in space. Sculpture, the plastic art, a representation of physical beauty. Architecture, building for building's sake—generally named last, on account of its compound nature, using sculpture and even painting as aids. And what now is music? Music is the art which expresses feelings by sounds. To prove, what to some may be new, namely, that our music sprang up with our religion, I must needs run over its history, which, for want of time, I must do in a very cursory manner. It is, however, to be regretted that the study of the history of the fine arts is not seriously a branch of education for all classes, from the lowest upwards. The usual objection, that it is beyond the reach of untutored minds, is by my experience entirely overruled. It has been a labour of love with me to teach my favourite study as art-critic for many years, to even very young pupils, with the greatest success. It behoves one, of course, to be master of one's subject, to be ever ready to answer any questions, and that always in such simple and intelligible language that it becomes clear to the slowest understanding. The patience required for such a proceeding is not a merit, but a condition; this, of course, applies to all tuition; those who lack that patience must not attempt to teach.

The early Christians had to hide their prayer-meetings; they met mostly at night, and were always afraid of persecution; they prayed together aloud—danger raises enthusiasm; they necessarily fell into a regular accent; and a kind of sing-song, (akin to that of charity children's choruses, when saying their catechism, or even multiplication-table); the most musically organised then always take the lead, and a regular rise and fall of the voice ensues. This became normal; their descendants inherited the tradition of these tunes, and in the fourth century St. Ambrosius invented a method of writing them down, besides making four scales at a guess, called the *authentic* scales, which differ from ours in having the semi-tones always anywhere than in the right places. In the sixth century, Gregory the Great revised these hymns, and added many, besides four more scales of the same kind, called Plagal scales, leaving us the Gregorian Chant—no doubt a wonderful thing at that time; but I consider the fact that enthusiastic archæologists have dug it up out of the dust of ages, one that shows more zeal than wisdom or musical taste.

Charlemagne was a great admirer of the Gregorian Chant, and through him it was introduced into all the countries his powerful mind reigned over. In the 10th century only we find the first attempt at harmony. Huckubaldus, or Hubald, a learned monk, based his very uncouth trials on the Greek system again, and called a chant which would drive you from home and hearth his "Organum." Guido, of Arezzo, also a monk—11th century—did not improve the harmony, but put some order into the way of writing music, by naming the notes after the first syllables of a hymn to St. John, ut, re, mi, fa, sol, la, si. He sent a great many pupils into the world to disseminate this little knowledge, which grew in the twelfth century,

nursed and fostered, as by giants' efforts, to our present system, as regards notes and their duration, minus, however, the division into bars, which was the work of the next century. These unknown workers at last also swept away the Greek prejudice against thirds and sixths, and thus prepared the way for a complete method, which was brought to light by Franco, of Cologne, in 1200, the first writer on music.

All I have yet named refers to sacred music. The people, meanwhile, composed their own tunes, all bearing that peculiarly original character anything moral or physical acquires by passing from hand to hand, and mind to mind—through thousands and millions of individuals—who all seem to leave an atom of the infinite in it, which only accounts for the vitality of rude creations by the people, never to be imitated by the most creative and artistic genius, excepting those very few cases like "God Save the Queen," by Dr. John Bull, in Queen Elizabeth's reign, Luther's Hymn, "The Marseillaise," by Rouget de Lisle, and "Wilhelm of Nassau," by Adelgonde; and, as these are always the only specimens of those individuals that show such power, they may be looked upon as a *lusus naturæ*. The "mysteries," street performances of religious history dramatised, were generally enlivened by popular songs, totally unconnected with the sacred drama, as also was the buffoon or clown. The creations of the Troubadours (*minnesingers* in German) were of a nobler and higher kind, as, besides the praise of love and Christianity, they introduced the epic tone, both in their spontaneous poetry as well as in their music. The church organs were improved considerably by Antonio Scuarcialupo, and later, 1470, Bernardo, a German, added an octave in the treble, and invented the pedal-bass. All this aided the progress of music. In 1313, Adam de la Hale wrote some music to a play, which was performed at a theatre built in Paris for the performances of the mysteries (this fact often has been quoted as the beginning of the opera); but the songs were entirely unconnected with the otherwise very clever play, and sung either without accompaniment, or, if there was any, in unison with the vocal part. Indeed, the singing in churches in Germany, till the end of the 15th century, was all in unison with the organ. From the end of the 14th century, music seemed to have left its cradle—Italy—and to have wandered to the Netherlands, where, for two centuries, the Flemish musicians worked in all directions, rightly and wrongly, to invent and exercise contrivances.

Counterpoint originated with William Dufay. Notes were then but points, having no stems—and adding a note below each note of the tune, was a point against a point, or "*contra punctum*," hence the name. If several notes of smaller value are added instead, as bass, then it is florid counterpoint; and if all the parts are so arranged or premeditated as to admit of their being turned topsy-turvy, then you have double counterpoint.

That counterpoint is the means, but not the end, of a musical composition may be understood. But the Flemish composers seemed to think otherwise. Their history shows an incessant labouring at heaping difficulty upon difficulty; counterpoint was the purpose, no longer the means; it was like poetry for the sake of rhyme, not reason. Their great feat was to write riddle-canons, to heap part over part, more for the eye than the ear; it was a school of casuistry and sophistry, in unison with the rage, somewhat earlier in literature, of acrostic achievements, &c. However, the contrivances gained by the enthusiastic perseverance of the Flemish school, served to build up the then "music of the future." Ockenheim, 1430 to 1513, his clever pupil Josquin des Près, Hadrian Willaert, and Orlando Lasso are the most renowned of 300 Flemish musicians, and the last-named had already arrived at a much more refined and restricted use of counterpoint; his European influence, great by his travels, left the strongest traces in Germany. The most striking defect of the Flemish school was the total neglect of any expression of the words; some only wrote fugues without the words, leaving the singers to fit them to the notes; it has even happened that different words were sung by the different singers of a choral part. Seemingly as a tribute to truth, and to stifle the pangs of conscience, some fell upon the ridiculous idea of using coloured notes; pink was symbolic for love, joy, &c.; green for nature, hope, and spring; black for death, eternity, &c. As they had totally neglected melody, they borrowed that of the people's making—often of very questionable character as regards words—for the subjects of their sacred music.

From this time, Palestrina, contemporary of Orlando Lasso, redeemed the former fame of Italian musicians. Although starting from the same point as Lasso, he soon left the beaten track. The Council of Trent, finding fault with the music in the churches, offered a prize for simplified mass music. Palestrina gained the prize; but the real touchstone of true genius was provided for him by innumerable misfortunes that befel him one after the other, and so powerfully acted on his sensitive mind that he rose to the climax of greatness in church-music. He died about the same time as Lasso; just when a number of enthusiasts formed the ambitious plan of re-establishing the Greek drama. Some singer had already, before then, had instinctive foreshadowing of a quality which he seems to have left ever since as heirloom to the whole singing craft, viz., he wanted to be heard all alone, so he sang the top part of a madrigal (till then singing in four-parts only was known amongst the musicians), while he played the second part on a violin, and the other two lower parts were executed by wind instruments. Finding, however, the long-drawn notes of the madrigal for one voice only ineffective, he and his imitators embellished their vocal part by flourishes. This helped to develop that splendid school of vocalisation of the Italians, but was also the beginning of the great evil afterwards that everything was sacrificed to the singer's ambitious vanity. Caccini (1579) was the first who composed songs for one voice. He called himself the inventor of a new kind of music, and this no doubt facilitated at last the next step, viz., the first opera. The re-establishment of the Greek drama with musical recitatives was aimed at when the first opera was being tried in the circle of Count Bardi, at Florence, where the composer, Peri, and Rinuccini, the poet, produced "Daphne." Delighted with their success, they immediately after composed "Orfeo and Euridice." This

attempt was soon followed by other composers. The orchestra consisted of pianos (not our kind, of course), different kinds of violins, harps, small organs, fifes, horns and trumpets, but there was no combined playing, like that of our orchestras. A curious fact gave rise to the name of oratorio, viz., Emilio del Cavalieri (1600), finding no stage on which to perform his opera, "Dell' anima e dell' corpo," had the oratory of the Church della Valicella offered him, and hence the name of oratorio. If one notices the long dreary intervals, the centuries that had to pass before one comes to this important point in the history of music, it is the more to be regretted that after all the right basis was missed. Instead of adopting the plays of the people, and following at once the romantic school, as reflecting the history and mind of the people of the middle ages, the Greek drama was chosen. This had no real life for the people. It was a corpse galvanised; it moved, but not by natural action—not by impulse. The luxuriant nobles of Italy envied the people's songs and dances; they would have them too, but washed in rose-water, and garnished with gold lace, to purify them, to improve them. Out of the healthy songs of the people, they made the effeminate "aria," a mere vehicle, not for dramatic expression, but for the exhibition of the skill of the vocalist, for which purpose the musician had to become the slave of the singer, and the poet the footman of the musician; but, as even aria after aria palls on the senses, some choral singing was introduced; and notice, even at our present time, how those good people always come only to serve as a foil to the solo singer, just as the "corps de ballet" relieves the unnatural contortions of the art-dancer, who, again, is an imitation of the graceful, natural dance of the people, with whom joy is the cause for dancing. This pernicious influence has ever since prevented the opera from rising into its legitimate place. The Italian opera has, with very little alteration, remained what it was; then the improvement of the orchestra has led to a little more care in instrumentation, and even some attempts at characteristic expression; but as a whole, it is but an exotic—an importation of a costly foreign luxury, and no nation deserves greater reproach for that state of things than the English. With such a rich literature, such poets, and, indeed, so much poetical feeling amongst all classes—with a Shakespeare, the beacon light of all ages, and no national opera! Although the French began with the Italian model, they soon found for themselves, if not the highest kind of school—one which is peculiarly suited to the national taste. The French care more for the drawing, the design, than the colour—with the English, by the way, it is the reverse; the French have always an interesting story for their operas, and have eminent talent for dramatic music, but cannot get rid of the dance rhythms—indeed, their music is entirely based on it. Notice, for example, two of the best representatives, Boildieu and Auber. The Germans started from the same point—indeed, most of their composers studied in Italy, where even Mozart wrote all his operas, excepting two, and two small operettas, written in Germany; but although the defective style remains, and cannot be remedied without a total rupture with the past, they had the advantage of all that wonderful help the ever-improving orchestral treatment gave them, and this again rests upon the creation of an entirely new feature in music, that is, chamber-music—a creation so entirely representing the German mind, that hitherto (notwithstanding some very few laudable efforts at imitation), it seems that Germany will always supply the rest of the world with this (undoubtedly one of the highest) kinds of composition. It has been called absolute music, and been often explained as music which does not tell its own tale, lacking words, and any indication but that conveyed by the individual feeling of the hearer; this is a fallacy.

If music is the art which expresses feelings by sound (and who can gainsay that?), there is no music where there is no feeling to express; but as words only are not thoughts, so notes only are not music. That the great mass will always be led astray on this point, as long as they lack that knowledge which, after all, is so easy to give them, is but a natural consequence; there will be always, in all the arts, a greater number of mere imitators than real inventors, and that seems a natural law, as there will always be an immense public that will find the commonplace more to their taste than the refined and thoughtful; the great mass has not time for serious reflection, it skims but the more realistic part of art for its amusement. There is no harm in even catering for a childlike mind by childlike amusements, and light music for the few leisure hours of the people, always hard at work to battle with the exigencies of the, alas! much too realistic life; but as, undoubtedly, pure, high art is virtue, so debased art is a falsehood and vice. Art is not an addition only to our existence, it is a condition; from the wildest savage state up to the highest culture, in every history, there is a steady reasoned progress, not a mere chance. Then let us keep in mind that, be the obstacles ever so great, art must be progressive; it must elevate, not debase. It is not the property of the few rich, indeed it is the only riches the poor can enjoy, notwithstanding their poverty. Art is the paradise on earth; it ennobles, gives solace in suffering, and hope for a happier future; and what art can more directly influence the feelings than music? It touches the heart directly. Schiller says, "Where there is song there stay—bad people do not sing." If there are musicians that—as in all arts—merely repeat what has been done before, and do so because they cannot do better, what is one to say to those who know better—who could help to elevate the taste, and cunningly apply all their powers to deteriorate the standard of art. To those that take other people's thoughts, distort them in such a manner as to hide their origin, and foist them on the great mass as originals, it becomes the more culpable the more it is done by design, and I fearlessly point to Meyerbeer. Had he possessed less talent and less learning, his influence would have been much less pernicious, but, using all his powers to pamper and flatter false taste, he reminds me of Macaulay's words, "The greatest criminals are those that use great intelligence with low desires." That I speak here only of Meyerbeer's doings as a musician I hope is quite clear. I refrain from all matters else; and yet Meyerbeer was fellow-

student with Carl Maria von Weber, one of the most genial and loveable artists, conscientious and high-minded; both were pupils of the Abbé Vogler, a great theorist of his time, but how different were they. Weber was the first opera composer who represented the romantic school; he found for it a libretto which fostered admirably his peculiar bent of mind, in "Der Freischütz;" the music to this opera was the outpouring of all his natural spontaneous genius, but he rose very much higher in his "Euryanthe," in which there is a foreshadowing of the new school not to be too highly rated; this consists remarkably in the carefully carried out "characteristic" of each of the *personæ*, and, although he cannot get rid of the old form of aria, he uses all his passionate, enthusiastic power to make one, as it were, forget the trammels of it. Weber's undoubted defect was the want of command over the so-called classical contrivances. He is not master of the fugue nor counterpoint, and, when he attempts it, he is always lame; but he often covers that real defect by such transports of deeply-felt ardour that one forgets his shortcoming. To speak of Beethoven's "Fidelio" (his only opera) with any kind of slight, may find opposition from some that place the opera, as a species of composition, on a lower level than a symphony or a sonata, who believe in the necessity of having some tunes in it for the gallery, and some "bits" to be hummed on leaving the boxes; indeed, who would perhaps have a kind of Flotow composition, quite ready to be, without alteration, cut up for school fantasias on that modern instrument of torture (the rack) called the piano. But those who can judge of Beethoven's grand soul, his gigantic conceptions, that reflect a whole world in his symphonies, must and will agree that "Fidelio," although a great work, is not equal to his symphonies.

Having several times used the words classical and romantic, you must allow me to make a digression, and enter into an explanation about their meaning. Classical, generally supposed to have come from the first class of Roman citizens—the patricians—means, in its widest sense, the best and highest. What, however, do those qualities consist in? Choice of noble and elevating subjects, elimination, pruning of all that can be spared (and therefore is superfluous), until the most refined work of art remains, from which neither anything can be taken away, nor added to, without damaging the perfection of the whole. This process requires strong reasoning powers, the searching intellect, self-command, and steady perseverance of the male intellect. The romantic—the modern element—is the reverse. The romantic peoples, after the fall of the Western Empire, brought their peculiarities into Rome, their language, and their love for tales of chivalry. Romantic feeling may be defined as sensuous, sentimental, imaginative; it pleases itself in indissoluble mixtures of nature and art, poetry and prose, seriousness and fun, reminiscences and presentiments, moral and physical, worldly and heavenly, life and death, all mixed together, without the serious criticism of classical severity. It is emotional and spontaneous; I therefore call it the womanly element. Classical, by excess, becomes pedantic, ossified; romantic, in extreme, leads to sensual and sensational. The classical refines, guides; the romantic infuses sentiment, tenderness, and young life into the stern classical. Both are necessary to each other, and, as I consider it the problem of our time to fuse a good many things, on the principle "that extremes meet," and I mean this most seriously, I say, marry them. I would say the same to the conservative and radical in art. Is not the woman conservative, and man radical? If not, I am afraid you will not take me for a man, as I am going to attack most radically one of the pets of the "Musical Dictionary," the sonata! Its first name was, "*Suite de pieces*," and decidedly it was a much more suitable one. What is a sonata? the answer stands, the most classical form of composition. That answer is rank nonsense. The origin of the word in Italian is "*suonare*," to sound. What is the form? From two movements (Beethoven wrote one in two movements) to as many as you please. An allegro, a slow movement, a minuet (or, since Beethoven, a "scherzo"), and a quick movement as a finale; but you may vary that, and reverse it, as you like. Where is there then a form? In many of Beethoven's sonatas even are chance-meetings of movements that would do well to apply for a divorce in a Prussian court of law, where incompatibility of character is a sufficient reason for separation. But, allowing even that the different component parts of a sonata were all created at one inspired moment, there is still no more connection in this so-called classical form than in so many different poems or tales printed in one book. Every work of art should be an organic whole—an entirety—it must spring out of the working up of an idea, which connects the whole together, so that no component part can be taken away without damaging the form. But there is no reason but habit against anyone joining movements out of different sonatas that may be more of one tone of feeling, and may better represent an entirety than even the composer's choice. How often does not a composer finish a sonata by seeking amongst his sketches for a movement that just might do? Beethoven is known to have done the same thing, and there are, even in his sonatas, many incongruities. Those that cannot bring their too conservative minds to this radical idea, let them study Liszt's splendid sonatas, composed of the legitimate movements, but connected by some ideas which traverse and link them together into one organic whole. Leaving aside entirely the manifold genius of the composer—whose remarkable pupils, and their pupils again, are, nearly in all countries in Europe, most finished pianists and musicians, all of unusual attainments—I consider Liszt's sonata a great and grand step farther—if we regard its form only—and, as a composition, full of refined imaginative beauty. To push radicalism in art still a step further, I protest for the future most emphatically against all repetition of parts (excepting, of course, rhythmical composition, as dances and marches), whether in sonata or symphony (that is a sonata for the orchestra), or, indeed, all other forms based on the sonata, like trios, quartettes, &c.; these repetitions are a barbarism. Do you ever read any part of a poem twice? Is there ever a scene of a play repeated on any pretence whatever? Why in music? The only answer I ever got in defence of this barbarism, and that

from sensible and very clever musicians, on reasoning with them on the subject was, "That one understands it better the second time." Now as I know myself a number of very respectable people, from dukes downwards, that would require to hear any, even very simple parts, at least 115 times before it would be quite intelligible to them, I drop this plea with a smile of contempt. And is not a grand work, after all, always new again? Does one not find in every repeated hearing of a master-work something one did not understand before? That is when the work has been acknowledged. How long ago is it that gentle pity was shown to what was called Beethoven's madness? Was not his deafness given as an excuse for unexpected and then unintelligible combinations? Now it is easy to admire him; but have you ever read the criticism of the leading censors of taste of his time? "Genius is prophetic," Schiller says; "the artist may be the child of his own time, but must neither be its bantling nor favourite; he must give what is wanted, without regard to praise." Though genius starts from his own time, the flight soon takes him out of sight; he soars to unknown regions; he forces his way through the dark unexplored forest, over turbulent seas into unknown lands; his dream becomes reality. Genius anatomises man's innermost heart, dissects the finest fibres of human joy and woe with the scalpel of almost divine perspicacity. Talent, which borrows its light from genius, has the honourable service allotted to it of running to and fro between genius and the great mass, to bring tidings, and to tread down the path to make it passable—often even after ages—only for the uninitiated.

One of the most remarkable of geniuses is Richard Wagner. The versatility of his gigantic powers is without parallel in history. It would take volumes were I to tell you all about this most extraordinarily gifted man. His profound knowledge is only equalled by his magic power of imagination. It has been my fortunate lot to have met in life most of our remarkable men, and to have been on terms of intimacy with them. Painters, poets, musicians, and philosophers of note have deigned to bestow their friendship on me. It has been the blessing of my life, my solace in trouble, and, not from motives of vanity do I name it here, but simply that, having studied those celebrated men with all my critical power, and then Richard Wagner in comparison with all of them, I can but say that he exceeds everything and everybody. I foresee that some one may tell you that our mutual friendship of many years' standing makes me a partial judge, but I pledge my word (I cannot say fortune, as musicians rarely have any) that I take a pride every time I go to spend my holidays with him, on principle, to scrutinise and watch him, to weigh every word he says, and always leave him amazed at such wonderful combination of excellence. Musician, poet, philosopher—he is great in all. His æsthetical writings form the most profound digest of all that can concern and influence art, from the earliest times of creation to our own. But whenever was a great man without enemies? Indeed, the virulent attacks of impotent critics have at all times been of great use; they hammer so incessantly on the one nail that they make even the careless passer-by look up to see what the matter may be; they have nowhere whetted public curiosity more than here. The study of and love for music have both made within the last forty years such extraordinary steps in advance—there is such a truth-loving earnestness in all an Englishman sets his mind to, and, above all, such a truly poetical feeling in the innermost heart of every Anglo-Saxon, be it even carefully covered over by the prosaic cares of everyday life's struggles, that my experience has led me to publish quite lately my conviction, in Schuman's celebrated *Leipzig Musical Gazette*, prognosticating the most complete triumph of Wagner's works in England, when they become known. I may remark here that the silly joke of "music of the future" was never Wagner's word, but the combination of the different arts was meant by "the work of art of the future." Wagner never decries melody, as is always falsely asserted, but he insists on dramatic truthfulness and rejects dance-rythms; he does not write down to the public, but places an ideal standard before them to draw them up to. Art is his life; his soul. One cannot describe music by words; but know, then, that Wagner's music is that which continues worthily the high standard of Beethoven's "Ninth Symphony," his finest and noblest posthumous quartettes. Wagner unites to the most tender and refined imagination all the grades upwards to the most intense passion, and is especially romantic; but he has the most profound knowledge of all contrivances, and a classical perfection of using them, so that he may be justly regarded as the founder of a new era in music. His earnestness of purpose is that of a great genius. He has a mission to fulfil; it is he who has solved the great problem of modern times; he has, by the fire of his sublime genius, fused classical reason and romantic feeling into one bright orb—a burning sun that will throw its beaming light over ages to come.

DISCUSSION.

Mr. Botly thought the public would hardly go with Mr. Praeger in the last portion of his paper, inasmuch as even the society which professed especially to bring Wagner's music before the public had found it necessary to mix other music with it in the concerts they had given at St. James's Hall. No doubt, eventually, Wagner would be better appreciated, but as yet he certainly did not hold a very high place in general estimation.

Mr. Christian Mast begged leave to differ from Mr. Praeger in his regret that England had not produced a national opera. He did not think it at all necessary that literature and music should go together, and, indeed, the classical period of music in Germany was contemporaneous with a very wretched state of literature. Glück, Haydn, Mozart, Handel, preceded Goëthe, Schiller, and Klopstock. But, in his opinion, it was altogether a mistake to require music to be national; no doubt it was well for national music to be produced, but, on the other hand, the language of music was universal, and consequently independent of nationality. It was also a well known fact that Mozart's greatest operas were connected with the most miserable text, showing that the musical genius would rise above his text. No one could deny that Richard Wagner was a great man, but at the same time he protested against the extreme praise sometimes lavished upon him, because he thought he should be judged by future ages, who would be more competent to do so. Let him continue

his good work, and do his work, and the future would reward him according to his desert. He regretted that Herr Praeger had not laid more stress on the classical period, for if there was anything of which a German might be proud, it was of the German classical music. The way in which England had acknowledged the great powers of German composers was very flattering, but he hoped they would not be carried away too far by a love of the romantic style, which, both in music and literature, was rather apt to lead away from the true path.

Mr. Edwin Lawrence thought that one reason why there was no national opera in England was on account of the extraordinary difficulty of singing the English words. The English language was not so well adapted for singing as many others, because it did not permit of the sounding of the E mute as in French, and therefore to sing in English to a large assembly, so as to make every word clearly understood, was an art only acquired by long study of Italian singing. This difficulty was considerably enhanced by the fashion which now appeared to rule more and more in the upper classes of narrowing the broad vowels. Indeed, he had been assured by teachers in singing that they found much more difficulty in teaching their pupils of the higher ranks to sing clearly than those in the lower class. Probably this was one great reason why composers did not venture to write operas in English. With regard to Richard Wagner he would only say that time must be allowed before any one could venture to pronounce a judgment for or against his music. That he possessed great genius no one could doubt. Whether his music would be the musie of the future, or whether it would lead others to produce something still better founded upon it—whether it would ever touch the popular feeling, was still an open question. It might prove so, but as yet the public generally were not prepared to accept it. As a general rule, old and familiar music charmed the feelings and touched the heart most; and an old man turned naturally to the music which he had heard from his mother as a child. Now to some people, as for instance Mr. Praeger, Wagner's music might be old, and therefore they might appreciate it, but most Englishmen at the present time were not prepared to give a dispassionate judgment upon it. In conclusion, he begged to refer to a report issued by the French Musical Academy, in which they said they had selected their pupils on account of musical ability and voice, but there was one quality worth more than either, namely *verve*, which could only be translated in English by the word "go." This would enable a person with but an indifferent voice—and some of our most successful singers had hardly any voice to speak of—to touch the feelings much better than those who possessed finer voices and more musical genius, but were deficient in this supreme quality.

Mr. Hyde Clarke began by alluding to the National Training School for Music started by Mr. Cole, which the Society was now so strongly interested in, and reminded those present of the expression used by the Duke of Edinburgh on the foundation of that school, that if the Society dealt with arts, manufactures, and commerce, music might truly be called first of the arts. He was rather struck, however, with the fact that on that inaugural occasion only a very small portion of the performance consisted of English music, the main portion being taken from one particular class. It had been well said that musie was a universal language, and England was not particularly called upon to assert her supremacy in music when she was able to give so good an account of herself in dramatic literature; besides it should be remembered that at the period when that was at its highest, England had a school of music which was esteemed throughout the Continent. The decline of music in England had arisen partly from local and accidental circumstances, but, no doubt, one great cause had been its universality of character. When the English school of music was in a low state, it had to contend in London with the first singers from the whole of Europe; and this was not peculiar to England, for the same thing happened in Holland and other countries, and where a nation had to contend with the world at large, it was very difficult for it to preserve its nationality. Even looking at the competition between German and Italian music, it was very unequally divided as to the different parts in which one or the other was supreme. He did not know that the French were very much better off in this respect. He rather dissented from Mr. Lawrence's view as to the English language standing in the way of perfection in music, because it was not borne out by history, and as to the fashion of pronunciation, it was not nearly so marked now as at the end of the last century and the beginning of the present, when the mincing style, as it might be called, was supported by the example of Sheridan. There was always a fluctuation going on in the mode of pronouncing these vowels, and a change to a broad fashion might very soon set in again. It must be remembered also that under Purcell England had a national opera in which songs were introduced which were remembered to the present day. And going back to the period when the drama was in a flourishing state, when there were two theatres with complete companies for tragedy, comedy, and English opera, the fact was that when Weber was commissioned to produce an opera for one house, and Sir Henry Bishop one for the other, the words did not then stand in the way. At that time there were many English singers who were as well encouraged as those on the Italian stage. Therefore, looking at it historically, he should be inclined to attribute the decline of English opera to the decline of the drama. Both in France and in England it would be found that there were periods in which a great many men of genius, as dramatists, actors, composers, and singers, made their appearance, after which there might be long periods of thirty or forty years when there was quite a dearth of such talent. Such had been the case with regard to the English stage since the death of the great actors; and it was also the case with the French, and he might almost say the Continental stages, with the almost solitary exception of Rachel and the great Italian tragedienne. He therefore attributed any decline of music which there might be to these causes rather than to any change in the pronunciation or inherent incapacity in the English language for musical purposes. On the other hand, looking to the English love for music, and to the encouragement which might be expected for a national school of music, it would be found that in Lancashire, Yorkshire, and other parts of the country, the efforts made were worthy even of Germany, showing that, wherever circumstances were favourable, there was a strong and sincere desire on the part of the populace to avail themselves of so noble an art. There were other accidental circumstances which had not been without their effect; for instance, the destruction of the monasteries, although, on the whole, a benefit to the country, had led to the abolition of from 50 to 100 schools of music; and although many other schools had been restored, unfortunately those of music and painting were but very ill represented during one or two centuries. In fact, it was only in the present day that England was endeavouring to regain its former position, in behalf of which great object he looked with very great hopefulness to the efforts now being made by the Society to establish a national school of music.

Mr. Praeger, in reply, said it seemed to have been forgotten that he had referred to the wonderful progress in music made during the last 40 years in England; indeed, in the whole history of the world perhaps no country had done so much. He spoke most sincerely when he said that the English had as much poetical feeling as the Germans, if not more, only that they were so much absorbed in money making as not to be able always to give it fair scope. In Germany there was

more leisure, and poetry was more an everyday affair. It would be absurd to say that England was incapable of understanding music; or, with such men as Macfarren and Benedict, and many others, that she need be ashamed of her progress in this noble art. But in order to get perfection, the classical and romantic styles must be wedded together; the classical formed the basis, but without a dash of the romantic it was liable to become pedantic. Even with a man like Mozart, the greatest genius that ever existed, if he had any defects, they were owing to his wonderful perfection in classical means and appliances. Occasionally he became commonplace, pouring in everyday ideas into his wonderfully perfect forms. On the other hand, Beethoven was entirely romantic; he had even been called revolutionary, because he overthrew old trammels. Music was then in its childhood, as indeed it still was, for it had almost everything to learn. Some seemed to think that after Bach and Handel there was an end of the world; but then came Haydn, a wonderful genius, nearly equal to Mozart himself. Some of his sonatas were almost entirely formed on a simple dance rhythm, but occasionally he broke through and rose almost to the height of Beethoven, even surpassing Mozart. As to the public not having yet judged Wagner's music, he was much too polite to use the words of Wilkes, and say that the public was a great goose, from which every wise man plucked a feather, but still he thought that saying displayed some knowledge of the world. The public must be educated before they could judge. The great mass of the public had a most intense love for music, indeed this was shown as much amongst the lower classes as in the rich, and they spent thousands of pounds on finishing lessons. It was quite a mistake to suppose that the French were a romantic nation; they were entirely classical, forming all their poetry on classical models. Even Voltaire, who cared for and believed in nothing else, believed in classical forms. This it was which occasioned any defects there might be in French literature, because it overpowered individuality. We did not want new ideas in old forms, nor yet old ideas in new forms, but a new idea in a new form constituted a real work of art. To which school did the English belong? He had asked many people who ought to know, and they said that the English were a classical nation, but it was no such thing; they were a thoroughly romantic nation, and that was the cause of their greatness in literature. Shakspeare and the early dramatists threw their wonderful ideas into new forms. The Spanish again were a romantic nation, as was shown in Cervantes, Lopes de Vega, and Calderon, who all chose their own forms. The Germans had accomplished in literature the same wonderful fusion which Wagner had achieved in music between the romantic and classical. This was exemplified in the works of Schiller and Goëthe, and could not be gainsaid. As to the shortcomings of Wagner's concerts, his friend, Mr. Dannreuter, the conductor, told him that he had a hatful of letters from subscribers, protesting against any music but Wagner's being performed. At the same time, there were various causes which prevented his music making so much way as it might, some of which were too personal to state in public. As to English being ill adapted for singing, he defied a singer in any language to articulate more clearly than Mr. Sims Reeves or Madame Dolby; and he believed the English language was as good as any other. It had been made by the people for their own use, and could not fail of being suitable for them. Certainly music had received severe checks in England, the principal being at the hands of the Puritans, who, as was well-known, destroyed all the church organs but two in the country. Of course Wagner could not be judged so fairly now as he would be hereafter. As he had already said, he remembered the time when Beethoven was considered a madman. Mr. Anderson, of the Philharmonic Society, told him that the symphony in A, for which they paid Beethoven £100, when first played was put away, and they said, "Poor man, he is mad; this is not music at all." When the score was covered with dust an inch thick, hearing that it was thought very highly of in Germany, they took it out again, and playing it in proper *tempo*—about six times as fast as they had tried it at first—they were delighted. It was no use for any one to go to hear music determined to find fault with it; he must not only pay for his seat, but must determine to accept the music and bring some sympathy in his heart towards it, or it would inevitably fall flat and tame upon his ears. All good and great men were before their time; in fact, if they wrote just what suited the public taste of the moment they would not be great.

The Chairman, in proposing a vote of thanks to Mr. Praeger, said every one listened with pleasure to the genuine opinions of any man who was master of his subject, and who spoke the convictions of his heart. He could not pretend to criticise Wagner's music, and if he attempted such a thing he would probably soon be found to be an impostor. At the same time, he was so fond of music himself, that he would rather listen to a barrel organ than to none at all. It was only justice to add that many of his intimate friends, who were great musicians, held the same opinions with regard to Richard Wagner that Mr. Praeger had expressed, and not only thought him the greatest of all living musicians, but one of the greatest of all times. There was no doubt whatever that people must be educated up to his music in order to enjoy it. A short time ago he was in Italy, and sitting one night in the stalls of the beautiful Opera House at Bologna, he had for his next neighbour a very intelligent Italian gentleman, who, on his complimenting him on the beauty of the orchestra, replied that it was considered the best, or one of the best, in Italy, adding, "We can even give Wagner's music here; we have given several of his operas." He then inquired if he liked Wagner, and his reply was, "He revolutionises music. We Italians have been accustomed to consider the orchestra as the accompaniment of the voice, but Wagner makes the voice an accompaniment to the orchestra; the orchestra is all in all, and the voice nothing; one has to be educated up to it, in fact." There could be no doubt of the love of Englishmen for music, as was evidenced a short time ago very plainly at Manchester, on the occasion of Charles Hallé giving the oratorio of "Judas Maccabæus." There was a very large audience, the hall holding something like 4,000 or 5,000 people, the body of the hall being filled with 1,500 or 1,600 people of the working class, who stood the whole time closely packed together, listening with intense earnestness to the music, whilst if any one sitting before them in the stalls happened to speak, he was hushed down immediately. In fact, anything like the genuine enthusiasm of the audience he never saw. He could not quite agree with Mr. Praeger that the English were so much more devoted to money getting than the Germans that it overcame their love for music, for at the present time there was a great deal of correspondence in the newspapers complaining that the Germans were taking the place of English merchants and leaving them in the rear all over the world. In conclusion, he was sure there was a vast amount of musical talent in all parts of the country which only required fostering to become something great, and one of the objects of the school now established was to extend the benefit of first-rate musical education to every one who was so endowed by nature as to be capable of taking advantage of it.

The vote of thanks was then carried unanimously.

Surveys have been completed from Westwood, North Queensland, for a mile past the summit of the Gogango Range, a distance of 48 miles from Rockhampton. On section 1, $8\frac{1}{2}$ miles from Westwood, all the earthworks are now completed. The piles for 27 out of 30 bridges have been fixed.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

Her Majesty's Commissioners have been informed by some of the exhibitors in last year's Exhibition that they derived considerable advantage from the means then afforded them of bringing their productions to the notice of the public. The Commissioners, therefore, invite other exhibitors who have been so benefited to inform them of the fact, and of such particulars of advantages derived as they may feel disposed to communicate.

The first meeting of the Committee for Ethnology was held at Gore Lodge, on 16th January, Dr. F. Mouat in the chair. There were also present—Mr. J. F. Collingwood, Colonel Harley, C.B., Colonel Lane Fox, Dr. G. W. Leitner, and Mr. G. S. Saunders, Secretary. Mr. H. Cole, C.B., and Capt. Clayton, R.E., attended the Committee. After considerable discussion as to the scope of the proposed collection, it was resolved that, although the special attention of the Committee for the current year should be directed to the tribes of Africa, offers of specimens of art manufactures, &c., of other countries should be accepted.

The Committee for Leather, Saddlery, and Harness held its fourth meeting on 15th January, at Gore Lodge. There were present—Captain J. Fenn, Messrs. H. H. Fleming (of the firm of Messrs. Whippey and Co.), Wm. Essex, J. D. McDougall, Christopher Cuff, M. T. Husband, R. Russell, W. Rickatson, G. N. Hooper, W. Southey, and H. M. Holmes. The applications received up to date were read to the Committee, and recommendations were made to apply for the loan of ancient saddlery.

SCHOOL OF COOKERY.

The following letter, from the Rev. W. Lea, giving an account of an experimental lecture on cookery, delivered at Droitwich, has been received by the Secretary to the Commissioners of the International Exhibition:—

St. Peter's Vicarage, Droitwich,
December 26, 1873.

Sir,—When I had a correspondence with you a short time since, on the subject of sending a lecturer on "Cookery and Domestic Economy" to country towns, I promised to send you some account of an experiment I was about to make, in case it should prove successful.

I invited the attendance of all interested by bills, and especially the mothers of children attending the schools; no payment was required, but all were requested to bring with them a plate and spoon, to taste the dishes which should be handed round.

About 160 women and girls attended, but only one or two men, as it was supposed that it was intended for women only. Many of them were of the very lowest class of the population, in fact the very people we wished to attend.

Before the experiments began, I spoke to them on the advantages of thrift and providence, and explained to them the operation of the Post-office Savings' Bank and government annuities, and showed them how some people could become in a fow years owners of cottages and land, while others receiving the same wages came upon the parish if they happened to be out of work for a week. I also spoke to them of improvident marriages, and suggested that a spinster should be worthy of the name, and provide a good stock of household linen and cooking utensils before she married, and require of the man to do his share in bringing the furniture of the house and a good sum in the savings bank. After topics of this nature had been touched upon, the experiments began. I had obtained the services of a professed man cook from a gentleman in the neigbourhood, and he had prepared several economical dishes, or dishes for the sick, which were warmed up in the schoolroom and handed round. After each dish I made a few observations upon it, and explained its ingredients and its cost.

The dishes prepared were as follows:—And first, how to make the most of 2 lbs. of parish mutton or parish beef, which is the usual allowance given under medical order to the sick.

The mutton was thus prepared—The 2 lbs. were stewed up for mutton broth, 1 lb. being cut up small and served with the broth; the other lb. was made into cutlets, which, after being used for the broth were served up as a separate dish, with a little parsley and butter, and were pronounced most excellent by an old invalid to whom they were sent.

The beef was then prepared—$1\frac{1}{2}$ pints of beef tea were made from it. The beef was then cut up and made into a potato pie, with onions, &c., which was also considered a great success.

At the same time $1\frac{1}{2}$ pints of beef-tea, made from two ounces of Liebig, and flavoured with vegetables, was also handed round. This was excellent, but it was thought that more water would have been an improvement (say, at least one quart to two ounces of Liebig, as it was too strong).

The next dish was soup made from coarse beef and vegetables, at the cost of 2d. a quart. This was also much approved.

Then came a dish of Irish stew, which was made of Australian mutton. The party were not informed of this fact until they had pronounced it "beautiful," &c., &c., as they have a strong prejudice against Australian meats.

This was succeeded by the potato-pie, in which the beef from which the beef-tea had been extracted was served.

Then came the greatest success of the evening, a potato-pie without meat. The potatoes were sliced, seasoned, and an onion or two added, and then placed in a pie-dish, covered with a paste made of ten ounces of flour and four ounces of lard, and baked. This was so savoury and good that the audience would not believe that it did not contain meat.

The next dish was a sheep's head and "race," which very speedily disappeared. This was succeeded by maccaroni and cheese, but this last evidently was not appreciated as the other dishes had been.

Instruction was then given on the best mode of boiling a potato, and two potatoes, originally the same size, were sent round, the one boiled in its skin and then peeled, the other pared before boiling in the usual way, to show the greater economy of the former plan.

Then came some sick-room dishes. The cook cut up a neck and loin of mutton in their presence, and showed them how to cut a chop or cutlet so as to take the fancy of the sick, and then explained the best ways of using up the rest of the neck, either in broths or by putting it in an Irish stew, or by "braising." Some eggs were then poached, and sent round on toast.

An omelette was next made, but this was rather above the audience. Then three varieties of light puddings for the sick, which had been prepared beforehand, were tasted, and similar ones mixed before the audience, and made ready for the oven.

The last experiment was appreciated least of all. It was, "How to make gruel for the sick," the very mention of "gruel" serving some of the women as a signal to rise. Some, however, seemed to appreciate it, and they finished the whole of it before they left the room.

I would ask your committee if something of this kind might not be carried out in a regular course of lessons, in large towns, under their auspices. The lectures might be made self-paying by a small entrance fee, and they would afford the opportunity of inculcating useful lessons of thrift and household management, in which our people in the Midland Counties seem more deficient than any other people in Europe. Perhaps you will bring the matter before their notice.—Believe me, yours truly,

William Lea.

The Secretary,
The Commissioners of the International Exhibition.

EXHIBITIONS.

Exhibition of Fine Arts at Naples.—The Provincial Council of Naples has lately voted a subvention of 50,000 francs for an Art Exhibition, to be held in that city. The Council has also decided to purchase 60 copies of the medal struck in memory of the late Italian statesman, Urbano Ratazzi.

ON THE NATIONAL IMPORTANCE OF LOCAL MUSEUMS OF SCIENCE AND ART.

An Address delivered in the Town Hall of Birmingham, on the 21st Jan., 1874, by Henry Cole, C.B., President of the School of Art for the year.

It is my duty this evening to address you as President of the Birmingham School of Art for the present year. My release from official functions has permitted me to undertake this duty. I perform it with pleasure, and thank the committee for giving me the opportunity of submitting to you some views on the national importance of local Museums of Science and Art. The free thought which distinguishes Birmingham will, I hope, give them searching criticism. I am sure it will be liberal and candid.

Scarcely a generation has passed away since there were no Schools of Art in the country. It is only 40 years ago since Lord John Russell first persuaded Parliament to recognise the importance of national education, and to devote a small part of the national taxation-money, £20,000, to it. This, one of the greatest subjects of the day, is now stirring the mind of the country perhaps above any other, and will continue to do so; whilst in 1834, for the first time in the history of this great nation—shall I say authentic history of 1,000 years—it occupied the attention of Parliament. How great are modern changes, and how transitional the times. It is only 80 years ago that the popular feeling of the Birmingham of that time burnt down Priestley's house and library because he avowed liberal tendencies; now Priestley's views have greatly conduced to the last election of your School Board.

In 1843 Birmingham was one of only four towns which had established Schools of Art. Birmingham now has not only its School of Art, but 21 night-classes for drawing, and 34 schools for science and art, besides having drawing taught to children in 32 schools for the poor—an organisation not imposed by any central authority, but established by the free will of the town co-operating with the State. I am going to try and persuade you that if you wish your Schools of Science and Art to be effective, your health, the air, and your food to be wholesome, your life to be long, your manufactures to improve, your trade to increase, and your people to be civilised, you must have Museums of Science and Art, to illustrate the principles of life, health, nature, science, art, and beauty. The Museums must be organised and administered on a scale worthy of the place. Happily, thus far, Science and Art have been kept out of wrangling over ologies or isms of any kind.

A thorough education, and a knowledge of science and art, are vital to the nation, and to the maintenance of the place it holds at present in the civilised world. At this moment it is Science, as contrasted with ignorance, which governs the military operations in the Ashantee war. This island is the workshop for supplying the wants of the world in manufactures, and Birmingham is the great centre of the greatest variety of manufactures. Science and art are the life-blood of successful production. All civilised nations are running a race with us, and our national decline will date from the period when we go to sleep over the work of education, science, and art. What has been done is at the mere threshold of the work yet to be done. Constituencies have still to convince their representatives of the real national importance of Science and Art, next only in importance to that of peace itself.

I wish now to speak to you freely upon what I believe is the key-stone of the development and progress of Science and Art in our country as affecting national welfare. Don't understand me to say that great inventors, or poets, or artists, or mechanics, or the like, are to be made by any social mechanisms or arrangements. The greatest men get their genius from a higher and more mysterious source than can be traced to man's agency. The age and its institutions only influence the direction which genius takes. Chaucer would have been a poet in any age, without or with any system of national education. Hogarth was not the outcome of an academy; and Watt and Whitworth were nor the product of any organised School of Science. Schools of science and art will not create geniuses. They will only assist them, and they instruct a public to understand and benefit by science and art.

Tho keystone to regulate the successful establishment of Schools of Science and Art, I believe, is Co-operation. This co-operation implies a united action between the individual, the municipality, and the State—that State which some leading minds in Birmingham regard as a traditional bugbear.

In days when monarchs were despotic, corrupt, and foolish, when municipalities arose in self-defence against brutal tyranny and violence, when Birmingham had no voice at all in the representation of its people, whilst the ruined, uninhabited walls of Old Sarum had two voices—the Stato might well be regarded as a bugbear. But things have changed even within the memory of many present. The State now is no bugbear. We may deplore its weaknesses, its timidity, and its imperfections, but nobody fears its power. In truth, it is very plastic clay, to be moulded by the intelligence of the people, and made obedient to their will.

But as popular government extends, so do the demands for the assistance of centralised action increase. Popular government promotes education. Education creates new desires and demands which only centralisation can meet.

And Mr. Stansfeld, at Marsden, well said that "One of the great problems of the future in our coming democracy (he might have said present democracy) appeared to be the combination of official and voluntary action in meeting the social wants of the State."

Yet, whilst centralisation is essential to the welfare and social organisation of a nation—over-centralisation saps its life and leads to its decline. Whatever an individual can do will always be better done by one than by numbers, call them State, or board, or corporation, or vestry. As Sir Robert Peel used to say, "the action of government is torpid at best;" and the prudent Marquis of Lansdowne, of the Reform Bill period, declared in 1847 that, "It is universally admitted that government are the worst of cultivators, tho worst of manufacturers, and the worst of traders." Centralisation, too, is apt to be petty and meddling. You well know what buttons are in Birmingham. Army reform has a

tendency to over-centralisation, imitating the pernicious example of French organisation, which failed ignominiously three years ago. Our present army reformers have centralised into a dull uniformity the buttons of the army. Regiments once had a pride in the insignia on their buttons. These buttons reminded the regiment of its ancient valour, and in a way inspired the regiment with the strength of individual action. But centralisation, misapplied, has taken them away. If a button would help to make men heroes, what ignorance of human nature it implies to take it away! I trust the ancient buttons will be restored. The existence of the Order of the Garter cannot be defended on reasons more logical than the private soldier's distinctive button. Again, in the manufacture of guns, centralisation has assumed that it has the monopoly of all the science which is necessary to them, but I could prove that through this fallacy the country has lost five millions.

Allow me to speak of the functions of the State in assisting Science and Art, which you men of Birmingham may call centralisation. Like it or not, I must give you instances where you cannot dispute the necessity of it. They shall refer not to such points as national security, or administration of justice, but to questions of Science and Art only.

Birmingham is now in great straits with its sewage. The ratepayers are beginning to pay for it, and I whisper to them that they will have to pay much more, unless they prefer to increase poor-rates and jail-rates, to pay more for doctors' bills, and die. The town must be clean. It must have pure air and pure water. It must have drainage, or the plague of past ages. You can't be clean and not pay for it. It is said that the sure sign of the civilisation of a country is the large amount of soap consumed. The Englishman stands the highest in the world in the quantity of soap he uses, and good soap results from the application of chemical science. Now, Birmingham is beginning to be clean and deal with its refuse. It would like to do so cheaply. It has got into Chancery, and I think it is very likely to stay there. It has no objection to be clean, and send its filth down to Sir Charles Adderley in the Tame, but Sir Charles does not see the good of that to him. Every town wishes to pass its filth on to its neighbours. But the welfare of the commonwealth forbids this. The ancient Egyptians, a most civilised people, five thousand years ago—very knowing, indeed, in much science and art—as knowing, I believe, on the whole, as we are at present—made one of their thirty-six laws to forbid the pollution of rivers. The present common law cannot be carried out. I read a few days ago that Richmond on the Thames has incurred penalties of £83,000 for its sins of nastiness. Heaven only knows what Birmingham will have to pay when the sequestration of its rates takes effect. Matters have come to that pass that Parliament will soon make a clear law, and say universally, "Thou shalt not pollute rivers." The river Avon runs through Warwickshire; it is a boundary of Northampton and Leicestershire; then it passes Rugby, and Warwick, and Stratford; leaving Warwickshire it goes to Evesham, in Worcestershire, and Tewkesbury, in Gloucestershire, and so on. Every town, if permitted, would make this beautiful Avon a foul conduit for its filth. But to prevent this, every town must be controlled by some kind of centralised authority. Shall there be an authority for every river in the country to keep it unpolluted, or shall there be one central authority for all rivers? One or other there must be soon. I do not say which, but I do say Birmingham cannot have its independence, and be free to be filthy, and persecute other places. Your municipality will not suffer the individual to be filthy in the street, and some central authority must take away the license of the municipality to be a nuisance to Sir Charles Adderley.

I might pursue these remarks into many other topics, such as health, food, &c., the effective treatment of which is regulated by science; but I must say one word upon railways, well understood by Birmingham. Railways could not exist without scientific principles. I believe England has the best railway system in the world. It is my belief that railways could not be worked well by the State; but, on behalf of the public, I think that, without destroying individual action and the responsibility of their present management, railways could be much better inspected in the interests of the public. What a scandal it is to the British character and morality that railways are not compelled, as far as possible, to keep their engagements, and be punctual. What a multitude of accidents of all kinds result from unpunctuality! What losses in life, time, temper, and comfort! The last time I addressed an audience on science and art, a thousand people were kept waiting because my train was more than half an hour late. If it be not digressing too much, let me show how the individual, the railway companies, and the State might co-operate to ensure punctuality. Prevent the public from coming late to the train by peremptorily closing the door a few minutes before the train is due. Give the public a simple cheap legal process of proving damage if the train does not keep the engagement. Let the railway company be compelled to post up at every station the statistics of its unpunctuality. Let the company reward the station master, attendants, drivers, and guards by a per-centage for punctuality, and fine them for unpunctuality. Let the State inspect and see that these regulations are carried out, and report the facts to Parliament and to the public through the *London Gazette* when Parliament is not sitting. The public will not be afraid of the inspector *Vastator*, an insect which the Solicitor-General has lately discovered, if it can only get to its journey's end with punctuality.

And now I will turn to Local Museums of Science and Art, and ask you to consider how the individual, the Municipality, and the State should co-operate in the establishment and conduct of them. I am not preaching a new theory, but applying to Museums those principles which have enabled the people spontaneously to have created 130 Schools of Art, and 1,000 classes and schools of science and art. If the people desire it, they might have a Museum of Science and Art in every town or district with ten thousand inhabitants. The people ought to desire it. They will shortly desire it—and they will shortly have it—to the great good of themselves individually and to the progress of their country. It is a want of the age, and I venture to prophecy all political parties will agree to meet it.

Schools of science and art instruct chiefly the young, but Museums can instruct both young and old. They illustrate the studies of youth if properly administered, and give lessons to manhood and old age which it will consent to receive in no other way. They are temples where all can worship in harmony; they teach good habits of order, and cleanliness, and politeness, and make every one feel that he has a possession in the commonwealth. Museums are antidotes to brutality and vice.

As the works of nature abound in every district, so every local Museum should have a division representing the natural history of the district—every object so clearly labelled that a child of five years of age might understand it. Such a Museum, too, should have its division of typical objects, illustrating chemistry and physics. If the museum be one of a manufacturing town, it ought to have a division affording useful illustrations of past and present works of industry special to it. All these divisions are comparatively easy to form.

The division of Fine Arts is not so easy. A top-lighted special gallery must be provided by the locality. It is indispensable for seeing pictures properly. Every district has pictures which can be borrowed, and the Museum will obtain bequests; but it is not easy to obtain a supply of very fine pictures, or very fine objects of art, without co-operating with the State, even in a wealthy, populous town like Birmingham. There is not in the

world an inexhaustible supply of Raphaels, or Titians, or Van Dycks, or Reynolds, or Mulreadys, to be had even for money. You can't get them as a permanent possession. But, if Birmingham will co-operate with the State, and not stand aloof as though it was still in the time of the Heptarchy and part of Mercia, it can borrow them from one central museum at least, and in due time will be able to borrow them from other collections in the metropolis. And it is more useful for study that you should have a succession of fine pictures, rather than one permanent collection of a few, never changing. With pictures, as with other things, variety is charming and attractive. Again, you cannot get an Elgin marble, or a *Venus di Milo*, but you can have what is quite as good for study, namely, casts of them. You cannot have the Queen's plate itself from Windsor, or the regalia from the Tower, or the Ghiberti gates from Florence, or the bronze doors from Hildesheim, but electrotypes give you them, and they hardly differ from the priceless and unobtainable originals.

It would be unprofitable to Birmingham and every large town to send its emissary over the world to try and get copies of such objects. And he would often be baffled in his attempts. But if you co-operate with the State you get them, and to induce you to have them, you get them at half the prime cost.

For its Museum of Science and Art the municipality must be responsible for all kinds of local management, suitable premises, cleanliness, order, &c.; and when these have been secured, the individual must do his part by paying the fee for entrance.

Museums I think should have the co-operation of the individual in their maintenance. The cost of the museum must be defrayed somehow. Whatever may be said for free compulsory primary education, I think payment in all matters of secondary and technical education, which cannot and ought not to be made compulsory, should be paid for, in part at least, by the individual that uses the Museum or School. The fee may be only a penny, but I advocate a penny fee for everybody's admission. This principle of contribution has been successfully tried for 18 months at the Nottingham Museum of Science and Art. The working expenses have been wholly met by it, and there is a balance at the bankers. The Museums Act enforces free admission; I think it ought to allow municipalities to make a charge. Such has been the success of the Nottingham Museum, that Nottingham Castle, which was burnt down in the Reform riots of 1830, is to be restored and made into a Midland Counties Museum—showing itself high above the plains as a beacon of progress and civilisation.

I will now attempt to place before you what I conceive to be the functions and organisation of parent or central Museums. As they must be supported by taxation drawn from the whole country, I contend that they must be at the service of the whole country, which should derive all the benefit from them that is practicable. I repudiate altogether the notion that they are metropolitan institutions. They are no more metropolitan than the Court of Chancery is a metropolitan institution. As central stores they must be placed somewhere, and they are placed in the metropolis because, whilst serving the purposes of the whole country, they may also be consulted there by the greatest number of persons. Excepting very bulky objects, and works of art of the rarest and most exceptional character, I know of none which may not from time to time be circulated, under proper regulations, to populous places like Birmingham, Manchester, Liverpool, Leeds, Sheffield, Nottingham, Bristol, &c. Indeed, every place in the United Kingdom which makes proper accommodation should have its claims for loans of objects duly attended to. Since 1857 the South Kensington Museum has circulated, not only examples, books, &c., to any School of Art that has applied for them, but it has contributed to more than 130 local exhibitions, which have been visited by just 4,000,000 of persons, who have contributed above £86,000.

Much more could have been done if other national collections had been made available for circulation, such as those of the British Museum and National Gallery. I say, advisedly, both these institutions are suffocated with a plethora of possessions which they cannot properly exhibit, and they will not allow the country to share in—and why? Because they are managed by irresponsible Boards, which Jeremy Bentham called "screens." Behind these Boards Parliament is unable to fix personal responsibility; and they defy all public wishes.

Having regard to popular demands, to the growing wealth and intelligence of the people, and to the exceeding profitableness of judicious investments in objects, especially of fine art, I will say, with all the force I can, that the public expenditure has been niggardly, imprudent, and impolitic. We have wasted millions, and failed to invest even thousands.

It is notorious that in late years the prices of works of Fine Art have increased, and are still increasing. Private collectors of works of art in this country, who have bought with caution and judgment, have made most profitable investments. In 1860, Mr. Henry Thomas Hope, a millionaire, informed a Committee of the House of Commons that he was willing to take the whole purchases of the Kensington Museum at the price which had been paid for them, adding to the price a handsome per-centage as profit. At the present time, I believe, the whole collections would fetch in the market double the amount paid for them, whilst some objects would realise ten times the sum paid for them.

In 1862, the national income was £69,000,000. Notwithstanding large remissions of taxation it has increased to £76,000,000 in 1873. In 1862, for purchases for the South Kensington Museum, the only storehouse for circulation for the United Kingdom, Parliament voted for the purchase of works of science and art the sum of £16,800, whilst in 1873, when the revenue had increased so largely, and the demand for works of art as well, the amount for national investments in works of science and art has actually been reduced to £13,000.

Sir Stafford Northcote, on one occasion, proved that the increase in the demand for decorative manufactures had augmented in greater proportion than for manufactures into which fine art did not enter. Political economy has hitherto had little effect in regulating wise and prudent investment. I wish governments would believe in the Scriptures. They teach us that "there is that scattereth and yet increaseth, and there is that withholdeth, and it tendeth to poverty." I wish they would also heed that account of the unprofitable steward, who hid his master's talent, and, for his mistake, was cast out where there was weeping and gnashing of teeth.

I think it would be justifiable and prudent that the constituencies should call upon Parliament to invest at least £100,000 annually in judicious expenditure in the purchase of illustrations of science and art. It would be only the third of a penny in each pound sterling of national expenditure. It would not be very crippling to the administration of a Chancellor of the Exchequer to insist, "for every pound we give you as a tax on our beer, wine, and spirits, you shall put aside and invest, not spend as upon gunpowder, a penny in works of science and art." The national debt would be paid off all the sooner.

The national Museums of Science, such as the natural history division of the British Museum, and the collection of mechanical science and inventions, miscalled the Patent Museum, should be in alliance with all local Museums and Schools for science. They should collect the best models for teaching; they should form small typical collections of objects, to be lent or to be purchased. All superfluities should be circulated. So with works of fine art. All the National Museums possessing

works of fine art, especially the National Gallery, should circulate to local Museums and Schools of Art all superfluities, and there are heaps of them. So heaped are the superfluous treasures at the British Museum, and hidden, that it has become, in the words of the modern Jeremiah, our great Carlyle, "little better than a continent of dung."

I have already said that original works of the highest art are hard to be obtained. For all purposes of general public instruction good copies serve equally well. Buy originals if you can; but there are some originals which cannot be bought, and of which copies ought to be made. A moderate annual expenditure would enable students of the schools of art to go abroad and copy such works as Titian's "Assumption of the Virgin," at Venice; Fra Beato's Frescoes at Florence; Giotto's Frescoes at Padua. This country ought to have two chronological series, illustrating the art of painting of all countries and ages, one being for circulation, and accompanied by a lecturer.

The making such copies for the benefit of all local schools should be the work of a branch of the Art Training School. The making copies of works of sculpture, by means of electrotyping and other methods, is comparatively easy. The only difficulty is to persuade the possessors to allow the copy to be made. Casts, thanks to Sir Stafford Northcote especially, have been brought even from the jungles of India; and for a very moderate sum you might have casts at Aston-hall which would teach what India and Indian art is, better than writings and talkings for a thousand years.

At the Paris Exhibition of 1867, with a view of smoothing away difficulties in obtaining permission to make copies, the Prince of Wales interested himself in forming an international convention with the princes throughout Europe. France, Russia, Prussia, Hesse, Italy, Austria, Sweden and Norway, Saxony, Belgium, and Denmark, all joined it. It was a real Holy Alliance. Although the funds for reproductions have been too small to do much, copies of many important works have been obtained for the use of Birmingham and other places, and foundations have been laid for a wide action as soon as the wisdom of Parliament shall recognise the policy of entering upon it.

The co-operation of Birmingham with the State in this matter of reproductions would enable the town, at an insignificant outlay, to assemble together specimens of the finest works of man in metal, illustrating the art from the time of the Pharoahs. If I can persuade Birmingham to believe this, I hope it will manifest its belief by asking its mayor to head its representatives, in an early deputation to the Chancellor of the Exchequer.

It has hitherto been the fashion to consider that the administration of matters concerning science and art should be intrusted to *dilettante* amateurs, and the church. the law, politicians of various ranks, &c., have been called in, and charged with the executive work. Experience has proved this to be a great mistake.

As Charles Buller said of the Record Commission in 1836, "Our experience of these Boards furnishes but one additional and almost superfluous proof of the folly of expecting efficient labour and systematic care at the hands of a numerous body, unpaid for the discharge of its duties, and occupied by other avocations of a more important, a more imperative, and wholly foreign nature."

And in spite of principles clearly announced by Bentham, John Stuart Mill, Sir Henry Parnell, Sir James Graham, Lord Langdale, Charles Buller, and others of like authority—in spite of a conclusive demonstration against Board management made by Lord Henry Lennox, in a speech in 1862, in which Mr. Gladstone and Mr. Disraeli both expressed agreement—it was actually proposed last August to supersede the individual Parliamentary responsibility of a single Minister, presiding over the South Kensington Museum, by a Board management of fifty irresponsible trustees.

The administration of Museums and Schools of Science and Art is just an affair of business and common sense. The first thing which a great manufacturer, wishing to employ his capital for a given purpose, does, is to engage a competent manager, and if he does not manage rightly, he changes him for a better one. If he wants science and art he pays the necessary professional charge for them, and there is no difficulty in obtaining them. His friends would think him a lunatic if he sent for his priest, the village lawyer and doctor, and the guardians of the poor, the inspector of highways, the beadle, &c., and made a board of fifty of the most illustrious local celebrities, and asked them to manage his business for nothing, and to superintend his works, either little or much, as they might like. If for political reasons the Minister wants a council of advisers, let there be one for literature, science and art, as a branch of the privy council. Let them be privy councillors whom he might summon when he wanted their advice, but don't expect this council to succeed as an executive.

The Society of Arts has, I am happy to announce to you, formed a standing committee for putting an end to this old-world idea of numerous Boards managing science and art. Statesmen, and members of the legislature of both Houses, have joined this league, and so have the chairmen of about 120 Schools of Science and Art in the United Kingdom—among them, of course, appears Birmingham. The objects of this association are:—1st. To cause all museums and galleries supported by Parliament to be directly connected with education and technical instruction, and to be made conducive to their advancement. 2nd. To extend the usefulness of national museums and local museums that may desire to obtain objects by loan or gift. 3rd. To induce Parliament to grant sufficient funds in aid. 4th. To place all national museums under a responsible Minister of Education. 5th. To aid municipalities in the work by amending the Public Libraries and Museums Act, so as to give increased freedom of action to municipalities.

The present Postmaster-General, Mr. Lyon Playfair, had undertaken to bring this subject before the House of Commons in the next session of Parliament, but his present duty has taken him away from this useful national work, and Mr. Mundella will act for him. Remembering Mr. Gladstone's recent noble declaration, that he only hopes to be remembered by posterity for the good deeds of his ministry, I indulge in the dream that if you men of Birmingham, and other towns interested in education, science, and art, appeal to the present Chancellor of the Exchequer properly, he will do the work himself, which the Society of Arts desires.

In conclusion, let me apply these general observations to Birmingham. Acting on the principles I have submitted to you, Birmingham, I hope, will possess fully developed municipal institutions for promoting museums of science and art. The Corporation already has begun the work. In the town there should be the picture and sculpture gallery, drawing its supplies from the National Gallery and British Museum; there should be the Museum of Industrial Art in connection with the South Kensington Museum; there should be the School of Music in alliance with the National Training School of Music—all these lighted up and open in the evening. In the suburbs should be a museum, a head quarters of natural history, which wants great space, and it should derive all possible advantages from the stores and experience of the British Museum. That noble specimen of old English domestic architecture, Aston-hall, should be a sort of Hotel de Cluny, and a loan museum for English furniture and architecture, to be collected from the midland counties. The Corporation should maintain the structures, the State should help with objects, and the people with their pence. Ought it not be the pride of Birmingham to possess in the highest perfection such instruments for educating and civilising its people?

England is still the most industrious, and, therefore,

the richest country in the world. Its land is the best cultivated. But Germany is running a race with England throughout the world, and that Germany can do so, and be in the race at all, is owing to her education. As the *Times* said lately, "The wisdom of Germany in education teaches a lesson that will have to be learnt by a rude experience if we do not heed the warnings now heard." To maintain this old England of ours in the place she now holds—the first in the world for freedom of all kinds—my firmest faith is, that Birmingham will take a lead and do its part nobly in education, science, and art.

PUBLIC MUSEUMS AND LIBRARIES.

The following returns of the numbers of visitors for December last have been made up to the present date:—

	Number of Visitors.
British Museum	(no return)
National Gallery (Trafalgar-square)	88,707
Kew Gardens and Museum	7,605
South Kensington Museum	87,570
Bethnal-green Museum	48,489
Geological Museum, Jermyn-street	
Patent-office Museum	29,151
Edinburgh National Gallery	10,518
Edinburgh Museum of Antiquities	8,447
Edinburgh Museum of Science and Art	23,665*
Royal Dublin Society:—	
Natural History Museum	5,392
Botanic Gardens, Glasnevin	3,836
Dublin National Gallery	
Zoological Society, Dublin	5,189
Museum of Irish Society, Dublin	9,937
Tower of London	
Royal Naval College, including Greenwich Painted Hall	18,321

NEW IMPORT DUTIES IN FRANCE.

The rates of import duty on petroleum and mineral oils, soap, and candles, have been fixed by a recent decree as follows:—

I.—Petroleum and mineral oils:—

	Per 100 kils. frs. cts.
Oil refined, of 800° of density and above, at a temperature of 15° Centigrade	37 00
Essence of 700° of density and below, at a temperature of 15°	47 00
As regards oils imported in an unrefined state, the Custom-house authorities will ascertain what amount of essence and of pure oil they contain, and apply to each of the two products the undermentioned duties:—	
For each 100 kilogrammes of pure oil, of 800° of density, at a temperature of 15°	37 00
For each 100 kilogrammes of essence, of 700° of density, at a temperature of 15°	40 00
When the density of oils imported otherwise than in an unrefined state shall prove to be between 800° and 700°, the duty of 37 francs per 100 kilogrammes shall be increased by 10 centimes per degree below 800°.	
II.—Soap:—	
In addition to the existing import duty, compensatory duty to countervail the excise duty imposed upon French made soap of	5 00
A drawback of 5 francs is allowed upon exportation.	
III.—Stearine candles and others of the nature of stearine, as well as candles and tapers with plaited, twisted, or chemically prepared wicks	10 per cent. *ad val.*
Also a compensatory duty to countervail the excise duty imposed upon French-made candles of the above description, of 25 frs. per 100 kilometres.	

* Total for year, 336,539.

It may be observed, with regard to these additional imposts, that as petroleum and mineral oils were not included in the provisions of the treaty of 1860 (which were renewed by the treaty of July last), the French Government has the power of imposing whatever rates it may think fit upon these products. The duty of 10 per cent. *ad valorem* upon candles is the same as that fixed by the treaty of 1860, which, however, was subsequently, on the 1st May, 1867, reduced to 5 per cent.; although this duty has now been doubled, it is therefore still within the treaty limits. The compensatory duties are levied by virtue of the power conferred upon both of the contracting parties by article 9 of the treaty of 1860, which provides that such duties may be imposed upon imported articles, in cases where national products are subjected to equivalent inland or excise duties.

CORRESPONDENCE.

THE PATENT OFFICE PUBLICATIONS.

Sir,—May I be allowed to supplement the few remarks I made last Wednesday, in the discussion on Mr. Webster's paper, with some statistics more accurate than I was able to produce at the meeting? The facts of the matter, as regards the two publications in question, are as follows:—

The descriptive catalogue of the Patent-office Museum was published in June, 1857, and was ready on the day on which the museum was opened. Later in the same year a second edition was published, and in 1859 a third. This has now been out of print some time, and has not since been republished. This catalogue contained a careful description of each exhibit, drawn up from an inspection of the object. As since its issue the number of models, &c., in the museum has greatly increased, the catalogue in its present form cannot pretend to be complete. In 1863 a smaller catalogue was published, which contained only the titles of the objects exhibited, without any description. This, being three years later than the last issue of the other catalogue, contained many more entries; but this, now ten years old, is not at present complete, and no second edition of it has ever been published.

As to the abridgments, the publication of them is going on, according to information obtained by me at the Patent-office, as rapidly as the size of the staff, and the funds at command, will allow. In 1871 15 subjects (in 17 volumes) were published; in 1872, 13 subjects (13 volumes); in 1873, 9 subjects (9 volumes). There are also several series now in hand. These abridgments, which are published in classes, are not brought down lower than 1866. Since that year each applicant for letters patent has been required to send in with his specification an abstract of the same. These abstracts were published in half-yearly volumes, from 1866 down to 1871. In July, 1871, a weekly issue was commenced, and that is now being continued, the number for each week containing abstracts of all specifications delivered during the corresponding week six months previously. As during the six months covered by the "Provisional protection" the specifications are not public, this is the earliest publication of their contents legally possible. With this weekly publication is also issued an alphabetical and a subject-matter index, brought down to date from the commencement of each year.—I am, &c.,

H. T. Wood.

January 19th, 1874.

GENERAL NOTES.

A Convenient Measure.—It may be new to most readers of the *Journal* that a bronze halfpenny is exactly an inch broad, and therefore gives us a very convenient measure. Laid on an Ordnance map of the inch scale the halfpenny covers just 500 acres. Now, also, that the third of an ounce is a postal unit, it is well to remember that a penny is precisely that weight.

Street Cleansing Apparatus.—The Asphalte Central Committee offer a premium of 50 guineas for the best apparatus for flushing and cleansing asphalte pavements, provided the apparatus is adopted. The principal conditions are that it should be always available, easy to fix, certain in its action, not liable to get out of order, and not interrupt the traffic. The model or design must be fully described, with estimate of the quantity of water it will consume, and the mode of obtaining the supply. The designs must be sent to the secretary of the committee, 14, Palmerston-buildings, Old Broad-street, London, not later than February 14.

Royal Architectural Museum.—The Art-Workmen's Evening Drawing and Modelling Classes are now in work in this museum, at seven o'clock, every Monday, Wednesday, and Friday evening. It is stated that these drawing and modelling classes have been established to give art-workmen the much wanted opportunity of self-improvement in their several branches of manufacture. The museum will be thrown open free of charge during the day to art-workmen while actually attending these classes. The museum is also opened specially on the above-named evenings, from seven to nine, to enable architectural students to take advantage of this fine collection of ancient examples from the earliest times down to the sixteenth century. The drawings and models for the prizes offered by the Goldsmiths' Company for designs for plate are now being exhibited in the museum.

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

The following arrangements have been made :—

January 28.—"Account of a Recent Visit to the Coal and Iron Fields of Virginia, United States of America." By Professor D. T. Ansted, F.R.S. On this evening Sir Antonio Brady will preside.

February 4.—"On Eastern Art, and its influence on European taste." By Dr. Christopher Dresser.

February 11.—"On Type Printing Machinery, with suggestions thereon." By the Rev. Arthur Rigg, M.A.

February 18.—"On Thrift as the Outdoor Relief Test." By G. C. T. Bartley, Esq. On this evening the Right Hon. the Earl of Derby will preside.

February 25.—"On the Channel Tunnel." By William Hawes, Esq., F.G.S.

March 4.—"On Bells, and Modern Improvements for Chiming and Carillons." By George Lund, Esq.

Indian Section.

The following arrangements have been made or Friday evenings during January and February :—

January 23 (this evening).—"On Indian Teas, and the Importance of Extending their Use in the Home Market." By Dr. A. Campbell, late Superintendent of Darjeeling. On this evening Sir Louis Mallet, C.B., Member of the Council of India, will preside.

February 6.—"On Indian Art." By Dr. Zerffi.

March 13 (not February 27).—"On the Races of Dardistan (north-west of Cashmere), discovered by him." By Dr. Leitner.

African Section.

The following Friday evening meeting has been arranged:—

January 30.—Inaugural meeting. The Right Hon. Sir Bartle Frere, K.C.B., will deliver an opening address.

Chemical Section.

The dates for the various papers are not yet fixed. The meetings will be held on the following Friday evenings, at 8 o'clock:—February 20th, March 6th and 20th, April 10th and 24th, and May 8th. The following subjects have already been arranged :—

"On the Production of Anthracene and Alizarine from Pitch."

"On the Manufacture of Chlorine."

"On the Utilisation of the Waste Products of Gas Manufacture."

"On some Recent Improvements in the Production of Carbonate of Soda."

"On Sugar Refining, with special reference to Finzel's Sugar Crystals."

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Social Science Association, 8. "The Law of Conspiracy as Effecting the Relations of Employers and Employed."
Royal Geographical, 8½. Lieut. Julian A. Baker, "Geographical Notes of the Khedive's Expedition to Central Africa."
Entomological, 7. Annual Meeting.
British Architects, 8.
Medical, 8.
Actuaries, 7. Mr. Alexander J. Finlaison, "On the Rate of Mortality found to prevail among Residents in India, being Subscribers, and the Male and Female Nominees of Subscribers, to the Uncovenanted Service Family Pension Fund, between the years 1837–1872."
London Institution, 4.

Tues. ...Civil Engineers, 8. 1. Discussion "On the Mechanical Production of Cold," and, time permitting, 2. Mr. John Birch Paddon, "Description of Gas Works constructed for the Brighton and Hove Gas Company, at Portslade, Sussex."
Royal Medical and Chirurgical, 8½.
Anthropological Institution, 8.
Royal Institution, 3. Prof. Rutherford, "On Respiration."

Wed....**SOCIETY OF ARTS, 8.** Professor D. T. Ansted, "Account of a Recent Visit to the Coal and Iron Fields of Virginia, United States of America."
Archæological Association, 8.
London Institution, 7.

Thur....Royal, 8½.
Antiquaries, 8½.
Philosophical Club, 6.
Royal Institution, 3. Professor Duncan, "On Palæontology, with Reference to Extinct Animals and the Physical Geography of their Time."
Society for the Encouragement of the Fine Arts, 8. Mr. John Saddler, "Line Engraving."

Fri.....**SOCIETY OF ARTS, 8.** African Section. Inaugural Meeting. Address by Sir Bartle Frere, K.C.B.
Royal Institution, 8. Weekly Evening Meeting. 9. Sir Julius Benedict, "Weber and his Times."
Royal United Service Institution, 3. Lieut.-Colonel H. Schaw, "Field Engineering: illustrated by some of the Operations of the German Engineers during the War of 1870-71."

Sat......Royal Institution, 3. Prof. G. Croom Robertson, "On Kant's Critical Philosophy."

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No. 1,106. VOL. XXII.

FRIDAY, JANUARY 30, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

TECHNOLOGICAL EXAMINATIONS.

The Programme for the Examinations in the Manufacture of Cloth is now ready, and can be had upon application to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C.

The following donations have been received since the last announcement:—

	£	s.	d.
The Worshipful Company of Clothworkers	10	10	0
The Worshipful Company of Vintners ..	21	0	0

ECONOMY OF FUEL.

The Committee met twice last week. Present—Major-General F. Eardley-Wilmot, R.A., F.R.S. (Chairman of Council), Mr. F. A. Abel, F.R.S., Major Ducane, R.E., Professor Goodeve, Dr. David Price, Rev. A. Rigg, Captain Scott, R.N., and Major Webber, R.E., attended by Mr. P. Le Neve Foster, Secretary, and Mr. S. W. Davies, in charge of the testing. The Committee completed their inspection, and it is expected the actual testing will commence next week.

PROCEEDINGS OF THE SOCIETY.

MEETING OF THE INDIAN SECTION.

A meeting was held on Friday, Jan. 23, 1874, Sir LOUIS MALLET, C.B., in the chair.

The CHAIRMAN, in opening the proceedings, remarked that the subject of the paper was one of the greatest importance, both to England and to India,—to India, because of the impetus which it would give to her native industry, and to England, not only because it would afford an additional bond between this country and the great Indian Empire, but also because it was most important to England to be able to depend upon an extra supply of an article of such large consumption as tea, instead of being confined to one source, namely, China. At the present moment the subject had a peculiar interest, on account of the revelations which had recently been made as to the great extent to which tea was adulterated, and therefore any means which would tend to check such a discreditable state of things would be a great public benefit.

The Paper read was :—

ON INDIAN TEAS, AND THE IMPORTANCE OF EXTENDING THEIR ADOPTION IN THE HOME MARKET.

By Dr. Archibald Campbell.

(Late Superintendent of Darjeeling.)

A recent correspondence in the *Times* on the adulteration of China teas, and the obstructions to the sale of pure Indian teas, by the practice of mixing them with this pernicious rubbish, has, as you are aware, excited a good deal deal of public interest. In that correspondence I took a part, and, as it appeared to our Indian Committee that the subject was of sufficient importance to demand a discussion, I was asked to open the proceedings to-night by reading a short paper on the subject. I should have much preferred that this duty had been allotted to some other person, but, as it has not been so, you must lay my shortcomings on the Committee rather than on one who is obeying its wishes, and who is very diffident of at all succeeding in the performance of the part assigned to him.

It may seem strange that the present company, who are, no doubt, well acquainted with the subject, should be detained by an inquiry as to what Indian tea really means, but the want of general information on this question is so great that I feel obliged to preface what I have to say regarding spurious and adulterated China teas by a few words on Indian teas generally.

A gentleman who has resided in London for some years, and is the owner of an Indian tea plantation, when talking to me lately about this want of information, said that not one person in fifty in this great city knew anything about it. My own observation leads me to believe that hardly one person in a hundred in the United Kingdom knows anything about it, although it is 40 years since tea was first discovered in Assam growing wild, and 30 since it was found in the same state in Cachar, a neighbouring district.

I have lately tried to ascertain the amount of information among grocers on the subject. It is exceedingly vague and scanty. It is mainly known by them under the generic term of "Assam," or "Asan," and as first-rate for mixing with China tea; but there is little or no knowledge among them of the numerous kinds of tea sent to this country from India, of their various excellent qualities, and of their perfect purity. One dealer, who prided himself on his experience in the tea trade, and his success in making good mixtures by the aid of "Assam," replied, when I asked his opinion about Indian Souchongs and Pekoe Souchongs, "You are talking, sir, about China teas, there is nothing from India but Assam;" and when I explained to him that "Assam" was a tea-producing province, and not a kind of tea, and that there were many other tea districts in India, he merely said, "It might be so, but he didn't know them."

You will, therefore, I am sure, pardon me for directing your attention to the board on the wall,

with the names of the tea-producing districts ranged alphabetically, and, curiously enough, in corresponding geographical succession, taking them from east to west, along the northern frontier of British India. Thus we have eight tea-producing districts running along 1,200 miles of the Himalaya mountains, viz., Assam, Cachar, Chittagong, Darjeeling, Dehra Dhoon, Gurhwal, Kumaon, and Kangra, besides Chota Nagpore in Central India, and the Neilgherry Mountains, and Wynaad, in Southern India, in the Madras Presidency. The present efforts to discover a trade route from Assam into Western China, make the question of how the tea plant came into that and Cachar districts an interesting one. Is it indigenous, or did it come direct from China? The species is the same, although the Assam may be ranked as a variety. Previous to this discovery, and perhaps even now, China was regarded as the only *habitat* of the tea plant.

It appears to me that the present time is particularly suited for taking a little wider view of the Indian tea-trade than that which has been specifically pointed out in the *Times* correspondence. I shall therefore bring the subject before you for discussion as briefly as possible, under three heads:—

1. Present state and future prospects of the trade.
2. The spurious and adulterated China teas, and their effect in obstructing the sale of pure Indian teas.
3. How best to protect the public from the spurious teas, and insure full and fair access to pure and good teas.

The Indian tea trade has on several occasions during the last four or five years come before the meetings of the Indian Committee in this room, in the shape of papers devoted to its cultivation and manufacture, by the late Mr. Fielder, of London, and Mr. Campbell, of Assam, in conjunction with the closely allied subjects of hill stations, waste lands, settlement of Europeans, supply of labour, and the defective means of communication generally in India. A prize was also offered by the Society for the best essay on the cultivation and manufacture of tea.

On all these occasions the subject generally has attracted much attention, a good deal of useful discussion ensued, and the Society on more than one occasion brought the drawbacks to the trade in India to the special notice of the Secretary of State, praying for their removal.

It is very satisfactory now to be able to state that the want of means of communication between the tea-producing districts and the sea-board has at last roused the Indian authorities, there and here, to vigorous exertions, and that the labour question in Assam and Cachar, the two districts most requiring imported labour, has been placed by the Government on a footing which the planters do not now complain of.

The Northern Bengal Railway to Darjeeling has been sanctioned by the Secretary of State, the line has been staked off through the fertile and populous district from the Ganges to the cart-road at the foot of the Hills, and the threatened famine has been the cause of immediately commencing this very important undertaking, as one of the relief works proposed by Sir George Campbell, and sanctioned by the Governor-General, Lord Northbrook.

A trunk road from Doobere, on the north bank of the Burrampooter river, into the valley of Assam, all the way to Suddiya, is under survey, and the Lieut.-Governor has urged the Governor-General to sanction a preliminary survey of the south bank of the Burrampooter for a railway into Assam, to cross at Gualando the present terminus of the Eastern Bengal railway, by which line the crossing of the immense drainage of the Bootan Himalaya along the northern bank will be avoided.

The same energetic and enlightened Lieutenant-Governor has deputed Mr. Edgar, the Deputy-Commissioner of Darjeeling, to visit the Rajah of Sikhim, and to report on the relative merits of three passes into Thibet, as well as the best site for a frontier mart near the passes. He has also strongly urged the Governor-General to move the India-office, and her Majesty's Foreign-office, to take steps at Pekin for the removal of all obstructions to free trade with Thibet from Bengal through Darjeeling. This is a most important subject in connection with the Northern Bengal Railway, and as a necessary means of procuring access to our trade in the eastern portion of Central Asia, at the same time that we are about to realise it on the North-west, through the mission now with the ruler of Kashgar and Yarkund. The opening of a frontier mart in Sikhim has often been advocated by me for facilitating intercourse and trade between Darjeeling and Thibet.

On the North-west of India the Oude and Rohilcund Railway has reached Bareilly, which will serve the Kumaon tea plantations, as the East Indian line to Saharunpore serves the Dehra Dhoon and Gurhwal districts, and as the Punjab lines do the Punjab hills and the Kangra valley.

There is still more good news for tea planters. We have recently heard that merchants from Thibet, Cashmere, and Affghanistan have come across the Himalaya into India, and are carrying off the teas from the factories in the North-West at highly remunerative prices, bespeaking all the crop of next year in Kumaon, and paying down half the cash in advance.

This saves the planters all the cost of packing, transit to the seaboard and to England, import duty, and all the time now required for getting their remittances in return for their produce. The *British Trade Journal*, of the 1st December last, remarks on this diversion of Indian tea from our own home markets:—

"Such facts are significant, and seem to point to the possibility of the great bulk of Indian tea being directed to other markets than ours. We cannot contemplate such an event with satisfaction, as this country is able to, and should, take all the tea produced in India. Seeing that our Indian empire can supply us with a first-rate article, we should be glad to see its sale greatly extended. But before this can come to pass India tea must be sold on its own merits, and not, as is now generally the case, mixed with inferior stuff."

The markets of Central Asia, for which these teas have been bought, may be said to offer a boundless opening for Indian teas. Tea is really the staff of life in Thibet, Mongolia, and Eastern Turkestan. The present unsettled state of the countries to the north of China renders the supply of China teas to them very precarious, so that India is now looked to for the supply of this necessary of life by countries containing millions

of people. Taking all the circumstances into consideration, it may be safely said that the struggle for existence has now terminated, and that people "going in for tea" have far brighter prospects than the pioneers of this great Indian industry could hitherto boast of; and that the great future, which I have always believed was in store for it, may now be confidently expected by the most sober thinkers.

Mr. T. T. Cooper, "The Pioneer of Commerce," who has recently made a journey from Assam for the purpose of introducing the Assam tea into Thibet, says, in his last book, "The Mishmal Hills:"—

"The whole aim in life of the Thibetans seems to be to procure a sufficiency of tea. For many centuries China has supplied Thibet with six or eight million pounds of brick tea annually. This article being a necessary of life to the Thibetans, the Chinese Government, who hold the wholesale monopoly of the export tea trade, have granted the retail monopoly to the Lama priests, who by this means hold the lay population of Thibet at their mercy. Thus the Chinese protect their tea trade, and the Lamas their religious and political influence over the Thibetans.

"This monopoly keeps the Assam and Darjeeling teas at present out of Eastern Thibet, into which it might be introduced under a system of free trade and open road, much more expeditiously and cheaply than China tea from the mart of Sechuen in China, whence it has to be carried by coolies for 200 miles, and after that for 60 days' journey on yaks, to Bathang in Yunan, whence it eventually reaches Thibet."

Thus the latest information we have adds cogency to the Lieut.-Governor of Bengal's efforts to procure the action of our Foreign Office at Pekin, for the removal of restrictions to the passage of tea into Thibet by the passes leading from Sikhim into that country.

The question now has arrived whether, with these favourable prospects, India will be able to meet the coming demands upon her production of teas. It is very difficult to form any accurate estimate of the extent to which the trade will eventually attain, as it is carried on in many districts from which I have no reliable statistics. I venture, however, on grounds which shall be presently stated, to affirm that in our own possessions alone there is land enough, with climates suitable for tea, to supply all demands that may arise in Europe, Asia, or America; and that there will still remain 700 miles of the Himalayas in the native States of Nepal and Bootan, with similar soils and climates not reckoned on now, but which by-and-bye may become tea-producing countries.

It is on the following reliable statistics from Darjeeling that I draw my conclusions:—

The tea-crop of all India was, in 1873, about 20,000,000 lbs., of which Darjeeling contributed 2,600,000 lbs., or one-seventh, increasing at the rate of 15 per cent. per annum on the land actually under tea, *i.e.*, 14,000 acres.

For 1874 we can reckon on 21,000,000 lbs., at the very least, of which about 3,000,000 lbs. will be from Darjeeling. There are, however, about 55,000 acres of land fit for tea still uncultivated, giving a total of, say 70,000 acres, which, when cultivated, will, at the rate of 400 to 500 lbs per acre in the hills and 500 to 600 lbs. in the Terai, give at least 20,000,000 lbs., as the eventual outcome of Darjeeling alone. There is no reason to believe that the other districts will fall off in any degree in their relative power of supply; and, indeed, we may reasonably look for Assam and Cachar doing more than their present share in the increase, so that we have the best reasons to calculate upon, say, 150,000,000 lbs. of tea in India, and this not at any very long time from the present day; and, under the present improved prospects, if the capitalists of England will direct their attention to the subject, with waste land still to spare, improved means of communication, sensible laws, and sufficiency of native labourers, it appears to me that the principal drawback to the rapid and great development of this Indian industry is the want of money at easy rates of interest, to relieve the planter from the incubus of Indian rates of interest and charges, which amount generally to 12 per cent. on all advances for cultivation and manufacture, and often to much more.*

While England is supplying the whole world with capital at very moderate rates, she seems to be still chary of speculations in India, which is one of her best customers; and in this Indian tea trade her capitalists may now look with confidence for profitable returns under judicious management. There is one thing to be kept in view, however. In all cases of breaking fresh ground for tea the speculation must be carried on for three or four years before the first dividend can be declared out of profits, when 10 to 15 per cent. may be reasonably expected; and more as the plantation grows older, and a higher style of culture can be carried on. The following extract of a letter from Mr. Lloyd, an experienced planter at Darjeeling, just received, is so *apropos* to the extension of the tea trade that I cannot withhold it. He says:—

"The Nepalese Government has withdrawn all obstacles to the emigration of the Hill population, and they are coming over the border into Darjeeling and British Sikkim, with their women and children, in great numbers. They are not likely to go back again when once they bring their families out with them. It appears that the locusts injured their crops this year to such an extent as to compel the authorities to let the people go.

"The people of Behar are also leaving their country for our tea districts; and, altogether, it seems that Providence is favouring the extension of tea cultivation in India. We have plenty of land, suitable climates, and skill. We wanted a railway and more labourers, and these the famine has caused us to get. A little money from England (not too much at once, for that would do harm), and we shall have all we want."

So much has been recently written about the spurious and adulterated China teas imported into this country, and the extent to which pure Indian teas are kept back from the public for the purpose of mixing to make them saleable, that I will take it for granted you are generally acquainted with these disclosures, and confine myself to noticing only a few of the most striking facts.

Within a recent period 5,000,000 lbs. of this rubbish has been disposed of, and 10,000,000 lbs. of it are now in bond awaiting distribution. There are three modes of supplying this deleterious article of food to all classes of the English public, but principally to the poor classes, who are tempted by its cheapness to use it. First, by adulteration; second, by spurious tea; third, by re-making out of tea already used. The *Glasgow Weekly Mail*, in commenting on the careful analysis of 27 samples of China teas, puts the result very forcibly and tersely:—

* 70,000 acres at 300 lbs. per acre will give 21,000,000 lbs.; at 500 lbs. per acre, the out-turn would be 35,000,000 lbs. for Darjeeling, or, say, 240,000,000 for all the districts.

"When we invest in tea (it says), we certainly do not bargain for a per-centage of lead, gum, prussian blue, turmeric, indigo, plumbago, iron filings, verdigris, chalk, gypsum, soap-stone, arsenite of copper, catechu, logwood, China clay, and rose pink, whatever that may be, besides a variety of leaves derived from plants widely differing in botanical character from tea, such as poplar, plane, sloe, or wild plum, beech, elder, hawthorn, oak, and willow."

Exhausted leaves, re-coloured with plumbago, have the requisite astringency imparted to them by the addition of catechu and some salt of iron, and the characteristic crisp and twisted appearance are given by skilful manipulation and treatment with gum and rice-starch. Further, the spurious leaves used in adulteration of tea are often so beaten up as to render their identification difficult, if not impossible.

The upshot of the whole investigation is as follows:—Out of 27 samples of black tea six were genuine, 20 were more or less adulterated, and one, which had been sent from London as a sample of cheap tea, contained not a single leaf of genuine tea.

The green teas examined at the same time were found to be even worse than the black; and out of 18 samples of China tea examined at Dundee there was not one among them which was not more or less adulterated with Prussian blue, black lead, turmeric, carbonate of lime, China clay, and other matters more or less poisonous!

This is surely a very serious state of things in the trade of an article of daily consumption by the whole population of this country; and especially for the poor classes, to whom tea is a necessary of life, and for whom these adulterations are mainly instituted, to tempt them by low prices.

This nefarious trade is exclusively carried on in China tea, for no one has ever said that any of the Indian teas are adulterated, or tampered with in any way. They are solely the produce of genuine tea-leaf, and are perfectly pure. It is very unfortunate, however, and I would particularly draw your attention to the fact, that this system of adulteration is in a great measure an effect of the new trade in Indian tea. Without these pure, high-flavoured, and powerful teas in considerable quantity for mixing, it is alleged, and it seems to be true, that it would be impossible to make deleterious tea a paying speculation; and as the quantity of Indian tea imported increases, so will this poisoning of China tea increase, unless steps are taken vigorously and speedily to protect the public from the China rubbish. At the same time, freeing the Indian teas from the disabilities under which they have hitherto laboured, and enabling them to reach the public in their pure and excellent state, when, although the price per lb. will be higher than is now paid for the adulterated stuff which they are used for to make saleable, the economy will be found to be really much greater, from their great strength of body, not to speak of their perfect wholesomeness, contrasted with the deleteriousness of the cheap mixtures.

The evils of adulteration, and its necessary swamping of pure tea, are not confined to the public of England and the Indian planters; they extend to the prejudice of pure and high class China teas also, which are overlooked in the market in favour of inferior sorts, which can be rendered comparatively good by mixture with Indian tea.

It has now been shown in some degree, I hope, that there is a real necessity for exertion, if the Indian planters would save their trade from the depreciating effects of China adulterations, through which prices are kept down, and of which adulterations their teas are, to a great extent, made the cause. It is, no doubt, the case that the English public are not yet fully alive to the excellence and economy of Indian teas. It is also true that the great strength and high flavour of these teas is advantageously tempered by mixture with genuine China teas, but these are additional reasons for measures being taken against tainting them with poisoned compouuds.

While pointing out the mischievous effects of importing spurious and adulterated teas from China, and mixing pure Indian teas with them, to make them saleable, by people who are ignorant of their quality, but are induced by their cheapness to use them, I wish it to be understood that I do not in any way desire to be considered as advocating the use of Indian teas to the supercession of good and pure China teas; on the contrary, I believe that it will be some time before the public taste will generally pronounce in favour of Indian as being preferable in every respect to China teas, however excellent the former may be. There is, certainly, a very remarkable difference between the two teas generally, and persons who have for some time been accustomed to the Indian teas only prefer them greatly. Still, as a rule, it may be said that, as mixtures of different kinds of China are preferable to any one kind, so mixtures of certain kinds of Indian with certain kinds of China tea are better than only purely Indian or purely China mixtures. With the best China Souchongs, or Kaisows, and the best Indian Pekoe Souchongs and Indian Pekoes, you can, I believe, make the best of any. The question, however, arises, as in all matters of taste there is no authoritative way of deciding, which out of all the ten Indian tea-producing districts furnishes the best for mixing with China teas. This must be settled for everyone by himself or herself. The difference between the teas of the different districts is very great, and so, indeed, is that between teas of different parts in the same district; each have their advocates, and there seems to be a necessity for mixing to suit individual tastes. Within the last few days I had a conversation on this subject with a gentleman owning a plantation in the Darjeeling Terai, who told me that, although his own tea was of first-rate quality, he always drank a mixture made of half of his own tea and half of the tea of the Soom Company, which mixture he considered to be perfect. Soom is also in the Darjeeling district, but at a higher elevation by 4,000 feet than the Terai, and this causes a great difference in the flavour and quality of the produce. What is primarily wanted is free access to all the kinds.

The following general descriptive characteristics may be of some use to the public, although it may appear very trite and imperfect to the initiated:—The Assam black teas are, I believe, the strongest and most economical of all, especially the coarser kinds. The finer kinds are full-bodied and high-flavoured. The Pekoes are very fine. The Cachar I believe to be equal in strength; they are full-bodied, dark infusion, and fine flavour. The

Chittagong are considered by many equal[*] to the Cachar, but I do not know them so well. The Darjeeling, to my own taste, are the best of all, so that I had better leave an impartial description to some other person. I may say, however, they combine the full body, rich infusion, and fine flavour of the best Assam and Cachar, with the great delicacy of the Kumaon teas. The Dehra Dhoon teas are of good body and fine flavour. The Kumaon teas are celebrated for their delicate and high flavour, but give a light-coloured infusion; and the Kangra teas are, I believe, equally good.

The Chota Nagpore tea resembles that of Dehra Dhoon. I have not experience of the Neilgherry teas, but the late Sir William Denison informed me that they were good, but that they did not pay so well as he expected before he left India. Of the Wynaad teas I have no information; but I see that the planters are applying to Government for assistance to procure labour, which looks well.

It may sound startling to people who set great store by "new season teas" to say that any teas improve by keeping; it is so, however, with the best Darjeeling teas. They are improved by being kept for one year, at least I find it to be so.

It only remains for me now to conclude with a few words on the best mode of protecting the public from spurious China teas, and insuring full and fair access to pure Indian teas. It will be for you to discuss this important question, and to bring it, I hope, to an efficient and practical result. It need scarcely be pointed out that the present plan of prosecuting grocers under the Adulteration Act, for selling adulterated, spurious tea, must be, in the main, ineffectual, as the adulterations are made mostly in China, and the grocers have no means, when purchasing these teas, of detecting these adulterations, so skilfully are they made. The public must fly at higher game than the grocers to secure themselves, and the Indian planters must do more for their own interests than await the result of the present prosecutions. They must, I think, combine one and all, in every tea-producing district in India, to form a defence association in England, whose business it will be to watch the importation of China rubbish, and to seek the aid of the Ministry and Parliament, if necessary, to protect the public and themselves from this iniquitous traffic. It may be also necessary to apply the system of co-operation, now so general and efficacious, in protecting the interests of different classes of the community, by opening co-operative stores, at which the pure teas from every district in India may be procurable, but on this head mercantile men will be best able to speak.

If I may judge from the numerous applications I have had through the *Times* office for the means of procuring these teas, I should say that a co-operative store, well managed, and based on moderate profits, would be most useful as well as successful. I have letters from Paris, Dublin, the North of Ireland, Aberdeen, Nottingham, Torquay, Warley, &c., and two days ago I had a card sent to me from Edinburgh, announcing the opening of a pure Indian tea store in that city.

Although the Chancellor of the Exchequer does not see his way to stopping the flooding of the country with adulterated teas by Government officials, I hope that the Society of Arts will prove equal to the occasion, and point out some means by which to protect the hard working classes and the people generally from this calamity, as well as to secure for the Indian teas a fair field in the English market.

[*] I find the prices of all these teas to be nearly the same, *i.e.*, they range from 2s. 6d., 3s., 3s. 4d. to 4s. per lb..

DISCUSSION.

The Chairman, in inviting discussion, said that unfortunately the only information available to himself was that which he had received officially, as he had no practical knowledge of Indian tea cultivation. From long experience he was well awaro that such practical knowledge was requisite to supplement official information, which was often imperfect; and, therefore, he felt much indebted to Dr. Campbell for the attention he had bestowed on this subject. A most valuable report had just been received at the India-office from Mr. Edgar, in consequence of the action of the new Department of Revenue, Agriculture, and Commerce, which had been established during the last three years at Calcutta. In June last, the Department sent out a circular to all the different districts, inviting reports as to the condition of the tea industry, the result being a series of very valuable papers, which had been summarised by Mr. Edgar, whose report would, he hoped, be shortly published. His facts, in the main, confirmed what had been said by Dr. Campbell as regards the order of importance of the tea districts, the out-turn of the tea during 1872 being as follows:—

	lbs.
1. Cachar (out-turn 1872)	4,831,883
2. Subsaujer	3,199,500
3. Darjeeling	2,953,926
4. Durrung	1,499,462
5. Luckimpore	802,825
6. Sychet	412,986
7. Nongong (out-turn 1872) ..	370,901
8. Kamroge	278,375
9. Chittagong	204,112

The total, therefore, was about 15,500,000, leaving, therefore, to make up the total, the 20,000,000 spoken of by Dr. Campbell, the Kumâon, Neilgherry, and other districts, which, though of less importance, were still interesting in their way. The great future of the tea-trade, therefore, might be said to lie in the Bengal districts. With regard to the area, Mr. Edgar stated that the quantity of land held in connection with the tea industry in Bengal was 750,000 acres, in round numbers, of which only 75,000 were actually under cultivation; there therefore remained 600,000 and more, held by those embarked in the tea industry, which was yet uncultivated. The fair inference, therefore, was, that before extending the area of land held, these 600,000 acres should be brought under cultivation. The report was a very temperate one, but it certainly conveyed a good caution against an unduly rapid extension of the quantity of land taken up, until the conditions necessary for the supply of labour, food, and means of communication were so far assured as to prevent the recurrence of evils which had left on his mind the most painful impression. The history of the last ten years of that industry, in fact, presented one of the darkest blots on British administration in India. These evils were attributable partly to the absencle of proper care on the part of the administration, party to the recklessness of speculators, and, in some cases, to gross dishonesty. The results were simply horrible. The importation of labour, which was one of the essential conditions to success, had been carried on in such a way that, from 1863 to 1866, something like 80,000 labourers had been imported, but so little care had been taken to provide the necessary conditions for their existence that they had died at the rate of more than 10,000 a year—

in fact, the account of their sufferings was most terrible to read. Besides that, the account given by Mr. Edgar of the jobbery and robbery which took place, in the way of getting grants of land, which were never properly surveyed, was very painful; and the general impression left on the mind was, that unless extreme caution were used, and great care taken, there might be a recurrence of these same evils. At the present time, however, the prospects were very favourable. The Assam district was most difficult to reach, and there the labour difficulty was still a serious one; but the Government were now engaged in making the Northern Bengal Railroad, which, though commenced under pressure, had been sanctioned before the commencement of the famine; and that great trunk line would, no doubt, be the commencement of a whole system of communication which would place those important districts within reach of ports and markets. The other measures which the Lieutenant-Governor had recommended would, no doubt, be taken up when the Government had means at their disposal, which he hoped would soon be the case.

Captain **Cockburn** (late 42nd Highlanders) said he had been, in some measure, the cause of the tempest which had for some time past been raging in the British teapot, as, about 18 months ago, he got the subject of the adulteration of China teas taken up and discussed in some of the public journals. China teas were very much adulterated, and the purposes to which Indian teas were put was, in great measure, that of mixing with these adulterated and low-class China teas, in order to make them in some degree palatable. He hoped, however, the result of the controversy which had arisen would be to bring together the sellers, and those who wished to buy pure Indian teas. His interest in this subject began as far back as 1858, when, having been wounded during the mutiny, he was sent up to a hill station, where he attended a tea auction, the tea being then sold at five rupees, or 10s. a pound, within 14 miles of the plantation. From seeing these prices realised, and studying Government statistics, he was induced to embark in the tea cultivation, it being clearly shown by the prospectus issued, based on the Government statistics, that the investment would return 100 per cent. at the end of three years. He was quite content to halve the percentage and double the time, and advanced his money, therefore, with the expectation of getting 50 per cent. in six years. Instead of that, however, he had had to pay nearly treble the amount he originally intended, and to wait for 13 years without any return whatever, whilst many others had been totally ruined. He was best acquainted with the Himalaya teas, which were totally different to those of Assam or China. The plant in Assam was indigenous to the country, and produced a thick, strong, soupy tea, which commanded its own price in the English market, where it was used for the purpose of mixing with adulterated China tea, so as to delude the British public into the idea that they were drinking tea, when it was really only rubbish flavoured with Assam. For this purpose it was as much superior to the Himalaya tea as the latter was to Assam for the purpose of drinking. The consequence was, when the Himalaya teas came to the English market, they were knocked out at far lower prices than tea inferior for drinking, but superior for mixing, and that was one cause of their non success commercially. Another difficulty was the carriage to the seaboard in many places. Each package had to be carried seven or eight days' journey on coolies' backs, before it reached the nearest cart-road. This difficulty would be overcome by the opening up of good roads, but another was the want of cheap and good agents at the presidency towns. Every one in India made haste to get rich, the only competition being who could charge most. The third difficulty was the low price at which these teas had been knocked out in the English market, from the causes which he had already tried to explain. He had known small parcels of tea, on which the agency charges in Calcutta were considerably more than the tea cost at the plantation, and it was generally a higher price than was obtained in Mincing-lane. Since he had left the service he had endeavoured to overcome some of these difficulties, by starting a co-operative agency for the purpose of disposing of these Indian teas at fair prices. If they could only get the Himalayan planters to combine together, instead of competing with each other, and so occasionally glutting the market—putting the supply into the hands of a society such as he referred to, which would put the teas on the market in accordance with the demand, he was sure that the results would be very satisfactory. The British public would get to know the taste of pure Indian teas, which would command higher prices, the demand would increase, and the planters would be fairly remunerated.

Mr. **White**, who said he had been a long time in the tea trade, could not agree that there was any want of appreciation of Indian teas on the part of the English public, as had been stated in the correspondence in the *Times*. On the contrary, the public fully appreciated the high quality of Indian teas, and would be very glad if the supply were larger. With regard to price of tea, like anything else, it must submit to the competition of the market; there was no such thing as "knocking-out;" the tea was put up and sold, like anything else, for what it would fetch, and if a good article it would fetch a good price; in fact, some Indian teas fetched higher prices than any other which had ever come into the market. Of course, if the quantity were suddenly very much increased, it would not tend to raise the price, but rather the reverse. With regard to the long list of abominable articles with which China teas were said to be adulterated, all who had any practical knowledge of the trade knew that there was an immense deal of exaggeration and misunderstanding on that point; but with regard to any article that had been prepared in any way, and then sent on a voyage of thousands of miles, it was impossible it should present exactly the same natural appearance as when first picked. No doubt there was a certain degree of adulteration in the preparation, especially in the case of green teas, but some preparation was necessary in order to ensure the tea arriving in a sound and dry state after the voyage. People had been accustomed to see tea green or black, but he did not think either was the natural colour of the dried leaf. He was glad to hear that the adulteration had all taken place in China; indeed, he did not think there had been one instance of a grocer having himself adulterated tea, and it was a great hardship for a man to be fined for selling an article on which he had paid duty.

General **Tremenhere** said his own experience of the Indian tea districts was limited to Kangra, which Professor Rawlins had pointed out many years ago as being eminently suited for the production of this plant. He had no doubt that the same was true of the whole range of the Himalayas, and that when the cultivation was developed, India would be capable of supplying enough tea for the consumption of the whole of Europe. Probably the great adulteration of China teas had been the best thing that could happen for India, which he hoped would continue to send, as hitherto, only the best qualities. The price of Indian tea was much higher than that of China, which clearly showed its great value.

Mr. **Rehden** begged to differ from a remark made by Dr. Campbell, that India tea was not appreciated, since the consumption had increased within the last fifteen years from 1 to 18 millions of pounds, and the trade here would soon be still more developed if the Indian planters sent a larger quantity. The prices also were, on the average, much higher than for China tea. The chief complaints of adulteration were with regard to Canton teas, and the same thing was practised twelve or fifteen years ago, before anything was heard of Indian teas. The late Adulteration Act, however, had brought the

subject more prominently into notice, but it was not practised to such an extent as many people seemed to suppose.

Mr. Branson said it was no use treating this question from a point of view hostile to the dealers, who were charged with simply using Indian teas to mix with low qualities of China. From a large and lengthened experience in selling tea to those who retailed it to the public, he could say that such was not the case. Undoubtedly there had been a great deal of rubbish imported from China during the last seven years, but the tea-trade, as a body, were as much disgusted with it as anyone; and if it was any comfort to the Indian tea growers, he could assure them that the importation of this low stuff had resulted in heavy losses to the parties concerned, and it would be probably some time before they resumed their operations. The lecturer had rather censured the retail dealers as a body, and led the meeting to suppose that they were an ignorant set of men, who did not know Pekoe, Souchong, Congou, or any other description of tea from Assam. He could only say that he had been in the tea-trade for about twenty years, and had been in the habit of doing business with the London retailers, and his experience was that they knew as much about tea as the men in Mincing-lane, and very often more. The higher classes of Indian tea, without exception, were used in the proportion of from one-third to one-eighth, to give body and flavour to China teas—to improve them. China teas differed from year to year, and consequently the requirements of the trade, as to the quality of Indian teas they used, varied also. Again, even if the retailers were ignorant, they had the wholesale dealers behind them, and these were as good a set of business men as any class in the country. They each had a certain trade connection to keep together, and were, therefore, always prepared to aid the retailer with their advice when required. He could easily give the names of half-a-dozen men in the City, from whom any quantity or description of Indian tea might be obtained, if the public required them; but because two or three letters had appeared in the *Times*, during two or three months, they could not expect to find Indian teas in the canisters of all the retail dealers, blended to suit the taste of everybody who chose to ask for them. He could only say that he did not believe the use of Indian teas, pure and simple, would be appreciated by the public, nor, indeed, was the supply anything like sufficient for a general demand. They must be sent over in larger quantities, and they must be fired in a much superior manner, if they were to take the place of China teas; because, though half of the Indian tea was simply magnificent in quality, the other half was so uncertain in quality that very often they did more harm than good. Some friends of his had bought Assam tea, and were so disgusted with it that they threw it away, and declared they would never repeat the experiment. A great improvement had been manifested lately in the firing and also in the bulking of the teas, so that, instead of selling each little parcel separately, by judicious bulking, those which were before unsaleable were disposed of without difficulty. He did not think co-operative societies would be of much service, for of all the unnatural and ridiculous ways of doing business he considered that the worst. The trade of England had not been created on co-operative principles, and he did not believe it would be supported by them; the only principles upon which trade could be satisfactorily conducted was the individual interest of every person engaged in the trade for his own benefit. He hoped, therefore, that neither Dr. Campbell nor any of his friends would risk their money in what he was sure would turn out a bad speculation. It was a curious fact, that Indian teas were used much more in Ireland and Scotland than in England, perhaps because the people in those countries drank a good deal of whisky, and were accustomed to something strong and good; at any rate, they would not buy the washy tea which the English did. To supply England, however, with Indian teas, there must be a larger quantity and a more certain quality, and it must not be forgotten that there were always the China teas in competition. You could buy black leaf tea in London at 1s. 6d. (in bond), which was very much better than any Indian teas you could get at the same price. This showed that Indian teas were not neglected by the trade. There was always a great competition for them, and, taking medium China and medium Indian tea, the latter cost the wholesale dealer from 3d. to 4d. a lb. more than the same quality of the former.

Mr. Hyde Clarke thought, after the many valuable remarks which had been made by various gentlemen connected with the trade, a few words from one of the general public might be permissible. In the first place, he would say that it still seemed a mystery what became of the millions of pounds of rubbish which had been discovered by the officers of Customs. There seemed a general desire on the part of the respectable members of the trade to repudiate any dealings in this stuff, but it would be very desirable to ascertain in what way this rubbish was conveyed to the mouths of the consumers, who were principally the poor. Dr. Campbell had by no means asserted that Indian tea was neglected; in fact, the statistics he gave showed that it had only been recently introduced, and that its use had very largely increased. But it was a matter of great interest to the Indian planter to know in what way this tea was used in England, and whether it came directly into the hands of the consumer, thus creating an increasing and well-established demand, or whether it was worked up by the trade in such a manner as to prevent its own intrinsic merits being recognised. That was an important question, and from the remarks which had been made, it appeared it was evident that the Indian teas were coming largely into consumption for the purpose of mixing with China, sometimes a larger quantity being used, and sometimes a smaller. Then came the question how far could teas be brought into the hands of the general consumer? Of course it took time to educate the public taste, but the question for the Indian planter was, were the public really being educated or not to use this tea. The dislike of unaccustomed tastes to the Assam tea, which had been mentioned, might be capable of explanation, and might be removed by better knowledge. For instance, the Secretary of the Society told him that when he first tried the Darjeeling tea he put too much into the pot and spoilt it. It was important, therefore, that some means for instruction should be afforded to the public, and whether or not that should be done by means of a co-operative association, in the first instance, was a matter for consideration. It might not be unnatural for retail grocers to dislike the idea of co-operation, but he apprehended what Dr. Campbell and other gentlemen chiefly referred to was, the co-operation of the planters in India for the purpose of establishing stores in this country, with the object of introducing their teas, and giving instruction as to its use; they by no means entertained the idea that they were going to upset the whole of the import trade, or remove the brokers and wholesale dealers of Mincing-lane from their functions. Nothing could be more interesting than the facts which had been mentioned as to the increasing use of Indian tea in Ireland and Scotland. No one attempted to say that the consumption of this tea had anything like reached its limit; on the contrary, he gathered that if much more were sent to the market, a demand would be found for it. Still, it came back to this, that the Indian planters must prepare the way for the consumption of the article. It was very gratifying to find all the respectable members of the trade repudiating those disreputable practices which had thrown such a slur on the commerce of the country, but there was no denying the fact that a large weight of the various substances enumerated by Dr. Campbell did get consumed, though, of course, every pound of tea was

not mixed with all the articles in the list. This was a great abuse which required to be checked, as much in the interest of the English consumer as of the Indian tea planter. He begged to thank Dr. Campbell for coming forward, though suffering from illness, to introduce this important subject, and he was sure that they all had but one object in view. If, on the one side, there was the interest of the retail trader, anxious to augment the earnings by which he maintained his family, on the other there were the great interests in India to which the chairman had referred; and all must feel indebted to him for bringing forward one of the first reports of that Department of Agriculture which the Society of Arts had solicited the Duke of Argyll to appoint. It was very satisfactory to find that such a valuable report had been prepared by Mr. Edgar, and he had no doubt it would prove the forerunner of a series, all equally valuable. The subject of tea cultivation in India was of great importance, and probably even Dr. Campbell hardly dreamed of the extent to which it would so soon grow when he first turned his attention to it. When a committee was first asked for in the House of Commons, it was said that it would be impossible to get 100 square feet of land in India for any agricultural purpose, but it now appeared that upwards of 700,000 acres in the hilly regions had been taken up, and that they were capable of supplying a quantity equal to that produced by China. Considering the increased demand in Central Asia, and the way in which it stimulated the attention of the Government to the increase of trade, considering also the way in which it acted on the native population of the hills, giving us better servants, better subjects, and better allies; in fact, either from the commercial or political point of view, whoever gave the subject his attention would find himself amply rewarded by the way in which it added to the resources both of India and of the mother country.

Mr. Conolly, in reference to an observation which had been made, that the public did not like the India tea pure and simple, said there was a constantly-increasing demand for the pure Assam tea.

Mr. Coates said he was engaged all day long in the retail trade, and his experience was that the public generally asked for Indian tea separate—Assam or some particular kind—and that on trial they did not like it; but if they asked for China teas in the same way, Moning, or Kaisow, or many other kinds, they would not like those either. He thought, therefore, the best way to induce a taste for Indian teas would be to judiciously mix them rather than sell particular kinds separately.

Mr. Trelawney Saunders thought hardly any of the products of India offered more profitable employment to its vast population than the development of this tea cultivation, and by a curious coincidence it appeared to grow to most advantage in that part where there was the densest population, and which was now threatened with such great disaster. With reference to the trade with Central Asia, especially that portion which was coterminous with the northern frontier of India, active intercourse was only prevented by political restrictions. It had been said that there were great difficulties in the way of carriage, but in truth there was no part of India where facilities of carriage might more easily be obtained. It seemed like a paradox to assert this of a district presenting the greatest physical difficulties, being on the borders of the Himalayas, the highest mountains in the world; but he referred to the facilities afforded by the employment of the vast flocks of sheep which existed on those plateaus, and which were used largely for such purposes. Only a short time ago, he found it stated on unquestionable authority that, where the paths crossed these mountains, half-a-dozen men could conduct a flock of a thousand sheep, each of which was capable of carrying a load of from 30 to 60 lbs. Those sheep had to be moved backwards and forwards for the purpose of pasturage, and might as well be utilised to effect an interchange of the respective commodities of the two countries. On the Indian side there was hardly any limit to the production of tea, and on the other side of the frontier there was the largest wool-producing country on the face of the earth. The future development of Central Asia would much depend on the turn things might take with regard to this matter, especially having regard to the advances now being made in that direction by Russia, with her exclusive tariff. He could not agree with those who thought it desirable to invite the Russian Empire to come down to the Indian frontier; they forgot, apparently, that as far as the Russian frontier extended there would be a cordon absolutely exclusive of our European manufactures, besides which it would be one of the greatest experiments in modern politics to bring into close friction two political systems so opposed to each other as the free government of England and the despotism of Russia. He hoped, therefore, that some pressure would be brought to bear at Pekin, for the removal of the political barriers which at present interrupted communication between the tea merchants of India and the consumers of Western China.

Dr. Campbell, in replying, said he must have completely failed in expressing what he meant, or he could not have been charged with saying two or three things which were quite contrary to his intention. The main drift of his paper was to refer to the adulteration of China teas as affecting the sale of Indian teas. He had not intended to bring a charge against any class of the community, and had only referred to one individual grocer, who confessed himself altogether ignorant of Indian teas. It appeared to be only in China that the adulteration took place, and it was no use going anywhere but to the fountain head, and preventing it being sent out from China. He suggested co-operative stores as a means of bringing pure, unadulterated tea before the public, and he believed the principle had proved so far successful as to warrant a trial of it in this particular case.

The Chairman said that with regard to the extent to which the adulteration of China teas had interfered with the natural progress of consumption of Indian teas, he gathered from the discussion that it really had not much to do with it; and that this adulteration, to whatever extent it existed—and he feared there could be little doubt that it did exist to a considerable extent—was practised irrespectively of any question connected with Indian tea. It also appeared that Indian tea was principally used for the purpose of being mixed with other qualities, to make them more saleable and palatable, and he thought its future consumption would be best promoted by a judicious admixture of it with China tea, or by mixing the different qualities of Indian teas together. Indirectly, the sale both of good Indian tea and of good China tea must be retarded and checked by the importation of spurious tea, the matter being simply a question of price. Of course these spurious teas were sold at very low prices, and to that extent must interfere with the sale of more expensive articles. One question had rather embarrassed him, namely, as to how this adulteration could be prevented. He had been led to infer, from the correspondence in the papers, that this adulteration took place principally in China, and many persons had said it might be checked by the action of the British Custom-house. But he could not avoid a very strong suspicion that this adulteration had taken place very much in this country, and that it was by no means impossible that the process which was now discovered in China, had been very much suggested and stimulated by the necessity of competing with the effects of adulteration in England, which latter, of course, might in some degree be due to the import duties. For a long time that duty was so high

as almost to create the necessity for adulteration, and even at the present time, although the duty of 6d. per lb. appeared moderate, still, on calculating it on the average value of importations, it represented at least 30 per cent., which was a very heavy duty on an article of such large consumption. So long as it existed he could not but believe that there would be a great temptation to adulteration, and so long as that existed in England there would also be adulteration practised in China. He was sorry to say that he had not gathered from the discussion any distinct idea as to what remedy could be applied. They all knew that application had been made to the Government to make use of the Custom-house administration to refuse admission of spurious teas, but these applications had not at present been favourably entertained, and they seemed rather to have been abandoned on the part of the public. He must say, however, that in his official life he had great experience of the Custom-house, which was a department of extreme efficiency, and he had had on repeated occasions to bear testimony to it, but he had always observed that they exhibited a very remarkable ability in finding objections to any change or reform that might be proposed; on the other hand he was bound to say that they also exhibited still greater ability and ingenuity in overcoming those difficulties which they had before considered insuperable, whenever they received instructions to do so, and he could not help entertaining the conviction that if they received instructions from the Chancellor of the Exchequer to use their organisations for the purpose of checking these importations, the thing would be done with the least possible injury and obstruction to trade. Mr. Saunders had called attention to the great importance of this question with regard to the trade between India and Central Asia, and to this part of the question he was particularly alive, and might safely say that the attention of the Government of India was fully directed to the importance of developing that trade in every possible manner. When the present unhappy circumstances which now absorbed the whole of their attention were removed, it might be hoped that this question would again come to the front, and be dealt with in a practical manner. There could be no doubt that the progress of commercial intercourse with the countries of Central Asia would operate in the strongest way to avert the political dangers which many persons were apt to consider hung over the northern frontier of the Indian empire, and any efforts in this direction would always command his entire sympathy. He concluded by proposing a vote of thanks to Dr. Campbell.

The vote of thanks having been passed, a similar compliment was voted to the Chairman, on the motion of **General Vaughan, C.B.**, seconded by **Mr. Ward.**

EIGHTH ORDINARY MEETING.

Wednesday, January 28th, 1874; Sir Antonio Brady in the chair.

The following candidates were proposed for election as members of the Society:—

Bosanquet, Samuel Courthope, Tanhurst, Dorking.
Brown, Henry, Mayor of Salisbury.
Chown, Thomas Collingwood, 29, Pembroke-gardens, Kensington, W.
Cockburn, George Ferguson, King's Farm-lodge, East Sheen, Mortlake.
Dean, William, Locomotive Department, Engineers' Office, Great Western Railway, Swindon.
Hayward, John Williams, M.D., 117, Grove-street, Liverpool.
Holder, Charles Henry Vane, 37, Grosvenor-place, S.W.
Knowles, John, Westwood, Pendlebury, Manchester.
Rainford, Bentham, 20, Regent-street, S.W.
Stevenson, George Wilson, 19, Great George-street, S.W.
Swanzy, Andrew, 122, Cannon-street, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Ashby, Morris, Colne-house, Staines.
Batley, John, 7, Kensington-park-gardens, W.
Beale, Joseph, Ash-mount, Abbey-wood, Lessness-heath.
Budenberg, Arnold, 23, Lower King-street, Manchester.
Burgess, Arthur W., 107, Strand, W.C., and 2, Thames-villas, Bray, Berks.
Burton, Walter Hally, 8, Mill-street, Hanover-square, W
Carr, Ellis, Heath-view, Clapham-common, S.W.
Chavasse, W., 505, Oxford-street, W., and Athlone-house, Shernhall-street, Walthamstow, E.
Cheney, Frank W., Messrs. Cheney, Bros., Hartford, Connecticut, U.S. America.
Cubitt, Leonard W., 12, Newgate-street, E.C.
Dann, Miss, 11, Chester-place, Hyde-park, W.
Drury, Mrs., 13, Radnor-place, Hyde-park, W.
Fowke, John C., Ann-street, Birmingham.
Frewer, Charles, 34, Nicholas-lane, Lombard-street, E.C.
Garland, Richard Wheen, Wharncliffe-works, Sheffield.
Hadland, John Henry, Wallington, Surrey.
Hurst, Thomas W., 8, Portsdown-road, Maida-vale, W.
Israel, Samuel, 1, Crescent, America-square, E.
Johnston, A. R. Campbell, F.R.S., Heatherley, near Wokingham.
Jones, Rev. John, F.R.G.S., 1, Crowland-terrace, Church-road, Islington, N.
Kempson, Mr. Alderman W., Mayor of Liecester.
Lambert, Thomas John, 59, Bishopsgate-street Within, E.C.
Lazarus, Abraham, 55, Euston-square, N.W.
Lazarus, Simeon, 38, Tavistock-square, W.C.
Leonard, Alfred Selfe, Ebley court, Gloucestershire.
Lindsay, Alexander, Bridgeton, Montrose, Scotland.
McFarlane, D. H., 62, Portland-place, W.
Nightingale, B. E., Albert Embankment, S.E.
Norris, Richard Stewart, C.E., Kenyon, near Manchester.
Norton, George, 19, Abchurch-lane, E.C.
Paget, Frederick Arthur, C.E., 1, Seymour-chambers, Adelphi, W.
Pasley, Lieut.-Col. Charles, R.E., Director of Works Department, Admiralty, Spring-gardens-terrace, S.W.
Postlethwaite, Alfred Perry, Royal School of Mines, Jermyn-street, S.W.
Pott, Robert, Bridge-street, Southwark, S.E.
Power, Edward, Oriental Club, W., and 45, Belsize-park, N.W.
Pratt, F. M., 18, Clifton-gardens, Maida-hill, W.
Prouse, Charles, jun., Melford-house, Upper Clapton, E.
Rivington, Septimus, 8, Kensington-gardens-square, W.
Robertson, R. A., 45, Scotland-street, Glasgow.
Sacré, Alfred L., 1, Mornington-crescent, N.W.
Scanlan, William Robert, 5, Grove-terrace, Walsall.
Selby, George Thomas, 1, Eaton-square, S.W.
Simpson, James Barron, 30, Baker-street, Portman-square, W.
Smith, Valentine, Thames-bank, Grosvenor-road, Pimlico, S.W.
Smith, W. J. Boase, Manaccan, Helston, Cornwall.
Steel, Harry J., Wharncliffe-works, Sheffield.
Steer, A., 83, Upper Thames-street, E.C.
Stephens, Henry Robert, 3, Cornwall-road, W., and 3, King Edward-street, Lambeth-road, S.E.
Taylor, Henry, 2, York-gate, Regent's-park, N.W.
Taylor, John Leigh, Oakleigh, Bolton-le-Moors.
Taylor, William, Westbourne, Chorley New-road, Bolton-le-Moors.
Tomkins, Alfred Savill, 29, Ladbroke-square, Notting-hill, W.
Webber, Major C., R.E., 101, Cannon-street, E.C.
Wight, James F., Gatcombe-villa, Croxted-road, West Dulwich, S.E.

Williams, Henry, Warwick-house, Loats-road, Clapham-park, S.W.; and 17, Warwick-lane, Paternoster-row, E.C.

AND AS HONORARY CORRESPONDING MEMBERS.

Satterlee, F. Le Roy, M.D., Ph.D., 42, West 21st street, New York, U.S. America.

Troy Ortolano, Don Juan de, D.C.L., K.C.I.C., Calle de San Miguel, No. 27, Madrid.

The paper read was—

ACCOUNT OF A RECENT VISIT TO THE COAL AND IRON FIELDS OF VIRGINIA.

By Professor D. T. Ansted, M.A., F.R.S.

Almost a year has elapsed since Major Hotchkiss in this room communicated to the Society an admirable account of the resources and statistics of the Virginia States, with which he is probably better acquainted than anyone, and his address on that occasion, published in your *Journal*, may be referred to with advantage on every point.

In bringing the subject before you again on this occasion, I do not propose to repeat what he has said, but to limit myself to the results of my own experience, obtained recently during a three-months' residence, chiefly among the iron and coal deposits briefly alluded to by Major Hotchkiss. These deposits, since his address, have been laid open by the completion of the Chesapeake and Ohio Railroad from Richmond, on James River, below tide-water, to Huntingdon, on the Ohio, a point below which there is navigation almost all the year. This line was first opened for general traffic in April last, but owing to delay in the completion of a tunnel under part of the City of Richmond, the opening to the tide-water was not available till November last. Practically, therefore, so far as the conveyance of minerals eastwards out of the State is concerned, the railway is only now coming into operation, and has not yet had an opportunity of being utilised.

The development of the mineral resources of the two Virginias was impossible until the completion of railway communication from the Atlantic to the Mississippi. The coal could not be carried to the iron ore, and had no free outlet to the west. It was equally impossible to carry the ore to the coal with any possibility of profit. The James River Canal is still separated from the waters of the Kanawha River by a transit of more than 100 miles over roads which, even at their best, would not be thought even passable in this country. Mineral traffic over such roads was out of the question, and was never attempted. I travelled over them myself twenty years ago, and they were then only fitted for the transport of waggons at a very slow rate. I have been upon them lately, and find them unaltered; and, after all, the James River Canal, in its present state, has not the capacity of doing a large business. It must be enlarged, deepened, extended through the mountain-chain, and completed before there can be that water communication between the West and the Atlantic that the mineral treasures of the two Virginias now urgently demand, and the rapidly increasing importance of the Western States as urgently needs.

My business in America was partly to make the requisite arrangements for the proper carrying on of the business of a company established to work a tract of coal and timber lands, and partly to inspect and report on a number of iron properties in Virginia and coal lands in Western Virginia. It thus became necessary for me to diverge from the line of the railway, and penetrate the creeks opening into the main river valleys. These vary in length from three to a hundred miles, and many of them have numerous forks and branches.

It is one of the peculiarities of the Virginian mineral-fields that the principal minerals are generally accessible above the water-level. No borings are needed to prove the presence of the minerals, no shafts required to reach them, no pumping to drain them, and no machinery to open and work them. They are easily and naturally ventilated. The exceptions to this condition are chiefly in the small coal-fields near Richmond, the gold districts in and near Buckingham, and the salt in the Kanawha. The magnificent and abundant iron ores, and the boundless wealth of the Appalachian coal-fields are of enormously greater importance than the comparatively small resources of the Richmond coal-fields, the gold of Virginia, or the miscellaneous minerals, many of them only rendered useful by the coal and iron.

The iron in the east and the coal in the west then must be looked on as the principal minerals to which the two States of Virginia and Western Virginia will owe their future importance. The principal deposits of both are crossed nearly at right angles by the line of the Chesapeake and Ohio railroads. They are thus brought into immediate contact with each other and with the outer world.

The iron country of Virginia occupies two distinct geological positions, and the ores are of different kinds. East of the Blue Ridge, which is the easternmost mountain chain of North America, there are bands of magnetite, not absolutely continuous at the surface, but visible and traceable by their contents for a considerable distance, ranging north-east and south-west, and crossed by the rail near Charlottesville, about 100 miles from Richmond. At frequent intervals, within a breadth of about twenty miles, are ridges rising as much as two hundred feet above the valleys, having a core of hard, compact iron ore of the finest quality, often yielding much more than 50 per cent. of metallic iron in the furnace. These ores are chiefly peroxides, with a small admixture of protoxide of iron and very small quantities of silica.

I examined several properties between Charlotteville and Lynchburg. In these there can be no doubt of the presence of enormous quantities of such ores obtainable at very small cost. They are now being leased under royalties which average about 2s. 6d. per ton of ore, and the leases on these terms are already being sold at high prices. They are well adapted for the manufacture of steel by Siemens' process, but at present capital has not yet enabled the ironmaster to avail himself of this source of wealth.

A transverse line of rail between Charlottesville and Lynchburg, connected with the main lines of communication both north and south, now renders all these properties valuable, and I have little doubt that in a few years we shall see steel rails manufactured here on a very large scale and at great profit, by both the Bessemer and Siemens process. There are already rail mills at and near Lynch-

burg, but these are supplied with fuel from the Richmond coal-field. I do not think it necessary to dwell on the features of this deposit, inasmuch as the coal is not of very good quality and must always be very costly to mine. Neither do I think it desirable to occupy your time by reference to the pyrites and gold deposits of Buckingham county, accessible at Tolersville, about 56 miles from Richmond. These are important minerals, but they cannot bear comparison with those further to the east.

The Blue Ridge forms a natural boundary, beyond which this class of ores does not pass in Virginia. To the west of this chain, however, and in the broad, rich valley that extends in this direction to the Appalachian Mountains, there is a group of Silurian and Devonian rock squeezed into folds, and containing, at intervals for about 50 miles, an important band of brown hæmatite, and a thinner deposit of rich peroxide of iron. These are repeated in some places three times, and in each repetition contain singularly rich and valuable deposits of ore, the hæmatites being sometimes more than 40 feet thick, and yielding generally from 40 to 50 per cent. of metal. This great bed is found to extend from Pennsylvania through Eastern Ohio and Virginia to Kentucky. From similar ore, found further north, some of the finest iron of Pennsylvania has been made, but in the northern part of its range the use of it has been checked by the cost of fuel. In Kentucky and Tennessee, however, where these ores have come into use, and in the few parts of Virginia where furnaces had also been erected previous to the opening of the Chesapeake and Ohio Railway, charcoal was the only fuel employed. The splint coal of the Kanawha has now been substituted in these same furnaces for charcoal, without lowering the quality of the iron.

So lately as 1864, when the well-known and exhaustive work of Dr. Percy on iron and steel was published, the magnetites and hæmatites of Virginia were not even alluded to, and had not entered into consideration as among the American ores practically available. We are there told that the principal iron manufacture of the States "must always cling to the Lehigh and Schuylkill and Lower Susquehanna Valleys in Pennsylvania, where the ore is abundant, the coal near at hand, and the flux on the spot." ("Percy's Metallurgy," p. 382.) Already it is evident that in Virginia iron can be made cheaper and better than in Pennsylvania, where the ore and fuel are both failing, and the wealthy and enterprising Pennsylvanian ironmasters are gradually removing southwards, and acquiring the iron-fields between Charlottesville and Staunton, where the ore is equally good, the coal nearer, the available quantity of both minerals greater, and where both coal and iron can be mined on much more favourable terms.

The hæmatite belt, as we may call this part of Virginia, commences as you leave the valley of Virginia a little west of Staunton, and the first deposits of ore of importance come in at a distance of about ten miles from that town. The deposit is here of great thickness, and generally of high per-centage. The first furnaces are near Siberton Station, at Buffalo Gap, but these are not at present in blast. The furnaces are very well situated for mixing ores, as there are very valuable deposits of magnetite at about 50 miles distance, hæmatite and fossil ore near at hand, and the best varieties of coal capable of being used raw in making first-class iron at about 180 miles distance by rail. The cost of the rich 70 per cent. ore at this spot would not exceed 10s. per ton, the cost of the local hæmatites of 40 per cent. 3s., and the raw splint coal 12s. Limestone is close at hand at a very small price. From Siberton (Buffalo Gap Station), nearly as far as Corington, a distance of 50 miles, there are very numerous localities, at any of which works might be established, with a certainty of obtaining on an average 50 per cent. ores for little more than 6s. or 7s. per ton, and the splint coal of the Kanawha at an average price of 10s. per ton. I do not hesitate to say that throughout this district iron may be made at a cost not exceeding 15 dollars, or 60s. per ton, and this iron would be of very fine quality, and equal to charcoal iron. A considerable number of properties within this belt, and near the rail, have been purchased by Pennsylvanian and New York capitalists, some for actual work, others for speculative sales, and in a few years the railway will be lined on both sides with furnaces.

In most of these places the ore is quarried, and has a thickness of very many yards. It exists in bluff forming the nucleus of low hills, 200 or 250 feet above the general surface, and can be obtained with exceeding facility. In many cases limestone bands alternate with the ironstone. At each recurrence of the deposit there are certainly millions of tons of ore within a very moderate distance of the railway.

The advantage of position will be manifest if this district be compared with those of Pennsylvania and Ohio. In them the iron ore is now chiefly obtained from Missouri, a distance of 90 miles by rail and 900 by water. In Pennsylvania, the coal is worked at great and increasing cost, and the iron can hardly be manufactured to sell at a profit, unless the price per ton of pig is as much as 26 dols., or 104s. The anthracite districts are not better off in regard to the cost of manufactured pig. Estimating the annual make of pig-iron in America at about $2\frac{1}{2}$ millions of tons, it is certain that two millions are made in Pennsylvania and Ohio, and thus the price of the metal is governed by the make in those districts, and requires high protective duties to enable it to compete with foreign pig under ordinary circumstances.

As the demand for railway iron alone in America is greater than the total present make of pig, it is manifest that there is an opening for a largely increased manufacture, even at high prices; and many years must elapse before the price will descend so low as to yield other than large profits and ready sale to the Virginian ironmaster. Capital alone is wanted to develop the best resources of Virginia in the matter of iron. This capital cannot come fast enough, and iron works in Virginia, on the line of the Chesapeake and Ohio railway, if properly conducted, cannot fail of success.

The opening for the manufacture of Bessemer and Siemens steel is not less promising than that for ordinary pig. No country has so large a need of steel rails as the United States. No country in any approximate degree so large, so well peopled, so prosperous, has so great a need of roads, and no one would think of constructing any road but

one of iron. The railroads already constructed are only sufficient to create a demand, constantly increasing, for this mode of conveyance, which is an essential before any new town can arise or any old one improve. But iron ore, even though present in a country where there are vast stores of wood adapted for making charcoal, cannot be properly utilised without coal. Less than a fourth of the native made iron, in 1872, was charcoal iron, half was anthracitic, and the remainder bituminous coal and coke. The anthracite is a comparatively small deposit, already being worked down, and not at all likely to become cheaper. The deposits are not large. It is certain that, to insure a large make of iron, the coals of Western Virginia must be brought to the iron ores of Virginia, or the converse. The cost of conveyance is about the same for coal and ores, and thus, if required, a double business may be carried on with advantage. The most westerly iron ores are about 100 miles from the most easterly coals, but the most easterly coals are not the best, as they consist of beds of only moderate thickness and few in number, underlying the Mahoning sandstone, which is a hard band of gritstone, separating the lower from the middle coal measures. The best coals seem to be the coals of the middle measures. There are, however, good and promising seams of tender coal now being opened at a distance of about 100 miles from the iron-ores.

The coal, then, is separated from the iron ore in Virginia by a railway distance of 100 miles. Geologically, the distance is greater here than either further north, where the lower coal measures are better developed, but where the middle measures are absent. An important fault, removing a considerable thickness of rock, brings the two minerals together. The lower coal measures comprise about five seams, one or two of them as much as five feet thick, generally of tender coal, believed to be well adapted for coking, but hardly yet sufficiently proved. These measures dip to the north-west, at angle of about one in a hundred, and are terminated upwards by a hard and thick bed of sandstone, believed to be the Mahoning sandstone of Rogers. This sandstone is an admirable building material, and being broken through by the gorge or canon of the New River, forms the highly picturesque cliff called Hawk's Nest. It is above this sandstone that we find the noble series of the middle Appalachian coal field, as shown in the Kanawha Valley. Commencing at Mill Creek, near Hawk's Nest station of the Chesapeake and Ohio railway, we find in Gauley Mountain, which rises behind the station to the west to a height of 2,500 feet above the railway, an unusual thickness of workable and valuable seams. There is here about 60 feet of workable coal in a number of seams within a thickness of about 800 feet of measures. One of the lowest workable seams has been lately opened for work, and is found to contain (about 1,000 feet above the railway) at least 10 feet of hard, compact coal, of the splint and bituminous varieties, and above this are several other seams equally valuable. The upper seams include cannel.

Between Mill Creek and Gauley River, where the united waters of the New River and Gauley form the Kanawha, and fall over the ledges of Mahoning sandstone, which here comes to the level of the valley, there is no access to the coal by any valley or gorge. Though not immediately available, there are, however, vast treasures of mineral wealth in this district that must come into use before long. Gauley River, like New River and the Kanawha, has a somewhat obstructed navigation, though it admits of easy improvement. It is the natural outlet of a large tract of remarkably fine and manageable coal seams. From the mouth of Gauley down the river Kanawha the whole country consists of coal lands for fifty miles. The great plateau is intersected not only by the Kanawha, but by many other streams more or less accessible, and is traversed along the Kanawha Valley by the railroad. These coal lands contain for a long distance the whole or nearly the whole series. The lower measures, and the middle measure as far as Kanawha Falls, dip gently to the north-west, at an angle of about one in a hundred. From that point they gradually become nearly horizontal, dipping for some distance little more than the bed of the stream. For a long way, therefore, almost the whole series is available above the water level, and it is not till after travelling for a distance of 30 miles by rail that the dip is found once more to increase and regain its angle of one in a hundred. At Charleston, the upper coals of the middle series come to the water's edge, and beyond to the west the upper measures commence. These are not locally important, although they increase in value, both towards the north and south. It is not unlikely that some of the coal seams pass occasionally into cannel, and occasionally into iron ore of the black band variety.

Cabin Creek, Elk River, and Coal River are three considerable tributaries to the Kanawha, penetrating the country for a long distance, and bringing into convenient working position many scores of thousands of acres of valuable coal land. The two latter are partly navigable, but there cannot be a doubt that before long all of them will be supplied with railroads, by which the coal will be brought into the market. They lay bare some of the finest deposits of cannel coal in America.

Near Charleston, there is another source of mineral wealth. The Kanawha, like many streams running through plateau countries, has cut for itself a deep groove, and occupies almost the whole of its river bed, leaving little available land for habitation or cultivation.

From the commencement of the coal field on the Kanawha, there is nowhere sufficient level ground near the railway to justify the building of a town of even moderate size. A little above Charleston, however, there is such a tract admirably adapted for the purpose. The town of Charleston occupies the part of it nearest the river mouth, but on the side opposite the railway, while a still larger level space exists, nearly adjoining, and on the railway side of the river; on that are numerous borings, reaching brine springs.

A somewhat important manufacture of salt is carried on here, and there is room for many other manufactures of even greater importance. The coal here, as in too many places in and near the Kanawha, comes close to the water level, and the beds are unfractured and nearly horizontal. The quality is also excellent, and the valuable upper seams, which generally include cannel, are close

at hand, and may be obtained by very deep mining. The railway crosses this tract for a distance of some miles; the river is here navigable ten months in the year, and the distance from the Ohio is only fifty miles by rail, and is little more by by water. The salt manufactured from the brine of the Kanawha valley has been much valued for the curing of meat, and the mother liquor contains large doses of bromides. At present the manufacture is little developed, though of long standing, but no place could be selected better adapted for chemical works, and the site is available for many purposes.

Nothing has been yet said of the vast and important forest of valuable timber trees on the line of country crossed by the Chesapeake and Ohio Railway, and now for the first time opened. So large is the quantity, and so excellent the quality, on and near the Gauley River, that this source of wealth must continue for a long time to occupy attention. The chief timber is oak of various kinds, hickory, ash, beech, white poplar or tulip-tree maple, black walnut, chestnut, and locust. The number of well-grown straight trees to the acre is unusually large, even for American forests.

Removed at present from existing lines of communication, but likely to be rendered accessible before long, are tens of thousands of acres of valuable land, covered with timber and abounding in mineral wealth. Large tracts of this kind exchanged hands a few years ago, at merely nominal prices, but are already acquiring a sensible value, and few better investments could be made by those willing to leave capital idle for a few years, than the purchase of these lands at present prices. At a cost varying from three to fifty dollars per acre, property may now be acquired that, a few years hence, will be saleable at twenty times that amount.

In endeavouring to direct the attention of members of this Society to the resources of a sister country, hitherto undeveloped for want of means of communication and capital, I feel that I am only carrying out, as far as in me lies, the object of the Society, and I am sure you will agree with me that the great importance of the subject is a full justification, if any were needed, for once more asking you to consider the resources of the "Old Dominion."

DISCUSSION.

The **Chairman** said that having twice within the last year visited the district described by Mr. Ansted, he could, in the main, corroborate every word he had said, and if he had hitherto abstained from speaking on the subject in public, it was from fear of being charged with exaggeration; in fact the mineral wealth of the country was scarcely credible to those who had not seen it, though, whether it was not equalled by its agricultural wealth it was somewhat difficult to say. There were lands there which had been cultivated a hundred years successively with Indian corn, which had never had an ounce of manure upon them, and yet they would produce crops of 80 bushels to the acre. And not only so, but the climate was one of the most lovely on the face of the earth; the Kanawha Valley was about 60 feet above the level of the sea, so that there was always a fresh mountain breeze blowing, and he was suprised to find the amount of labour he could get through in the way of walking without feeling fatigue. Although the weather was sometimes very hot in the summer, yet the air was so bracing that no inconvenience was felt from it.

Mr. Hyde Clarke thought probably the statements brought forward by the lecturer, and corroborated by the Chairman, really fell short of the reality; in fact, as had been stated, it was not until the seams came to be worked that their real worth was known. It had been his duty to collect information on this subject from a variety of sources, and to a considerable extent from those who were the commercial rivals of Virginia, but if he went into figures he should have to give precisely those which had been stated by Professor Ansted as to the cost of production, and the prices and profits obtained in the northern districts. The production which must take place in this and the neighbouring districts would certainly produce a great influence on the iron markets and industries throughout the world, and England especially must be affected, so that no apology was needed for bringing the subject forward and bespeaking for it the most careful consideration. His own object on that occasion was the same as had actuated him when he offered a few remarks on Major Hotchkiss's paper last year, when, after listening to a wonderful account of the natural resources of Virginia, he said the question naturally arose how it was that those great advantages had not already been turned to better account; the fact being that our kinsmen in Virginia had not been equally blest with moral worth, and had been completely undmindful of their obligations to their creditors. Old, or Eastern Virginia, had not adequately provided for its bonds, and Western Virginia had done nothing at all. The neighbouring State of North Carolina was in the same circumstances, and, therefore, it would be totally impossible for Virginia to obtain the funds necessary for the due development of her great natural resources until she was prepared to do justice to her creditors, the capitalists of England. Even after the testimony of high-minded scientific men like Professor Ansted, corroborated by disinterested witnesses like the chairman, it would be impossible for persons in England to invest money in Virginia until they were fully assured that public obligations would be fulfilled. He took this opportunity of mentioning the matter, because the Society of Arts was not only the proper place in which to bring forward economical questions, but also to defend commercial interests and moral principles as they affected financial engagements. The discussion reproduced in the *Journal of the Society of Arts* a year ago, had undoubtedly produced good results in Virginia, and materially affected the last elections: party leaders had professed their readiness to carry out the financial engagements of the State, and the result was now awaited with anxiety. He hoped that evening's discussion would also not be without effect in obtaining the accomplishment of the promises made last year. He wished to add that he did not make these remarks from personal motives, but as representing a large body of men and women, who, having trusted to the ancient faith of Virginia, found that her obligations were not fulfilled, and were therefore obliged, in this public manner, to appeal to the sense of honour in her citizens.

Mr. D. Macomber said he had been highly pleased with the valuable paper which had been read, though he should have liked it better if it had been of a more general character, and there were one or two statements in it which he, as an American, fully acquainted with the coal regions of the United States, wished to correct. One was the allusion made to the anthracite coal regions of Pennsylvania, which were in no degree diminishing in importance. They covered about 470 square miles, whilst the bituminous coal region of the United States covered 200,000 square miles, exclusive of that which lay along the line of the Pacific railroad.

The anthracite coal of Pennsylvania was divided into three measures, the middle and southern being about 50 miles by 20, while the northern, including the Wyoming valley, was about 50 miles by less than 10. The great portion of the anthracite coal lay all above the water level, as did a great portion of the bituminous coal in Virginia. There were also large quantities of bituminous coal in Pennsylvania. The anthracite coal beds were not known in 1748, when Penn purchased the land, nor for many years afterwards, but they lay in a very convenient position, and he knew of one instance where a tunnel which was being carried through a mountain would cut off 36 veins, varying in thickness from 2 ft., below which they did not reckon anything, to 30 ft., and these ran for 1,200 ft. before they reached the top of the mountain. These minerals had not been hitherto developed because they were the property of old families who had not given their attention to the matter. In immediate juxtaposition were three kinds of iron ore, one being the "black-band," and also limestone for flux. He did not wish to say a word against Virginia, but he believed the reason these beautiful deposits had not been worked was the curse of slavery, which until recently had hung over it. That had now been removed, Virginia was opened to the world, and he was glad to see that there was a disposition to invest capital in the country. He believed the deposits of bituminous coal extended almost to the Rocky mountains.

Mr. Hale thought if England did not improve her methods of iron manufacture she would find her trade leaving her.

Mr. Galloway said the paper called back to his memory a time twenty years ago, when it was his lot to reside in South America. He had heard a remark that coal and iron was used in all parts of the world, and that night they had heard of coal and iron being discovered in Virginia. Iron and coal not only formed the staple commodities of countries, but formed the base of wealth and manufacture. One important feature arising from the paper would be that, just in proportion as coal was discovered and worked in other countries, so would the supply necessary from this country be so much the less, and so would coal fall in price, which would be a general benefit. With respect to the qualities of iron, he quite agreed with the sentiments of the previous speaker, that if we were to devote all our skill, talent, and energy to the improvemant of the manufacture of iron, they would be far in advance of what they were now, and would produce a better quality of iron than any other part of the world.

Mr. Boorn said about two or three years ago he was in Virginia, and he could confirm the statement in the paper as to the wealth of that State. But there was one sentence, if he had understood it aright, that he must take exception to, viz., that the iron ores and coal, although 100 miles apart in Virginia, were more valuable for the manufacture of iron than in some other parts of America, where the coal and iron were not so far apart. The reason assigned for that by Professor Ansted was that the iron ore was not so pure, but what districts he had visited to fortify that statement he did not know; but this he did know, that for very nearly 800 miles running parallel with the Apallacihan chain there was no very wide distinction in quality. Some places were richer than others, and more or less pure, but he knew of no place that was richer in iron ore than Eastern Tennesee. The iron ore there was charged with manganese, which was a great advantage, as it rendered the ore easily capable of being converted into spiegeleisen. Again, the hematites of that region did not average more than ·03 per cent. of phosphorus. With reference to the remarks which had fallen from Mr. Hyde Clarke, he thought the best way to help Virginia was by sending capital there, and believed that when she developed her resources she would be able to pay all her debts.

Mr. Russell Gole said, as the dip of the strata had been mentioned, he should like to know the highest point where coal began, where it reached the water level, and how far they would have to go down to reach the coal?

Mr. Smartt said he should like to know what would be the cost of iron when produced, delivered at the coast, and also the cost of its delivery in England? He had inspected some property in North Devon, where he found almost pure iron, but at a height of about 1,000 feet, and as the road there was almost perpendicular, it was impossible to place it on board ship, and it had to be carted a considerable distance at great cost, thus rendering it almost useless. If in Virginia they had to cart the coal 100 miles, and then to convey the production afterwards down to the coast, it appeared to him quite possible the cost would become so great, that it would be unable to compete with the iron production in other places.

The Chairman, in reply to the last speaker, said the railway did not at present extend beyond Richmond, where there was not sufficient depth of water for colliers and vessels of large draught, but it was being continued to Heart's-Content, where there was deep water, and then much greater facilities would be afforded. The railway authorities were willing to convey the coal at $1\frac{1}{4}$ dollars a ton for 100 miles. With regard to the position of the coal, and the mode of getting it to the railway, the line ran along the side of the mountain on a ledge close above the river; and above the line there were no less than sixteen seams of coal, making a thickness of over sixty-six feet. The angle of the cliff was about 45°, and, a double line of rails being laid on the incline, the loaded waggons came down, the speed being regulated by a break, drawing up the empty ones at the same time. Thus the coal was easily placed either in the cars or on board boat in the river, at a cost not exceeding one dollar a ton. The river below the Falls was navigable to the Ohio, which ran into the Missouri, and thus opened up an inland navigation of more than 200,000 miles; on the other hand, it was only 300 miles from the seaboard, and, therefore, the cost by rail at one and a-quarter dollars a ton could easily be calculated. At present the railway was only a single line, but he observed that all the bridges and culverts were arranged for a double line, and the company was only waiting for the traffic to develop to raise capital and double the line. The question raised by Mr. Hyde Clarke was an interesting one; but, no doubt, Virginia had suffered cruelly during the war, though she was now recovering; and he believed that, with the example of Pennsylvania before them, her citizens would strain every nerve, and make every effort loyally to pay their debts. The discussion in that room a year ago had had some good effect, and he did not doubt that that evening's proceedings also would not be without results. Virginia abounded in natural wealth, and he had no hesitation in saying that she had a great future before her. No doubt the deposit of coal and iron was very general over the continent; in some parts it existed almost in one solid mass, but then it was 2,000 miles from a market; whereas in Virginia the markets were close, and communication would soon be easy. In the valley north of the one they had been discussing, there was a railroad, for which a loan had just been negociated of two millions, and this twenty years ago opened up the Pennsylvania coal-fields. The coal there was quite equal to that of Virginia, and was now carried to Baltimore, which was about the same distance as Richmond was from the Virginian coal-fields. In six or eight months, when the railway was finished down to the sea, there would be an opening both east and west for these magnificent coal-fields. The great rise in the value of land had been referred to, and no doubt the same thing would take place here as had happened on the Cumberland basin, where land had been

sold for fourteen to twenty dollars an acre, the mineral rights alone on which were now worth two, three, and four thousand dollars an acre. There was a wonderful field, therefore, for investment, but it must be done carefully and prudently. Timber on the mountains, or coal in the fields, was of no earthly value, unless it could be cheaply brought to market. He wanted people in England to look at this from a commercial point of view, because, after all, it was a question of vital importance to the trade and commerce of England. He was proud of English manufactures; England had the finest raw material in the world in the shape of artisans, and she had supplied the whole world with coal and iron. But he wished to bring before the notice of trades' unions and the Legislature also, that if she lost that trade, the safety and stability of the empire would be endangered. With that impression on his mind he could not help the feeling that, with not only Virginia, but Kentucky, Tennessee, and Pennsylvania, we should have such rivalry in the iron trade that, unless England could reduce the price of coal and labour, or improve the method of production, and so cheapen the manufacture, her trade would be in peril. This was a solemn subject, on which he should be sorry to be guilty of the least exaggeration; but he found that at Pittsburgh they were making iron at a cost of 35 to 36 dollars a ton, but they had to mix that with iron from the Missouri mountains or Lake Superior, which cost at Pittsburgh 14 to 16 dollars a ton; on the other hand, it had now been shown that they could make equally good iron in this Virginian district for 15 dollars. In fact, the Pennsylvania iron-masters were securing some of the best mineral properties in Virginia. There was plenty of capital in America ready to be invested in anything really good, but the difficulty was to be safe. These lands had been mostly held by old families in the days of slavery, but he was happy to say that since that horrid curse had been done away with he had seen the blacks labouring most diligently fourteen hours a-day for three-quarters of a dollar or a dollar. At the present moment the demand in America was greater than tho supply, and consequently England had still some trade there; but it had already diminished to a most alarming degree, and if that went on—though as yet they had recourse to protective duties—England would be left in the rear, and America would be independent of her, at anyrate, for raw material. He did not think it would ever be profitable to import coal from America, but every ton of iron exported represented a consumption of four or five tons of coal at home, and if the raw material (the iron) could be imported from America, the demand upon English collieries would be very materially lessened. After describing the difficulty of travelling in some parts of America for want of good roads, and the curious accident of a railway tunnel being on fire, compelling the stoppage of the traffic, the Chairman concluded by saying that, as yet, there was not much demand in America for coal and iron, but iron-works were now in course of erection, and he did not doubt that in a short time a very large trade would grow up.

Professor Ansted said many points had arisen in the discussion of considerable importance, to which he should be glad to refer. In the course of the paper he had adhered as strictly as possible to the outline of facts which he had wished to bring forward, and had not diverged to points which always arose in discussions of that kind, but many things had been mentioned in which, to a certain extent, he perfectly agreed. One of the points in the discussion which had attracted his attention was the question of the demand for coal, which was a matter strictly bearing on the subject of the paper. The Chairman had stated that the demand had not yet arisen, but he could assure them there was no question as to that demand existing abundantly at the present moment. He was interested in the development of coal mines in America, and in New York and other towns further north; he could have entered into contracts immediately for the taking of 1,000 tons a day, at prices which even in England would be considered remunerative. But besides that, there an enormous demand elsewhere. It was quite true that hitherto there had not been a great demand, but that arose from the fact that the persons who opened mines had not sufficient capital, and when they got the coals they could not place them, What was wanted was to find a regular market in different places, so that towns like Cincinnati might have a sufficient supply all the year round at something like an average price. The want of capital had compelled the coal owners to sell almost for nothing in the summer, but owing to rivers being closed there was no supply in the winter. He was satisfied, from inquiries he had made, that at this moment, if five companies were getting each 1,000 tons a day, which was not likely to occur for some time, that amount could be sold at prices far beyond those made at present. A steady supply was the only thing that was wanted. It had been said that there was plenty of capital in America for sound investments, but that was a mistake; there was not enough capital for the work that had to be done, consequently the capital that was available was placed in the very best and safest affairs, but there were equally good and safe things in which no capital was embarked, simply because there was none for the purpose. There were railways, coal and iron properties, and many other things which were not commenced, simply from the want of funds, and he knew of many large and valuable properties which could not be properly worked from the same cause. If people invested money there, and looked after it pretty sharply, it would be quite safe. Another point mentioned was the manner of getting the coal. In Pennsylvania the coal was found at a considerable depth, and the plan had been to raise it by inclines; this plan had been introduced into Virginia, where it was found to be an utter mistake in principle, and the worst possible economy, the style of mining being unadapted to the country. There was not one mine in the Kanawha Valley from which more than 300 tons were raised in a day, and they could not possibly get more than 600 or 700 tons per day by the present mode of working. In many parts of England they could sink a pair of pits and in one day get 1,000 tons, and there was no reason why it should not be so in America. The method he had adopted there was to run a railway at a slight gradient, 1 in $3\frac{1}{4}$ miles, up to the coal on the side of the mountain, and go into the coal on the level, and by that means, in one seam, he would be able to remove 1,000 tons a day without any great difficulty. He proposed to run a stone-drift or tunnel into the mountain, sink a shaft from the highest seam, and drop the coal down, instead of sending it down the incline. He had no doubt that would be the way in which all the coals would be mined in that country. The question as to the importation of coals to Europe, and the cost of iron delivered in England, had not entered into his serious consideration, for America wanted all the coal and iron she raised herself for railway and other purposes. The price of iron in America was very high in consequence of the expense of manufacture, the expense being so great at the present time that they could hardly live without their protective duty. They had not yet been able to take full advantage of the making of iron, because of the want of railways. The reason why Virginia had been neglected so long was not altogether on account of slavery, but the want of more capital and labour. The existence of the Chesapeake and Ohio line through the Apallachian mountains had not been completed, and iron would now be able to be manufactured in larger quantities, because fuel could be conveyed with greater facility. All the iron and coal that could be got in America would be consumed there for many years to come. which would relieve the demand on England to some extent, and enable her to send her iron and coal to other places. He saw no great proba-

bility that the coal of America would be carried across the Atlantic to England, and there was very little doubt but that England would find plenty of means for using all the coal and iron raised in other quarters. The coal seams in the parts referred to in America were never inclined at a high angle or dip, the dip not being more than one in a hundred, although it might be a little more on the eastern side of the mountains, and a little less accessible. The coals rose above the water-line almost from the bottom seam, and there was no great difficulty in getting the coal in the Kanawha Valley. The Kanawha river was only navigable during eight months of the year, and the two months when the river was closed was just the time when the coal was most required. With regard to obtaining the coal in the western district below the water line he did not know that it was necessary to go into any great calculation on the subject, because it was not likely coal would be looked for there for some considerable time to come yet, or any attempts made to get it while it could be got cheaper elsewhere. The cost of conveyance was not now so great as formerly, being reduced to one per cent per ton per mile, so that in fact conveyance had now become manageable. With regard to iron ore in other parts of the country, according to analyses made, it was undoubtedly the fact that many of the iron ores become more injured by phosphorus than in other parts, though it was possible to find very large banks which would not contain more phosphorus than in the middle districts, and in the southern districts the ore did contain more phosphorus than in other places. He did not mean to say that iron could not be made as cheaply and conveniently in those districts as in Virginia, and no doubt it would soon become a very important manufacture. With regard to the remarks made by Mr. Macomber as to the anthracite coal-fields, he did not mean to say that these would soon become exhausted; it was a coal very highly valued for manufacturing purposes, but it was not a cheap fuel, and never would be. It had already gone up in price, and in New York the price was very high as compared with bituminous coal. No doubt in Pennsylvania there was still a large quantity of coal left, but the owners seemed to be well aware that they would work to more advantage by transferring themselves to Virginia.

The **Chairman** proposed a vote of thanks to Professor Ansted for his valuable paper, which was carried unanimously.

CANTOR LECTURES.

The first lecture of the second course of Cantor Lectures for the session, "On the Chemistry of Brewing," by Dr. Charles Graham (University College, London), was delivered on Monday evening, December 8th, 1873, as follows:—

Lecture I.

The brewer's art yields to few in remoteness of origin; indeed, when one studies attentively the customs of mankind, in all climes and in all ages, we find throughout evidences of his love for fermented liquids. It seems to me a fair argument against the opponents of the use of such liquids to adduce this universal practice among all races of men as evidence of a want, at times, of such stimulants to energy. Indeed, were the use—I exclude, of course, the abuse—of such artificial aids wholly pernicious, it would be difficult to explain this universal discovery of the art and use of fermentation among people of even low states of civilisation.

The use of fermented liquids, made by the spontaneous fermentation of mashed cereals, is so remote that we have no dates by which to fix its origin. When, however, other arts had become more developed, and when, above all, the art of writing had been discovered, we begin at once to obtain some evidence as to its use among peoples of ancient times. Thus we learn that Osiris (1960 B.C.) is said to have taught the use of fermented extract of barley to those countries which did not possess the grape. Though there must be much of mere vague tradition in this account of the Egyptian discovery, yet we know that Pelusium, at the mouth of the Nile, was distinguished, long before the Christian era, for the excellence of its barley wine.

The Greeks, who derived the greater part of their civilisation from those wonderful people, the Egyptians, obtained from them also the knowledge of artificial fermentation—the art of brewing, in fact—and at a very early period. We find mention, for example, in the writings of Archilochus, the Parian poet and satirist, who flourished about 630 B.C., that the Greeks of his day were already acquainted with this art. Again, we learn from Æschylus (470 B.C.), from Sophocles (420 B.C.), and Theophrastus (300 B.C.) that the Greeks employed barley wine or beer—their zython—in their daily life, as well as in their festive meetings.

The Romans, in very early periods of their history, made use of beer—their cerevisia—prepared from barley, wheat, and other cereals.

Tacitus, in his immortal work on the manners and customs of the Germanic tribes, mentions their great love for their, even then, excellent beer—a love, by the way, which has not altogether died out among their descendants of our own day.

Pliny mentions that even in his time almost every kind of cereal had been employed in one country or another in the preparation of beer or cereal wine.

The ancient Gauls, Britons, and Scandinavians we learn—so soon as we find any authentic accounts of them—were noted for the use of beer in all their festive meetings.

From the first, beer seems to have been flavoured with one aromatic substance or another. Among the northmen we find that they employed roasted chestnuts to flavour and colour their ales; but it is not until the end of the 11th century that we find that the Germans had discovered the value of the hop as an aromatic and preserving agent. Indeed, it may be said, that from this discovery beer, properly so-called, dates its modern origin.

The Germans soon obtained a marked superiority in the art of brewing, and it may interest some of you here to know that so far back as the 16th century, the German "hopped beer" was largely exported to other beer-loving countries. So great did this export trade become, that we learn that about the middle of the 16th century, Rostock and Lubeck exported very large quantities to England, amounting to the enormous extent, for those days, of 800,000 barrels annually. The Germans, however, while they sent us their beer—unfortunately for their trade with us—sent us hops and the knowledge how to grow them, as the old distich has it. I am reminded of this by your able secretary—

> "Hops, reformation, turkeys, carps, and beer,
> Came into England all in one year."

That is "beer," not ale (which was not hopped), and which had been for ages the national beverage of Englishmen as well as of their northern ancestors. The foreign trade then died off, and England soon obtained high excellence for sound and well-keeping beer.

Without pursuing this historical examination further, we have chemical evidence of three main modes of brewing, viz.:—

1. The fabrication of beer from raw grain, as practised, for example, in the preparation of the kwas of the Russians, made from the grain of rye, mashed, as well as fermented, at ordinary temperatures.

2. The preparation of beer from germinated grain, a method, whether discovered in the time of Osiris or not, which was undoubtedly first known among the Egyptians. This method has become now almost universal.

3. The employment of a mixture of germinated barley, or other grain, and of raw grain, the discovery of which is attributed to the mythical Gambrinus, King of Flanders, 1200 B.C. (John I., Duke of Brabant, reigned 1261-1294, and, *Jan primus* is evidently the origin of Gambrinus.)

This mixed method is still in use among the brewers of modern Flanders, who employ malted barley mixed with unmalted wheat, barley, oats, and other cereals. It is interesting to note that the Chinese have long used this method for the preparation of their worts, which are fermented and aromatised under ground.

Now, in this very brief historical examination, the two discoveries of the highest importance are undoubtedly that of the use of germinated grain discovered by the ancient Egyptians, and that of the hop by the Germans of the middle ages. These two discoveries are not only important from the point of view of flavour, but also from that of the keeping qualities of beer; they are the two salient achievements of empirical practice, and are, and have been, of the highest importance to the art of brewing. I shall have to examine these important applications more fully in our subsequent meetings.

Before leaving this part of the subject, it may be of some interest to note the present enormous development of the brewing industry in our own country. For example, at Burton alone, more than half a million of quarters of malt are used annually, and this consumption is rapidly increasing, owing to the great development of the "pale" and "bitter" ale trades. At present I suppose that more than 2,000,000 barrels of beer are brewed annually in Burton alone. In the United Kingdom the annual consumption of malt amounts to some seven millions of quarters, representing some twenty-five to thirty millions of barrels of beer used in the home or export trade.

Now, when we consider the large capital employed in the three or four thousand breweries, large and small, in the United Kingdom,* and in the various arts and industries depending on beer; when we consider the vast capital engaged in the retail trade, and the large sum contributed by beer to our revenue; and, lastly, when we think of the effects of the use and abuse of beer on the public health, I think there is furnished sufficient evidence of the importance of this industry in our national life, and ample reason for this Society including it amongst the subjects of its study.

Now, ladies and gentlemen, there is perhaps no more remarkable fact in the history of the arts and manufactures than that of the very high excellence obtained by ages of practice, aided solely by the knowledge and skill acquired from long years of empirical, that is, unscientific, observation and experiment. The knowledge thus obtained has been built up by a long succession of labourers in the field, unaided by modern science and by modern scientific methods of observation and of experiment.

Indeed, many of the arts we practice are too needful for our well-being—and even existence—to have been left until such time as science could furnish us with the necessary knowledge to create them; and when one sees the high rate of excellence which man has obtained in agriculture, metallurgy, and many other arts—including the processes of fermentation—solely by empirical methods, the thought may arise that we may safely trust to these methods for a continuance of progress.

True, to some extent; yet the time arrives when mere empirical methods, with the innumerable errors and failures necessarily attendant on such methods, can progress but little further, or but slowly; hence the practical man must seek the aid of science in every stage of his art, in order to meet the requirements of our modern high-pressure conditions; in short he must—with the Royal Agricultural Society of England—adopt as his motto, "Practice with Science," twin sisters, equally needful for sure and rapid progress.

As regards agriculture, science has—since the memorable work of Liebig was first published—done much to secure more rapid progress and development, though many of us may justly say she might have aided the practical agriculturist even more.

Of late years metallurgy, especially that of iron, has been greatly aided by the adoption of this motto by Bessemer, Siemens, Lowthian Bell, and others. Indeed, as regards our iron industry, we live at present in a period of revolution, which must bring about vast changes in the art as practised by our forefathers. Again, when we consider that science may be said to have created the locomotive and steamship, photography and the electric telegraph, and many other additions to our well-being and power, I think the question must arise in our minds, when we consider how little science has done for the brewer, as to whether she is solely to blame; and I think we must honestly answer that the blame rests equally upon the practical man, who has cared but little for her aid and done nothing to assist her, and upon the scientific man, in that he has been more engaged in studying the phenomena of the moon or other equally distant objects, than those of fermentation.

Yet something has been done, thanks to foreigners, by Mulder, Berthellot, Payen, and others, and above all by Pasteur, whose remarkable and truly able study of the phenonema of fermentation will be, in the seed sown, as prolific of future improvement in the science and art of brewing as was the work of Liebig in agriculture. In our own country, science has done little to assist the brewer in acquiring a knowledge and mastery of the complex phenomena underlying his art.

The Council of this Society, ever foremost to aid in the application of science to the arts, some time since, did me the honour to request me to deliver a course of lectures on the chemistry of brewing, with a view to stimulate discussion and inquiry, and therefore advancement, since it may be taken as an axiom that earnest inquiry leads ever to improvement.

Though I regret, for your sakes, that they did not select a more able exponent of the science, still it behoves me, as a soldier in her ranks, to do the work placed before me, and to secure, as far as my powers will admit, and so far as a perfect freedom from prejudice can help, the objects which this Society has in view, viz., not only to bring before the brewers of our own country a chemical exposition of the different methods employed by them, but also those employed by foreign brewers, so that they may take up the discussion and examination of their methods with a view to secure and maintain the superiority of their products against all comers.

Now, in order to assist in these objects, I shall examine, from a chemical point of view—in engineering we have little to fear—each of the several main processes of brewing, from the preparation of the malt up to the final product. As the methods adopted by different brewers vary more or less in each stage of the process, and this even in our country, but still more in foreign countries, I have found it necessary, in order to lay before you a critical examination of these variations, to make myself personally acquainted with the more important of them, and hence in our subsequent meetings I shall describe the various processes—at least the more important of them—employed in the United Kingdom, contrasting them with each other and with those adopted abroad. By thus drawing upon the vast practical experience, not only of our own country but also upon that of the Continent, we shall be the better able to select those conditions which are essential, and to put aside those which are unimportant or injurious.

As regards drawing upon foreign experience, it is to Germany, the birth-place of modern beer, that we must look mainly for such extraneous aids. Indeed it is to Germany, enriched of late with a vast increase of material

* Licensed "Common" Brewers, 2,699; General, 30,798. House of Commons return, February, 1873. John Locke.

wealth, and enlightened by the scientific researches going on in her numerous universities, that we must look as our great competitor in the future.

They have already commenced to compete with us in foreign trade, and I feel convinced, from some years' residence among them, that if we do not bestir ourselves we shall find, in the course of the next decade, that they have obtained a considerable hold of the trade with North and South America, with Australia, India, and China. Nor is this all; aided by their keen business talents, by their general culture, by their high scientific enlightenment, they cannot fail so to modify their products as to become serious competitors even in the large towns of our own country. Should they brew a modified Burton and Christiana ale, as soon they will, they will conquer Englishmen's prejudices and win the race; as yet, however, the race is our own, and I feel confident that our brewers, when fully alive to the danger, will bestir themselves with all our old English determination, and keep their advantage, compete who will.

Now, I think every one must admit that beers of very great excellence are produced by what are in the main empirical methods; but all efforts are not successful, and all beers not good; and though the middle and working classes can now, at moderate cost, obtain "Gladstone" clarets and sherries, still beer, after all, is our national beverage. There may perhaps be no representative here of the great mass of our countrymen, the working classes; still this Society has been ever anxious and willing to further their comfort and well being, and therefore I may be allowed to represent their opinions on these matters by quoting from an old song, doubtless known to many of you, expressive of their views:—

> "I likes a glass of good beer, I does,
> I likes a glass of good beer;
> Let gentlemen fine sit down to their wine,
> But give me a glass of good beer."

But does he always get it good? I fear we must answer, No. Though excellent beer is produced, and can be obtained by and kept in the rich man's cellar, I fear the great masses of the people are not so fortunate, since, even when well brewed, many accidents occur with it, as with milk, before it meets the consumer's lips. It is, however, not always well brewed, and this because changes occur in the mashing and fermentation processes, which are but ill understood by many, and hence cannot be guarded against or cured by mere empirical rules. Thus many a quarter of good malt is spoiled, to the loss of the brewer, and therefore to the nation at large. Even the most skilful run risks and incur losses, for brewing is not all profit; but were the brewers of England to unite, much of this uncertainty and loss would in time be avoided. It may be true that science has done but little to aid the brewer; but has she been asked? Have the brewers aided to any extent in the scientific examination of their art? In all England you will not find one single school of study and research—not one experimental brewery, however small—not one school where the young brewer may study the application of science to his art. All this, however, must be changed if we wish to keep our position in brewing as in other arts, else we shall soon find the foreigner at our doors.

I have not made these remarks because I believe that science is prepared at once to teach how all loss and inferiority of product may be avoided. Science is rather in the position of a fellow-student, and, if practical men will, of a fellow-worker, in endeavouring to obtain a greater mastery of the art of brewing than we at present possess.

With these remarks I will now pass on to the immediate object of our meetings. It is, however, necessary, before we can study with advantage the changes which occur in the different stages of the manufacture of beer, that we make ourselves acquainted with the chemical properties of the chief materials employed.

Fortunately, these are few in number, since the substances with which we have mainly to do are cellulose, starch, dextrine, glucose, and certain nitrogenised or albuminised bodies. They are all organic, *i.e.* obtained from organised structures. In addition to these, there are some of mineral origin present in the water, and in the various materials used; these, however, as well as the very important study of the properties of the hop, will be noticed as the occasion arises.

Now, as my purpose is to make this distinctly an educational course of chemistry as applied to brewing, and as our object therefore will be to study together scientific principles rather than to discuss receipts, which have often but limited application, I will take up this evening the study of the chemical properties of the different substances employed by the brewer, in much the same way that I should in a college class-room. With reference to the substances I intend to draw your attention to, I will first of all explain their sources, secondly, the method of their preparation, and lastly, their chemical tests. You see here a diagram, on which is marked cellulose, starch, and dextrine; and here on the table are some specimens of woody fibre, starch, and British gum. The formulæ placed on the diagram indicate that all these bodies are composed of carbon—or charcoal—hydrogen, and oxygen; the formulæ there being C_6, H_{10}, O_5; taken N times, because we no not know exactly the molecular weight; but in each one hundred parts of cellulose, starch, and dextrine we find the same quantity of carbon, hydrogen, and oxygen. Again, you see two substances on the table called cane-sugar and grape-sugar, or glucose, the composition of which is slightly different, and they both differ from the previous bodies by having not more water in their composition, because it does not exist as water, but the elements of water, hydrogen and oxygen, which are there in greater proportions.

First, then, as to cellulose. Cellulose, or woody fibre, forms the solid framework of all plants. An ordinary piece of wood, for instance, is built up mainly of cellulose. In the early stages of the development of a young plant, the cell is formed by the action of albuminous bodies, and the cell wall is mainly composed of cellulose. As time goes on, these cells thus formed become encrusted with gums, and resins, and other foreign substances, so that a piece of ordinary wood, or sawdust, for instance, is not an example of pure cellulose; a portion of it is cellulose, but there are foreign products there also. In addition to wood, it occurs in ordinary cotton wool, also in linen, and in many other materials of that kind. A cambric handkerchief, for instance, is an example of very pure cellulose. It also occasionally occurs in an exceedingly hard form. The materials are precisely the same in composition, but the one is much denser than the other. This (specimen shown), for instance, is a piece of what is called vegetable ivory; but in addition to this particular example, I dare say you may remember the date stone, which is mainly cellulose, and is exceedingly hard. In the growth of the young yeast cell, cellulose is gradually formed from the dextrine of the worts. Now, the method of preparing pure cellulose is, of course, not to take ordinary sawdust, which, as I have told you, is very impure, but to take some paper—some ordinary white unsized paper; or to take some cotton wool—you could not do better than to take some of this "medicated" cotton wool, which has already been partly purified. If this be treated first with weak alkali, then afterwards washed thoroughly, and then again treated with weak acid, such as common hydrochloric acid, we shall obtain at last perfectly pure cellulose. The chief properties of cellulose are, that it is white, that it is about $1\frac{1}{2}$ times heavier than water, and that it is not soluble in water. You all know that if you wash a pocket handkerchief it does not disappear. Nor is it soluble in alcohol. It is not soluble, for instance, in a glass of whiskey; in the same way it is not soluble in ether, or in the volatile oils; and lastly, and this is an impor-

tant point, pure cellulose is not acted upon by moisture, or by the oxygen of the air, which is a mixture, as you know, of oxygen and nitrogen. Yet we know as a matter of fact that woody fibre of all kinds gradually decomposes. I have here, for instance, a bottle in which I have some sawdust. It was put in the bottle, which was then stoppered, so as to confine the air within it. In process of time this mass of sawdust has been decomposing, owing to the action of the albuminous matter present, and has absorbed the oxygen which was in the air, and has formed carbonic acid. If no accident has occurred, we shall find that on taking out the stopper it will put out a light, much in the same way as a light or an animal would be put out on being placed in the gas of a fermenting tun. The experiment is almost a failure, but still you observe the light does not burn at all well; probably the stopper has slightly moved; at any rate, you will grant me that sawdust gradually decomposes in moist air. That is due to a slow burning process, but this process is set up by the albuminous matter present in the tissues of the wood. You know in the fermenting tuns and cleansing squares, and in the barrels in which beer is put, there is gradually, on account of the wood being slightly porous, a destruction of the wood; and in addition to that destruction which is going on there is also an absorption of the decomposing matters from the organic matters of the worts or beers, or what not. This is a matter, as you know as practical men, of very serious import, and hence some of our largest brewers have abolished wood for their fermenting tuns. Now, it is partly in connection with this question that I have brought cellulose before you, in addition to its being a very natural commencement of the series, because there is no substance except starch which is used more largely by brewers. I have here a piece of ordinary oak, representing an oak stave. Here is another one rather thicker, representing the fermenting square, or cleansing square, and in addition to that I have here two small pieces of pine, which you know is very different in structure. These have been prepared in a way to prevent the absorption of the decomposing substances, and to prevent decomposition of the wood itself. These pieces of wood were heated up to about 150° C., or a little above 300° Fahr. After they had been slowly heated and kept to that temperature for some time, they were then dipped into a vessel containing paraffine wax, perfectly fluid, at a temperature of about 300° or 350° Fahr. Of course there is a large quantity of air actually condensed in the pores of the wood, in much the same way as it is in a piece of ordinary animal charcoal. After a time the air, being driven out, these pieces of wood were removed, and they are now perfectly impervious to all kinds of liquids. After the lecture, those who are interested in this matter may examine them. I will place upon each a little oil of vitriol, which you know is a more powerful liquid than any you are likely to have to deal with. But I may tell you that not only is paraffine not acted upon by strong acids, but neither is it acted upon by alkalies, or anything which is likely to be found in worts or beers of any kind; and, therefore, not being acted upon, of course there is no taste, so that in making use of this you may be perfectly sure there will be no flavour of any kind communicated to the beers, simply because it does not dissolve. I will place upon these specimens some concentrated oil of vitriol; and though I do not mean to say there will bo no action whatever, still it will be only very slight, whilst on some other pieces, not treated with paraffine, I will do the same, in order that you may have a fair comparison. After a short time I will show you the result, and you will see that the action in the case of the paraffine is merely a surface-action—there will be no absorption. Impurities which may adhere to the surface of the paraffined wood may be removed by chloride of lime. I prefer the use of chloride of lime for such purposes to that of bisulphite of lime, which I am aware is largely used for this purpose, as well as for the prevention of acidity. The action of chloride of lime is to oxidise—to burn, in fact—whereas that of the bisulphite is the very opposite. I therefore recommend you to destroy adhering impurities by means of this powerful agent. Of course it must be used with care, and you must remove it before filling the vessels with worts or beer. You will find that the chloride of lime breaks up and destroys the putrefactive albuminous bodies, as well as the carbo-hydrates in the barrel or fermenting turn. Now, probably most of you have suffered from having linen returned by the laundress in a dilapidated condition; this is chiefly due to the use or abuse of bleaching powder, which destroys, or burns, cellulose.

Another point I wish you to notice is the action of oil of vitriol upon cellulose. My assistant will be so good as to prepare what is called by some vegetable parchment, because I wish to show you that the action of oil of vitriol, when diluted with about half its bulk of water, is very peculiar upon paper. If the acid be stronger, it will dissolve it up completely, but if we take care not to have it too strong, it will have a parchmentising action upon it. You see the portion of paper not so treated, when dipped into water tears directly, but the other, which has been treated with the acid, is in a sort of leathery condition. This material is now used largely for covering jam-pots and for other purposes.

One of the most convenient methods of dissolving cellulose is to employ oxide of copper dissolved in ammonia. I have here such a solution; it has been made in this way:—Ordinary blue stone was first of all precipitated with an alkali—with potash, for instance—then washed, and the hydrated oxide of copper was then dissolved in ammonia, thus forming a cuprate of ammonia. To this has been added some cotton-wool or paper. If I add some acid to it, I will show you what I have not yet shown you—disintegrated cellulose. You will see it gradually collect in fine flocks in the glass vessel. This is the plan generally made use of for the purpose of detecting whether silk has been adulterated with cotton wool or with linen, tho animal product, silk, not being dissolved, as is the case with cellulose.

I will pass now to the next member of the series, the most important of them all, because from starch practically you obtain the rest. You know that starch occurs in many vegetable substances, much as fat occurs in animals, that is, it is deposited when the food conditions are very favourable for the purpose of being used up afterwards, either when the food conditions are unfavourable or when a greater supply of nutriment is required. It is, therefore, thus found stored up for future use in the so-called albuminous seeds, that is to say, practically, the starch that surrounds the germ. It is also found in the cotyledons, or fleshy seed-leaves of the young embryo. It is found in pith, and, as you know, in bulbs, tubers, rhizomes, and roots. I shall have occasion, at our next meeting, in speaking of malting, to explain how it is that these stores of insoluble food are made use of for the nourishment of the young plant. The methods of its preparation are well known, but there are two main methods which I may as well mention to you. If you will take wheaten flour, or rice flour, or any other farinaceous material, and mix it up with water, then afterwards allow it to stand, it will in process of time ferment spontaneously, and gradually you will get rid of the albuminous matter which is there. That is one plan for getting rid of the albuminous matter from the starch. The liquid becomes sour, it is washed, and finally the insoluble starch is dried on plates. The other plan, which is a more rapid one, is to attack the problem from another point of view, and to dissolve out by means of an alkali the albuminous matter. I dare say you know the action of caustic alkali on the skin—it makes the skin feel soapy, that is because it is dissolving the albuminous matter of the skin; so in the same way the flour is acted upon by potash. No matter, then,

which method be adopted, starch is obtained. The size of the cells from different kinds of grain is very different. The cells from the potato are as much as ·185 of a millimetre, that is to say, about the one hundred and fiftieth part of an inch; they are therefore tolerably large. In the case of sago they are as small as ·07 of a millimetre, that is to say, about the two hundredth part of an inch; and in the case of wheat they are still smaller, being only about the five-hundredth part of an inch. When starch is heated to a high temperature, it is gradually converted into dextrine. Long boiling has also a peculiar action. The first action of boiling on starch is to convert it into a soluble modification. Now, this is of some interest to brewers, because if they have been mashing in such a way—I will not say how at present—that they have obtained in their worts starch in the insoluble form, in addition to that which may already exist in the soluble form, then this insoluble variety becomes converted into the variety soluble in water on the subsequent boiling of the wort. I shall hereafter have to explain to you the very serious danger which arises from the presence of soluble starch in the boiled worts. I have in this test tube some of this soluble starch, and I will prove its presence by employing the usual test, which consists in adding a few drops of the tincture of iodine. Before the addition you may observe that the liquid in the tube is clear and colourless. On adding the tincture of iodine you see that we obtain a dark blue precipitate, due to the formation of a compound of starch with iodine. Now, as soluble starch sometimes occurs in the worts, even after being boiled, and as the presence of such in the subsequent fermentation process is the cause of serious injury to the brewer, I think you will all agree with me that it is of importance, not only to study its formation in the mashing and boiling processes, but also to have an easy and rapid method of detecting it. Starch is converted into dextrine and sugar by boiling with dilute acid. If you boil starch by means of dilute mineral acid, you convert it into dextrine, or British gum, and finally into grape sugar. The dextrine may be either made from starch in this way by the action of dilute acid, or it may be made, as is usually the case by the torrefaction of the starch. If starch be heated to about 160° C., about 320° F., it will gradually alter in structure and chemical properties, and if the experiment be continued sufficiently long, you will obtain what is called British gum, though ordinary British gum generally contains some unaltered starch. In addition to this action there is, of course, also the action of the so-called diastase. I may mention that in the case of mashing you have soluble albuminoid bodies, which convert starch into, first of all dextrine, and afterwards to a certain extent into grape sugar. I do not enter into a consideration of this important point to-night, as it belongs naturally to the subject of mashing. I will, however, show you now a means by which we may readily detect the presence of dextrine in a liquid.

We have seen that the action of iodine upon the insoluble or soluble varieties of starch is to give a blue precipitate. If the dextrine be perfectly pure, we do not get this. It is very important in the course of mashing, to be able to distinguish it readily. I have dissolved a little of the ordinary dextrine, which, I think, has been made by the action of a high temperature upon starch, and here is some iodine. Before I add it, and I had better make the explanation first, I may tell you that if it be pure dextrine—if there be no starch present—we shall obtain a marone or reddish colour, but if there be any starch present, that colour will be tinged with a little of the blue that we saw just now, from the starch itself. The probabilities are, however, that we shall get a sufficiently distinct production of the marone colour. On adding the iodine, I can see that there is a trace of starch there, but still the experiment shows the red colour due to the dextrine. It is evidently not pure, however; there is somewhat more starch than I expected. The only point of any interest, as regards that iodine test, is that you must never get any colour as dark as this, it must always have an appearance like the marone coloured liquid in this jar, which you see here. So long as you have any of this soluble starch present in your worts, so long will you have a little darker colour than you ought to have—in short, a little blue mixed with the red. I need hardly say that tannin does not precipitate dextrine. As regards the importance of dextrine in beer, in reference to the slow fermentation which goes on in the store vats, and in reference to its power of holding carbonic acid, and making a viscid frothy liquid, I shall have more to say when I come to the question of fermentation.

Now we may pass on to cane sugar, which sometimes is used, I believe, in brewing. It is a substance which will not detain us very long. There are some samples on the table. Cane sugar of course occurs in the ordinary sugar cane, and the beet. When cane sugar is treated with oil of vitriol, it froths up, and the elements of water are absorbed. I will add to this solution of cane sugar some oil of vitriol, in order to shew you the difference between the action on cane sugar and grape sugar. Oil of vitriol, when added to grape sugar, does not produce this blackening effect. When cane sugar is treated with potash, a strong alkali, there is no discolouration. By the action of dilute mineral acids, it is very readily converted into what is called invert sugar, which is a mixture in equal parts of dextroglucose and lævoglucose. This is made, as I understand, by the Anglo-Bavarian Company. Cane sugar is not directly fermentable. It has first of all to be converted into the glucose variety of sugar by the action of the yeast cell in the fermentation process, and therefore cane sugar requires more yeast to perform a given fermentation than grape sugar does. I need hardly say that the samples I have pointed out here are tolerably pure samples of cane sugar; but, of course, our raw sugars contain, in addition to sugar, albuminous bodies, and hence these impure varieties of sugar are liable to produce a bad form of fermentation, owing to the large quantity of decomposing ferments in them. Therefore, it is always better, when the trade allows it, to get rid of this by the conversion and precipitating processes.

I come lastly to glucose or grape sugar, as it is called, because it is obtained in the largest quantity from the grape. It is formed in plants by the action of soluble albumenoid bodies. The soluble nitrogenous bodies act upon cane sugar, upon dextrine, and also upon starch, and I have no doubt in some cases, upon cellulose itself. It occurs, not only in the ordinary grape, but also in honey, which is nearly all grape sugar, and also in many fruits often associated with cane sugar. As to its preparation, it may be obtained from honey by pressing it, so as to squeeze out the inverted sugars, and then digesting the remainder with alcohol. By repeating the operation you may obtain tolerably pure glucose. It is now made on a very large scale by the conversion of starch into grape sugar, or glucose. I have on the table some samples of what are known among brewers as "saccharine"—some made by the Brewers' Saccharine Company, and some by the Manbré Company. I have had the pleasure of seeing the process carried on by one of these companies, and I should have gone to the other, but have been too much pressed for time, so that I had to defer it till another occasion. At one of these companies I saw the whole process from the beginning to the end, and it was excessively interesting to me as a chemist, because I found that the practical man was able to treat starch in a much better way than I could do under the conditions of the ordinary atmospheric pressure. I found that they were using rice ground very small; it was then mashed with water containing one per cent. of oil of vitriol. I believe the other company uses some other form of starch, but it makes very little difference, except that potato starch,

and the cheap inferior starches of that kind are rather liable to unpleasant oily bodies, and, therefore, they should not be used. This starch, mashed with water, and one per cent. of oil of vitriol, is then run into a digester connected with a high pressure boiler, and so soon as they have got the whole charge into the digester, they then turn on the steam, and in a very short time, of course, the pressure in the digester is the same as that in the boiler. That is run up in the course of two or three minutes to about 50 or 60 lbs. per square inch, and on account of this high pressure they are able to use the very small quantity of sulphuric acid which I have named, whereas if I were to attempt to do that, I could not convert starch into sugar in the course of ten minutes as they do. They test the total conversion by this dextrine reaction, and I may tell you that they not only get rid of all the starch, but they do not finish the action until the liquid when drawn off, and treated with a little carbonate of lime, gives no reaction, either blue or red, with iodine, on being filtered. When this occurs one knows that the starch has all been converted into glucose or grape-sugar. This takes on an average, I believe, about ten minutes, In the laboratory, at the ordinary atmospheric pressure, it would take us—I was going to say as many hours—but it would certainly take some four or five. There is one other advantage which is secured by this method. From time to time they can, at pleasure, let off the vapour or the steam from the digester, and in that way they get rid of any unpleasant oily hydrocarbons. Thus, even from the rice, I noticed a peculiar smell from the steam that came over, but by working under this high pressure they got rid of this altogether. After the action is completed it is run into a vessel, where it is mixed with carbonate of lime, in order to precipitate the sulphuric acid, sulphate of lime being formed. It is then deprived of colour by animal charcoal, at any rate to a considerable extent. I have here a sample which has been kindly lent me by the Brewers' Saccharine Company, which has been much more decolorised by the action of animal charcoal than the other one. One is called pale, the other is amber, and the third brown. The light sample has been treated more effectually with animal charcoal. Of course there is a slight difference in the expense from the use of so much charcoal in the preparation of the finer samples.

Not only, however, may grape sugar be prepared from starch in this way, but it may also be prepared from linen, from sawdust, or from paper. I have here two samples kindly prepared for me by one of my friends and pupils. This one has been prepared from sawdust, and it is a fair sample of grape sugar, though it is not quite so pale as the "saccharine." Here, also, is a sample of glucose, something like a "Muscovado" sugar, only it is grape, not cane, which has been made from paper. Perhaps the day will come when the Norwegians—who, I can assure you, from the ales I have tasted in Christiana and other Norwegian towns, according to my opinion, and I believe of other Englishmen, already brew very excellent ales—will work out a rapid and cheap method of doing what is now being done in the laboratory in a clumsy and expensive way, and thus make grape sugar from their thousands of tons of sawdust, which have no value in their country. Thus they will secure a considerable commercial advantage.

Not only is grape sugar prepared, as is done by the two saccharine companies I have mentioned, from starch or farinaceous substances, but I understand—although I am unfortunately not supplied with samples—that there is a company in Southampton, called the Anglo-Bavarian Company, who convert sugar into dextroglucose and lævoglucose by the action of dilute acid. No doubt they have their reasons for selecting cane sugar rather than starch. In this way they prepare a considerable quantity of grape sugar.

Now, grape sugar is not acted upon by oil of vitriol. You see, from the experiment I performed just now, we have got a solid piece of charcoal from the liquid oil of vitriol and the solution of sugar; but in the case of glucose there is no action whatever of this kind. And this is a rough method for distinguishing between grape sugar and cane sugar. On the other hand, potash has an action upon grape sugar, for, on warming a mixture of the two together you will find it will gradually become brown. In the case of cane sugar this does not take place. This is another difference by which you can recognise readily enough which kind of sugar you are dealing with. Another good method of detecting the presence of grape sugar in a sample of cane is to employ the nitrate of cobalt. If this has been previously mixed with either glucose or a sample of cane sugar containing glucose, it is not precipitated by potash. If, on the other hand, there be no glucose there, you will obtain a precipitate. Pure cane sugar is not very easy to get, because even the best "lump" contains some "invert" sugar; but if you take special precautions to dissolve it out with alcohol or water, you may obtain cane sugar so pure that it will not prevent the precipitation of the cobalt. The best test for its detection, however, is the action of Fehling's solution.

I will show you first the action of this blue liquid upon cane sugar. It is a solution of ordinary blue stone in water, to which tartaric acid is added, and then potash added in excess. The oxide of copper is not precipitated, even although it is very alkaline; the presence of the acid prevents the precipitation of the hydrated oxide of copper by the alkali. If I add to this some cane sugar there will be no change, if the cane sugar be pure. You see there is none. It is perfectly limpid and clear. If on the other hand, I add to such a solution of sulphate of copper in potash and tartaric acid, some grape sugar solution, there would be an immediate precipitate. This precipitate is due to the formation of a sub-oxide of copper, owing to the reducing action which grape sugar has upon certain metallic oxides. You will see in a moment, upon the addition of this grape sugar, that there is a precipitate formed, which, upon being heated, will become gradually a bright red. The mere colour is not a very characteristic point, because it is due to the nature of the aggregation of the particles. The composition will be the same, though it be not of the same colour; it is now a brown, but finally I dare say it will become a bright red.

I will now say one or two words on the composition of the albumenoid bodies, in order that I may start fair at our next meeting with "malting." Albumenoid bodies, whether they be derived from vegetable or from animal sources, all contain carbon, hydrogen, and oxygen, and therefore to that extent they are like the other substances of which I have spoken. But there is this difference, that all of them contain nitrogen to the extent of about 15 to 16 per cent. In addition to nitrogen, some of them (as in the case of white of egg, which is pure animal albumen), contain about $1\frac{1}{2}$ to 2 per cent. of sulphur. I daresay some of you must have made the following experiment—viz., that if you knead some wheaten flour with water you will find gradually the starch will separate out, and you will have finally left a pasty, doughy mass. Now this pasty doughy mass is called roughly gluten. It is insoluble in water, but still it may be divided into two kinds of albuminous matter, and although it is insoluble in water, still alcohol dissolves from it a portion, a variety different from the other, in that it is soluble in alcohol. This variety is called by some chemists glutin, in order to distinguish it from the mixture which is called gluten, and the portion which is insoluble in alcohol is called vegetable fibrine. There has, however, in that kneading been some albuminous matter dissolved, because, though it would now take too long to shew you, if you were to take such a liquid you would find that you would get a partial precipitate upon boiling, as occurs in boiling worts. Even after that a small portion can be precipitated by acetic acid, but there remains yet another portion

which is neither precipitated by heat nor by acetic aeid, unless you have previously neutralised it with an alkali, and then it is readily enough precipitated. Another variety still is one which is not precipitated by heat, but is precipitated by nitric acid. Now, I have classed them according to Mülder in this way, but I would rather you would put aside all that, and not look upon these bodies as being anything else than mere soluble albumen. What they are, and what their particular condition is, we know not. We know not their molecular structure, for we cannot get them pure, and when we chemists cannot obtain a pure material, of course we are not in a position to assign any molecular formula. If, therefore, you look upon the wheaten flour as giving you, not only starch, but also insoluble albuminous matter, and at the same time a small portion of soluble albuminous matter, you will have done that which I particularly wish to draw your attention to. If you examine that mash of cold water and wheatened flour you will find that there is a gradual change going on, and you would notice by filtering such a liquid that you have actually got dextrine formed and some sugar. Here is some flour which has been treated in that way, and kept for a short time at a temperature of about 140° F. I wish to draw your attention to that which, I think, I forgot, namely, that, in addition to employing iodine as a test for dextrine by the marone colour obtained, alcohol also may be employed. Alcohol preeipitates dextrine, for although it is soluble in water it is precipitated by alcohol. If we obtain a semi-transparent precipitate we shall know that we have got dextrine formed by the action simply of soluble albuminous bodies upon the flour itself. There was no malt added to this. We may also prove that sugar is formed in the usual way. I will employ this alkaline solution of copper again, and Mr. Christopher will kindly warm it. Then if we obtain the red precipitate we shall have definite proof that even in that short time the soluble albuminous matters were able to eonvert starch not only into dextrine—as the precipitation by alcohol has proved—but also into sugar. Starch, therefore, is not only converted into sugar by the diastase obtained from malt, but also by the action of the soluble albuminous bodies existing in wheaten flour. I may indeed say that, roughly speaking, almost every soluble albumenoid substanee has this property. The glands of the mouth, for instance, secrete a liquid which contains a soluble albuminous body; and I have here a solution which has been formed by adding saliome to starch. It was then filtered, and we could obtain a reduction of the oxide of copper if we were to employ Trommer's reaction. What I want to call your attention to is this. Although Payen and Persoz, and some other chemists, speak of diastase as if it really existed, and as if this peculiar body was that by which alone starch is converted into sugar, yet we now are all agreed, first, that there is no such body; and, secondly, that that this is not an action peculiar to diastase, even if such a body exists. It is due to the soluble albuminous matter, and here, in this beaker, is a proof of my assertion. Ordinary wheat flour was digested with cold water, then raised gradually to 140° Fahr., then filtered, and not only do we obtain, as you see, dextrine, as shown by the alcohol precipitate, but, in addition, we have proof of the presence of sugar, as you observe, in my testing with Fehling's copper solution. Now, there are many animal secretions which produce the same change upon starch—the bile, the pancreatic fluid, and others. I will presently show you, by means of the eopper solution, that the starch treated with the saliva of the mouth has been partly converted into sugar by the action of this important animal fluid.

You will see afterwards, when I come to speak of mashing, the reason why I lay especial importance on this point—viz., that as a general prineiple, soluble albuminoid bodies will (doubtless themselves in a state of change, probably owing to the breaking down of the complexity of their structure) produce this effect. It is not due solely to the action of what is called diastase, but is a general property of most soluble albumenoid substances. Mr. Christopher now hands me the tube in which the clear filtered liquid obtained from the action of the saliva upon flour, and which has been boiled with the copper solution, and you see there has been obtained a considerable red precipitate, proving clearly the formation of sugar from starch. I will now pass on to the methods for the detection of the albuminous bodies in grain. They need not, however, detain us long, as I shall have occasion to revert to them hereafter.

Tannin, as many of you know, forms a white precipitate with soluble albumen. I have here in this tube some white of egg mixed with water, and on the addition of a solution of tannin, you observe, we obtain a very dense precipitate. The tannin of the hop, we shall find, precipitates some of the albuminous matter of worts; some, but not all.

The very best test by which you may detect the presence of albuminous substanees in a liquid, is the following. Add to the solution in question—a wort for example—some acetic acid, strong white vinegar, and then add a few drops of a solution of the yellow prussiate of potash. If there be some albuminous bodies present, you will observe the formation of a yellow precipitate; this reaction is extremely delicate, as by its means we can detect very minute quantities of albuminous matters.

As I have already detained you too long, I shall, at our next meeting take up more fully one or two matters of considerable importance, whieh I have only been able to allude to in a brief way this evening. I shall again draw your attention to the changes produced in the presence of heat and moisture, by the aetion of albuminous substances upon starch, and we shall find, when we come to study the nature of the germination of grain, that the process is attended by a eonversion of the insoluble starch into soluble dextrine and sugar.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

The Committee for the Representation of Modern Bookbinding met on the 28th of January, at the Royal Albert-hall. The following were present:—Mr. Henry Cunliffe, Mr. Jas. Toovey, Mr. A. Suttaby, Mr. W. Watson, Mr. F. H. Rivington, Mr. R. S. Turner, and the Right Hon. Sir David Dundas; Lieut. H. H. Cole, R.E., also attended. The applications to exhibit received up to date were read to the Committee. The Committee made several suggestions for making the collection more perfect, and requested to be convened again within twenty days.

The very varied collections made by Dr. Leitner, Principal of the Government College of Lahore, which were exhibited at the Vienna Universal Exhibition of 1873, will shortly be shown in the Royal Albert-hall. The collections consist of about 1,000 Bactrian and other coins; 184 Græco-Buddistic and other sculptures; 3,200 Himalayan butterflies and beetles (Kulu, Dharmsala, &c.); 25 rare manuscripts in Tibetan, Sanscrit, Turki, Arabic, Persian, Kasmiri, &c.; 177 ethnographical articles from Dardistan, Kafiristan, and various parts of Central Asia; 197 industrial and other articles from Central Asia and Northern India. There is also a collection of Himalayan plants and minerals between Kulu and Ghilghit, and an educational colleetion. If possible, these eollections will be opened to the public before the Exhibition itself is opened, and they will remain on view during the continuance of the Exhibition. In order to raise the interest

in ethnographical, especially Central Asian, researches, and in order to satisfy the speculations of savans, Dr. Leitner also brought over with him to Vienna a member of that hitherto mysterious race, the Siah Posh Kafirs or "black-garbed infidels," as the Mohammedan Affghans term them. Some suppose them to be descendants of a colony planted in the Hindu-kush by Alexander the Great when he invaded India; and others believe that they are Zoroastrians, who were driven into the hills on the occasion of the Arab occupation of Balkh, &c. Many again contend that they are aborigines of the plains of India, who were forced into the hills by Mohammed of Ghazni. The Kafirs' European appearance favours the first view, their Parsi names, the second, and their Sanskritic dialects, the third view. Burns, Elphinstone, Masson, and Wood, give short conjectural notices regarding them. Dr. Trumpp has given a sketch of one of their dialects, which, however, appears to be Kohistani or Dehgani, the language of neighbouring hill tribes. Native Christian Missionaries have visited them, but no European. They are reported to have some notions of Christianity, and to consider Europeans as their brethren. They are surrounded on all sides by a belt of Mohammedans, with whom they wage a ceaseless war because they kidnap their children. They are dressed in goats' skins.

The following appeared in the *Engineer* of last week:—

According to the plan of previous years, the London International Exhibition of 1874 will consist of three "divisions," the first being devoted to the fine arts, the second consisting of manufactures, raw materials, machinery, and processes, while the third comprehends recent scientific inventions and new discoveries. Leaving for the present the domain of the fine arts, we proceed to note a few features relative to the second and third divisions. There will be a number of lace-making machines, including three sent by the Nottingham Chamber of Commerce. The next class in the programme is that of civil engineering, architectural and building contrivances, sanitary apparatus and constructions, cement and plaster work, &c. Efforts are being made to raise a fund for the purpose of testing the strength of materials. Hitherto such tests have generally been applied on too small a scale to command perfect confidence. If the committee in this case receive the requisite pecuniary aid, the trials will be on a scale sufficient to give trustworthy results. No span of less than 20ft. will be allowed, and the materials tested will include rolled iron joists. Mr. Kirkaldy's co-operation is expected in these matters, and we trust the societies appealed to on this subject will deem the opportunity of sufficient importance to call for their cordial support. The Patent Stone Dressing Company will show their machinery in operation, and Messrs. Middleton and Co. will exhibit their brickmaking machines. Woodworking machinery, for all kinds of joiners' work, will be shown by Messrs. Ransome and Co., and by Messrs. Worssam and Co. Different methods of concrete building, and the application of other materials for building purposes, will appear in the western annexe. In the same locality will be several sewage processes in action, including among others the lime and cement method invented by General Scott, and the famous A B C process of the Native Guano Company. All these sewage experiments are to take place in closed vessels, or tanks, with glass sides, so that the operation shall be clearly seen and yet no disagreeable effluvia shall by any chance annoy the visitors. It is intended that the sewage to be experimented upon shall be pumped up from one of the metropolitan sewers at a distance from the Exhibition, and brought to the building in air-tight tanks in Messrs. Mowlem's carts. In a trial of this kind it is evident that the precipitationists will have some advantage over the irrigationists, though a little extra ingenuity might enable the latter to illustrate their principles. Intermittent downward filtration might be shown with the vilest of raw sewage at the top and the brightest of effluent water flowing out at the base, with always somebody at hand to drink the water. The boldest scheme for exhibition purposes seems to be that of the Carbon Fertilising Company, who employ charcoal somewhat after the fashion of the dry earth system. They are building a house and a stable, and forming a regular section of a street, to show the application of their plan on the working scale. Even Mr. Hope need not despair, seeing that he can grow a crop of Italian rye-grass in a month, or at the rate of an inch in twenty-four hours, though he has never yet done this in a glass case.

Heating by all methods and with all kinds of fuel comes next. Here the Society of Arts appears on the scene, offering prizes to the amount of £500 for the best stoves. More than 200 stoves have been sent in, and are undergoing the preliminary process of selection. Out of this number a large percentage will certainly be rejected. The testing will probably commence in a few days, but at present the buildings for this purpose are not ready, neither is the gas completely laid on. Messrs. Glover and Co. supply the meters. The testing of the various contrivances, to be thorough, will take considerable time, and it is to be hoped that ultimately we shall all be the better for the ingenuity which is now being directed to the important subject of combustion for domestic purposes. Leaving the stoves until they have been finally overhauled by the committee, now busily at work, we arrive next at the leather department. Here we have a goodly number of exhibitors, England alone furnishing more than a hundred. Bookbinding and foreign wines form the two remaining classes of the second division. In bookbinding a complete set of machinery will be shown by Messrs. Hopkinson and Cope.

The third division, devoted to inventions and discoveries, will contain some very interesting contributions. Messrs. Chance Brothers and Co. will exhibit the revolving light apparatus constructed for the South Stack Lighthouse near Holyhead. The revolving action will be shown, and possibly the lamps will be lit. This contribution cannot, however, be ready earlier than June, and we apprehend that it will be scarcely practicable to let it remain quite to the close of the Exhibition. A very attractive item will be Gramme's magneto-electric light, which excited so much interest when shown from the summit of the clock tower at Westminister. It is probable that Messrs. Sington and Co. will exhibit a portable 200-light gas-making machine. A device certain to draw crowds is the Siebe German diving apparatus, to be shown in action under water with the electric light. A machine for casting metal under pressure will be shown by Mr. Fowles. Messrs. Eassie and Co., of Gloucester, send a steam pile driving machine. Concerning the foreign exhibitors in the various classes we cannot say much as yet, but they appear to be coming forward freely.

It may be as well to say a word as to the organisation of the official staff connected with the Exhibition of 1874. Her Majesty's Commissioners are at the head, with the Prince of Wales as President, Major-General Henry Y. D. Scott, C.B., being the Secretary. A board of management comes next, the Earl of Carnarvon holding the position of Chairman, Mr. H. Cole, C.B., being the Acting Commissioner. The executive officers are Captain E. G. Clayton, R.E., Lieut. H. H. Cole, R.E., and Mr. T. A. Wright—the last mentioned gentlemen being the secretary of the International Exhibitions. Lieutenant Cole's special department consists of the fine arts, lace, and foreign wines; Captain Clayton has charge of the remainder. In reference to the stoves, the Committee of Selection have the assistance of Major Webber, who was officially connected with a similar department in the Paris Exhibition of 1857. Into all the ramifications of the relationship between Her Majesty's Commissioners and the Royal Horticultural Society, we do not propose to enter, but it appears that the difficulties which beset

that relationship are not yet fully settled, and in the meantime the irruption of the Ashantees, the Fantees, and other tribes of the earth, into the upper gallery of the Albert-hall is necessarily postponed, inasmuch as the approaches from the Exhibition to the Albert-hall are on the territory of the Horticultural Society.

EXHIBITIONS.

Vienna Exhibition—The official report of the Vienna Exhibition gives the annual products of iron in the producing countries as follow:—England (1871), 134,664,277; Zollverein (1871), German bund, 33,296,042; France (1871), 23,620,000; Belgium (1871), 11,406,480; Austrian Hungary (1871), 8,492,122; Russia (1871), 7,208,141; Sweden and Norway (1871), 6,138,347; Italy (1872), 1,474,180; Spain (1866), 1,474,180; Switzerland (1872), 150,000—total, 227,793,099. North America (1872), 46,900,000; South America, 1,000,000; Asia (Japan, 1871), 187,000; Asia (other countries approximated), 800,000; Africa, 500,000; Australia, 200,000—full total, 276,500,000. It will be seen by this statement that England produces more than one-half of the production of the world; North America, about one-fifth; France, about one-twelfth; and Belgium one-twenty-fourth; these four constituting the great iron-producing countries of the globe.

Philadelphia Exhibition.—Professor Raymond, president of the American Institute of Mining Engineers, wishes it to be generally known that preparations have been already commenced for holding an International Exhibition at Philadelphia in 1876. The institute invites the "Iron and Steel Institute" of this country to visit America at that time, and extends its invitation to the scientific societies of Europe generally.

KIDDERMINSTER SCHOOL OF ART.

On the 23rd inst., Mr. Cole distributed the prizes, and called attention to the Standing Committee of the Society, for connecting technical instruction with all public museums of science and art. He pointed out how the British Museum, National Gallery, Patent Museum, &c., might assist, if they were placed under a Minister of Public Education. He recommended the committee at Kidderminster to support the movement of the Society, and to go in a deputation, headed by their member, Mr. Lea, who was present, to urge upon the Government the adoption of the resolutions of the Society. Passing on to the threatened suppression of the South Kensington Museum, Mr. Cole said:—"The South Kensington Museum has been as my child, to which I have devoted days and nights of more than twenty years. Without undue self-conceit, I think I may say it has been a real and useful success. It has set an example which has been copied by thirty-five new museums in Europe. Some weeks ago I had to defend its present constitution, on which the life of the museum depends, and I was provoked to make observations on a late political chief. I omitted to say that during his connection with the museum as Vice-President, he had shown me uniform kindness, had taken a cordial interest in the working of the institution, and had on all occasions been its champion, but had lately become its opponent, and seriously endangered the independent existence and usefulness of that museum, for which I would lay down my life. These observations have caused regret to my best friends. I must have been wrong in making them, and I regret having done so."

PUBLIC MUSEUMS AND LIBRARIES.

The following is the complete return of the number of visitors to to the National Gallery and the South Kensington Museum during the year 1873:—

	Trafalgar-square.*	South Kensington.†
January	64,904	67,705
February	46,564	47,793
March	70,807	67,562
April	103,850	89,422
May	68,307	62,100
June	89,923	85,145
July	70,048	70,585
August	81,864	77,153
September	75,512	80,371
October	closed.	65,497
November	75,708	58,134
December	88,707	87,570
Total	836,194	859,037

Total for the year 1,695,231
Daily average at Trafalgar-square 4,410

* Open to the public four days in the week, except during the month of October, when the Gallery is closed for cleaning, &c.
† Open to the public six days and three evenings in the week.

INDIAN TEAS.

The following is taken from the *Produce Markets Review*:—

The subjoined table shows the progress made in the use of Indian teas in Great Britain during the past three years. The figures are based upon imports given by the Board of Trade returns, and upon the brokers' returns of the stocks left in the country; and although they differ from those obtained from other sources, we think that these statistics give the correct account of the consumption. The discrepancy may in most instances be traced to the different modes of calculating the average net weights of the packages; for instance, in some cases it has been taken at as low as 82 lbs., which must be altogether wrong, as the lightest packages will average this, while a not inconsiderable portion vary from 90 to 100 lbs., broken Pekoes and dust teas frequently weighing from 100 to 110 lbs. It will be seen from the table that the proportion of the consumption formed by Indian tea increased about two per cent. during the past year, and that it now forms nearly a sixth part of the entire British consumption of tea, while in 1867 the population was only about 6 per cent., or less than a sixteenth part of the entire consumption, or about 6,500,000 lbs. of Indian tea, against 111,000,000 lbs. of China. In short, the proportion of Indian teas used in this country has nearly trebled during the past seven years—a proof of the high appreciation in which these teas are held by British consumers. It only requires largely augmented supplies to enable them to enter into yet more general use.

Indian Tea Statistics.

	1871	1872	1873
	lbs.	lbs.	lbs.
Imports of Indian tea into Great Britain	15,125,759	18,059,304	20,326,882
Estimated deliveries of Indian tea in Great Britain	15,000,000	17,250,000	20,300,000
British home consumption of all kinds of tea	123,529,642	127,792,299	132,022,155
Proportion of the deliveries of Indian tea to the British consumption of all kinds	per cent. 12·15	per cent. 13·49	per cent. 15·37

CORRESPONDENCE.

INDIAN TEA.

SIR,—As the discussion which followed the reading, at the Society's rooms, on Friday evening, of Dr. Campbell's very interesting paper on Indian tea, was unhappily (for lack of time) closed before any practical result had been obtained, you will, I trust, kindly forgive me for asking you to add (if not too late) a few lines to the minutes of the meeting.

It was urged by more than one of the speakers that Indian tea had not had fair play in this country, in other words, that it was not sold by itself but only used for mixing purposes. The fault, if fault there be, rests entirely with the cultivators. To explain this I will ask you to suppose that there are two wine houses in the Strand. At one of these houses they sell a fine old port, and an equally fine dry sherry, and a customer would obtain there a year hence precisely the same wine as that he had a year ago. That house would never lose a customer. At the other house I will assume that they have a still finer port, and that by advertising it they secure for it a good connexion, and that when their customers come again they are obliged to say, "We have exhausted our cellar, we can get no more port wine, but we have replaced it with sherry." The reply will be "We do not drink sherry, we liked your port, but if you cannot now supply us with it we will go elsewhere." Thus, having lost its connexion for port, the house shall again exert itself to make another connexion for its sherry, which it shall lose in turn, because it will have to replace its sherry with claret, and so on time after time. Would the house, labouring under such disadvantages, have tbe remotest prospect of success? I think not. And yet this is exactly the case of Indian tea. A dealer can purchase upon the market to-day a hundred chests of fine red or black leaf (China) tea which will please the public, and a week or a month hence he can again go into the market and obtain a hundred, nay a thousand, chests of tea almost identically the same as that which he purchased first (at least his customers shall not be able to detect any variation), and so on year after year. There is no difficulty in replacing or matching China tea. On the other hand, no two samples of Indian tea are alike. They run in lots of two chests, six chests, eight chests, or twenty chests, and hence a dealer committing himself to the sale of such tea would place himself in the position of the second wine house to which I have referred. It is the tea producers who require education, and not the tea drinkers, as Dr. Campbell suggested. I should not have occupied your space with these remarks if I had not a remedy to propose, and it is this—Let the planters devote themselves wholly to the cultivation of tea, and let some person undertake its manufacture and exportation upon a large scale; let him erect large factories and lay down the necessary plant of the best description, and, above all, let him obtain from the best tea producing districts of China skilled and experienced journeymen tea makers as foremen (not mere novices), and let them collect and manufacture the half cured produce of the tea plantations. The tea grower will then be able to give himself wholly to cultivation, and will have larger and more profitable crops; the manufacturer will be able to study and cater to the likings of the public; musty Indian tea will be a thing of the past, and in its stead we shall have uniformity of quality and breaks of 250 chests of a sort, and then, and then only, shall we see Indian tea at 3s. per pound announced in the shop window of every dealer in tea.

Dr. Campbell, I think, made a very strong point of the fact that China tea was adulterated with Prussian blue, turmeric, and gypsum, and that as Indian tea was pure and unadulterated it ought to be preferred to China tea. I have before me a catalogue and a sample of a large consignment of fine new Indian tea, which was sold only a month ago, and which was as grossly adulterated as the China tea referred to by Dr. Campbell; and only yesterday I received samples of two other parcels of adulterated Indian tea. It may not be generally known but the importation of such tea has been going on for some time. What will become of the bright prospects of the Indian traders if any of the dealers into whose hands this tea is at this moment passing, are prosecuted for selling it? The people who are making and importing this tea ought (to say the least) be remonstrated with, for if they are not checked they will assuredly do their fellow tea-planters no little injury.

If the catalogue and sample of the adulterated India tea to which I have referred would be of service I shall have much pleasure in producing them.—I am, &c.,

WHITWORTH JACKSON.

27, Spital-square, E., January 24, 1874.

SIR,—I was rather disappointed that the discussion of this important question was not adjourned from Friday last. When I addressed the first meeting on Indian subjects, about five years since, I almost stood alone in speaking hopefully of the prospects of tea cultivation in India. I am happy to be able to add, I should stand in isolation if I now took a depressed view of the matter. I form great hopes of the successful adoption of Indian teas on their merits in the home market, particularly those from Darjeeling, so specially recommended by Dr. Campbell. I can but regret that Dr. Campbell introduced the question of co-operation, because, if Indian tea cannot do without it, co-operation alone won't make it successful. I feel the importance of these teas being obtainable by the general public; then, if they find them too good and strong, and like to mix them with inferior teas, well and good; but if you had a case of very fine brandy, over proof, presented to you, I take it you would not mix it with a low-class under proof brandy, but simply add a greater proportion of water to the genuine article. As Mr. Hyde Clarke informed you, the Secretary of the Society put too much tea into the pot, and spoilt it. A little practical experience is all that is required. Tea should be weighed out for use; but as materfamilias would object to take this trouble, we must ask her, when she obtains a fine Indian tea, to use two spoonfuls where she has been in the habit of using three, and the result will prove satisfactory; and a good high-class fine tea, costing 4s. per pound, will not prove dearer than low-class teas at cheaper rates.

The first Indian teas coming from Assam, it has been the rule to call all Indian teas Assam, which may account for the grocer telling Dr. Campbell there is nothing from India but Assam. Indian teas are known in the trade as Assam, but, if I mistake not, Darjeeling and other districts will feel the importance of having their produce properly designated. Darjeeling will this year produce only about 2 per cent. of the produce imported here, so that the old advice, "When you ask for Darjeeling tea see that you get it," is applicable to fairly test the question. The fact that Indian teas are much approved in Ireland and Scotland, tends to prove that when the English have acquired the taste for them, flat and insipid teas will prove unsatisfactory. Indian teas are sufficiently strong and pungent to require no admixture of green tea, so that the use of this coloured and adulterated article is no longer necessary.

Dr. Campbell is quite correct in stating, "Persons who have for some time been accustomed to the Indian teas, prefer them greatly. I have for years drank pure unmixed Indian tea. The value of Indian tea is well known to the trade, but much ignorance prevails with the general public." Dr. Campbell's quotation from

the *British Trade Journal* hits the point. Indian tea must be sold on its own merits, and not, as is now generally the case, mixed with inferior stuff. If the planters can trade direct with Thibet, and can get hetter prices than by sales in Calcutta or shipping to London (at present the best market), of course they will do so. They will be wise enough to sell in the best market.

The supply of tea from India is limited, and must for years remain so; and the Chairman did well in sounding the note of caution against unduly rapid extensions. Mr. Edgar states that only ten per cent. or 75,000 out of 750,000 acres are cultivated, hut it must not be concluded that the remainder can he profitably cultivated. Thousands of acres, after having had much money spent on them, have been ahandoned as unsuitable. A frightful amount has been wasted in tea cultivation. Do not again let us have the report, "the results were simply horrible." As Mr. Lloyd judiciously writes to Dr. Campbell, "A little money from England (not too much at once, for that would do harm), and we shall have all we want." The necessary limits of this letter prevent my more than briefly noticing this most important part of the subject.—I am, &c.,

Samuel Ward.

MEAT PRESERVATION.

Sir,—I observe in the *European Mail* newspaper of 11th July, 1873, a report of the proceedings of the 119th annual meeting of the Council and members of the Society of Arts on the question of the supply of food for the people. The Council expressed their disappointment that, up to the present time, no process had heen discovered by which meat could be preserved in a raw state for importation into England from our colonies or elsewhere.

I beg, therefore, to offer the following information, trusting it may be of service in the cause. Some years since, when in Canton, China, I observed numerous preserved meat shops, pigs cut in half, like a side of bacon, geese, ducks, &c., &c., the latter being quite flat, the whole being covered over with a light brown preparation, said to be lacquer, such as is used for tables, &c., and it certainly smelt like it. The Chinese use it extensively as provision in their sea-going junks, and when their voyages were known to last sometimes for a year or more, and always in the tropics. I do not see why some preparation to exclude the air might not answer with the beef and mutton in these colonies; these provisions were perfectly dry, and not discoloured in any way. When in England, lately, I tried to obtain information on the subject, but was unsuccessful; I would, therefore, suggest that her Majesty's Consuls in China should be requested to report on the subject. Some preparation, not offensive or likely to taint the meat, I should imagine, might easily he discovered by our chemists, removable before cooking by soaking in warm water or other process. I may also remark incidentally, that soy is used in China to a great extent in preserving meat, salt not being used. Soy is obtained, I helieve, from the calavance, or French bean, dried by pressure.

It is evident we have much yet to learn, from both China and Japan, and the British Government might obtain most valuahle information on food supply, such as preserving meat, fish, poultry, grain, &c., through the Government agents in those countries.

I trust you will excuse my troubling you with these remarks, but being an old colonist I feel deep interest in all progress relating especially to the Australian group, but New Zealand in particular.—I am, &c.

John Alexander Smith.

Napier, New Zealand, Nov. 10th, 1873.

THE PATENT-OFFICE MUSEUM.

Sir,—In the report on the deputation to the Lord Chancellor, I am stated to have said that our Patent Museum would really be a disgrace to "the most uncivilised community on the face of the globe." This is, of course, an exaggerated picture of a thing already so hideous as to need no exaggeration. Your report is otherwise so accurate, that I am quite willing to suppose the slip may have been mine.

It is true that our Patent Museum would not disgrace the Ashantces in their present condition; but when that intelligent people shall arrive at the patent state of civilisation, I make no doubt the accommodation which they will provide for inventions will surpass that at present existing at South Kensington.—I am, &c.,

Alex. Strange, Lt.-Col.

London, Jan. 26th, 1874.

PATENTS AND CO-OPERATION.

Sir,—The progress made of late years in the various branches of trade and commerce is not only enormous, but seems every year to increase in speed, so that the consumer, not being in trade, stands a fair chance of being left out in the cold, exposed to the torrent that may possibly overwhelm him in the end.

The grand principles of trade consist in forcing and education. Forcing is carried on by means of commercial travellers, advertising, placarding, and puffing in every possible mode, involving in the aggregate a vast expenditure of capital, the whole to be ultimately recouped from the consumer. To all this must be added the system of patenting, now carried on to excess, principally with the view of defeating a rival, but to the great damage of the consumer.

It is notorious that no patent is taken out in order to reduce the cost of an article, an increased price being always demanded because "Patent" is stamped upon it; and it should be observed that by far the greater portion of the cost of the patent passes into the hands of the gentlemen of the law.

Education means that the trader shall endeavour, in every possible way, to teach the consumer that he is to purchase nothing that is not of a composite nature, or that is not the result of complicated operations and elaborate manufacture on a colossal scale. Moreover, it is the fashion of the age to make as much use of artificial products as possible, instead of those produced by nature, as for instance, artificial stone, burnt clay (terra-cotta), instead of real stone, and artificial cements in lieu of natural lime-mortar, whereas the native are much better and far cheaper.

The fact is, that all in trade are banded together, whether amicably or otherwise; no matter, the consumer suffers much the same in either case, and the worst feature of this league is, that there can be no counter-banding by the consumers in self-defence, as by co-operation, except by a few artisans and officials. Even if possible, the result would be but partial, for it would require an impossihility—co-operation in everything. The bulk of the consumers could not associate for their mutual benefit, and must have their every shilling and more dragged out of them to satiate the cravings of trade, that holds out every possible inducement, fair and unfair, to entice the consumer to his loss. How invariably the rich tradesman looks down upon the poor gentleman—his customer.

These are a few of the mighty causes through which this country, though so rich, is almost overwhelmed with poverty. The International Exhibitions that were to do so much good, have dwindled down from the truth in 1851, to a mere tradesman's puffing shop, and will never be of the slightest benefit to consumers until every species of patented appliances shall be rigorously excluded, and there shall be written over the gates "No patents admitted."—I am, &c.,

H. W. R.

LAURIUM MINES OF GREECE.

Sir,—Allow me to offer a few remarks on an article on the Laurium mines of Greece, in a recent number of the *Journal*:—

No evidence has yet been adduced of the existence of any first bed—to say nothing of the second "still richer and intact," and the total value of the ore hitherto found in the old workings, may, I am sure, be reckoned by units rather than millions, whether of dollars or pounds.

It is strange that anyone who has visited the old workings at Laurium can state that the ancients worked with very rough implements, that only the very richest galena was used, or that the ore smelted contained 50 per cent. of galena, three-fifths of which only were extracted. It is certain that no one could make these assertions who knew what he was saying. I have seen at Laurium trial sinkings quite unproductive, made in hard granite, in two stages of 100 yards each, equal in careful accuracy of work to any mining carried on in Saxony. No doubt it is because slave labour was used that the works were carried on in this way, with so little regard to economy, and there is no reason to doubt that the means both of mining and smelting were the best that could be adopted at the time. The remains of the furnaces are as elaborate as those of the dressing-floors and tanks, and it would be difficult to surpass these in mechanical finish. The "old man" was a great deal better informed than some of his successors.

It is not true that the Hellenic Government has lavished thousands of pounds in bringing persons from Germany to assay the ecbolades. It is very difficult to sample these heaps, and the only effectual means has not been adopted; but the samples taken by the Government Commission were sent to Paris for assay, and the Government has spent very little on the subject. The information, though obtained carefully, is, however, certainly incomplete, both as to value and quantity. That this value both of the slags and ecbolades is very considerable is extremely probable, but Greece is not the only country that has yielded valuable slags and waste heaps from ancient mining operations.

When I was at Laurium a year ago, there was no evidence whatever in existence of the presence of valuable ore from the old mines that had been opened. On the contrary, I never saw old mines more thoroughly cleared out.—I am, &c., D. T. Ansted.

24th Jan., 1874.

SWAN RIVER MAHOGANY.

Sir,—We are very much indebted to your correspondent, Mr. Reveley, for his every now and then calling attention to some valuable and practical point.

In your issue of the 2nd inst. he draws attention to the *Eucalypti*, so characteristic of Australia. These woods are very valuable for many purposes, and in those colonies no better could be wished for house-building purposes and for furniture.

They have not, however, been altogether neglected amongst ourselves for furniture. One of the heads of the largest house in Scotland in that line, informed me that his firm had tried some of these Australian woods. He believed that they had tried the particular species referred to by your correspondent as "Swan-river mahogany."

The principal objection was their being harder to work than other woods which served all purposes equally well, and were much lighter. It was found, however, that besides injuring the tools, the extra time spent in the manufacture of the various pieces so added to their expense as to render them virtually unsaleable alongside of like articles in other woods.

For the other purposes mentioned by your correspondent, such as ship-building for certain kinds of craft, jetties, pier-heads, piles, and railway-sleepers, no other woods can surpass them. The attention of railway engineers in India has been drawn to them, owing to the valuable way in which they resist the attacks of that most destructive pest, "the white ant." A plank 148 feet in length is not to be got everywhere.

Why Western Australia, with its fertile districts, its pasture lands, its fine harbours, and its finer climate, should lag behind as it does, is one of those anomalies which time alone can explain. It is satisfactory, however, to notice that timber now appears as one of its staple exports. A good deal of the sandal-wood exported finds its way to China, where it is carved and made into those little boxes and other like nick-nacks which exhibit the ingenuity and industry of the Chinese so much.—I am, &c.,

H. F. Alexander.

Edinburgh, Jan. 7, 1874.

GENERAL NOTES.

Utilisation of Waste Steam.—By the invitation of his Grace the Duke of Sutherland, a number of gentlemen met on Wednesday last, at Stafford-house, to see exemplified Mr. T. Berger Spence's "steam regenerating principle." The invention consists in passing steam at ordinary atmospheric pressure into a solution of caustic soda, which is thereby raised to its own boiling point. It is proposed to use the heat thus developed to generate steam, the waste steam from an engine boiler being employed in the first instance to heat the caustic soda. Mr. Spence showed that the effect was absolutely produced by raising a solution of caustic soda to a heat considerably over 212° by means of a jet of steam, but he stated that he had not yet worked out practical details as to the employment of the idea, though he exhibited a sketch of an arrangement of boilers which he considered might render it available.

NOTICES.

THANKSGIVING MEDAL.

A medal has been presented to the Society by the Corporation of the City of London, struck in commemoration of the National Thanksgiving at St. Paul's Cathedral, on February 27th, 1872, for the restoration to health of H.R.H. the Prince of Wales.

THE LIBRARY.

The following works have been presented to the Library:—

Account of the Operations of the Great Trigonometrical Survey of India. Vol. I. (Standards and Base Lines.) By Colonel J. T. Walker, R.E., F.R.S. Presented by her Majesty's Secretary of State for India in Council.

Society for the Promotion of Scientific Industry: Artisans' Reports upon the Vienna Exhibition. Presented by W. C. Aitken.

The Study of Sociology. By Herbert Spencer. (Henry S. King and Co.) Presented by the Publishers.

Commentaries upon International Law. By Sir Robert Phillimore, D.C.S. Presented by the Author.

The Jurisprudence of Local Administration. By Edwin Chadwick, C.B. Presented by the Author.

Statistics of the Colony of Victoria for 1872. Part 6, Production and Census of Victoria, 1871. Part 9 (a), Occupations of the People.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

The following arrangements have been made :—

FEBRUARY 4.—"On Eastern Art, and its influence on European Manufactures and Taste." By Dr. CHRISTOPHER DRESSER. On this evening Sir EDWARD LEE will preside.

FEBRUARY 11.—"On Type Printing Machinery, with suggestions thereon." By the Rev. ARTHUR RIGG, M.A.

FEBRUARY 18.—"On Thrift as the Outdoor Relief Test." By G. C. T. BARTLEY, Esq. On this evening the Right Hon. the Earl of DERBY will preside.

FEBRUARY 25.—"On the Channel Tunnel." By WILLIAM HAWES, Esq., F.G.S.

MARCH 4.—"On Bells, and Modern Improvements for Chiming and Carillons." By GEORGE LUND, Esq.

INDIAN SECTION.

The following arrangements have been made for Friday evenings during February and March :—

FEBRUARY 6.—"On Indian Art." By Dr. ZERFFI.

MARCH 13.—Dr. LEITNER, Principal of the Government College of Lahore, will give an account of the Races of Dardistan (north-west of Cashmere), discovered by him.

AFRICAN SECTION.

The following Friday evening meeting has been arranged :—

JANUARY 30 (this evening).—Inaugural meeting. The Right Hon. Sir BARTLE FRERE, K.C.B., will deliver an opening address.

CHEMICAL SECTION.

The dates for the various papers are not yet fixed. The meetings will be held on the following Friday evenings, at 8 o'clock :—February 20th, March 6th and 20th, April 10th and 24th, and May 8th. The following subjects have already been arranged :—

"On the Production of Anthracene and Alizarine from Pitch."

"On the Manufacture of Chlorine."

"On the Utilisation of the Waste Products of Gas Manufacture."

"On some Recent Improvements in the Production of Carbonate of Soda."

"On Sugar Refining, with special reference to Finzel's Sugar Crystals."

CANTOR LECTURES.

The second course is on the "Chemistry of Brewing," by Dr. CHARLES GRAHAM (University College, London), and consists of seven Lectures, the remaining five of which will be given as follows :—

LECTURE III.—FEBRUARY 2ND, 1874.

On mashing.

LECTURE IV.—FEBRUARY 9TH, 1874.

On Boiling. Hops, their properties and uses.

LECTURE V.—FEBRUARY 16TH, 1874.

On fermentation. (Primary.)

LECTURE VI.—FEBRUARY 23RD, 1874.

On fermentation. (Secondary.)

LECTURE VII.—MARCH 2ND, 1874.

The beer of the future.

These lectures will include a chemical examination of the chief features of the methods of brewing adopted in England, Scotland, Germany, Belgium, and Norway, with proposals for the prevention of acidification and other destructive changes which occur in beer. The lectures on fermentation will include an account of the nature and chemical functions of the various yeast plants. During the course, chemical tests will be described for the guidance of the brewer in the mashing, boiling, and fermenting processes, and for testing the purity of the water and utensils used.

Other courses will also be given during the Session, one by Professor BARFF, M.A., having been already arranged. These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture.

MEETINGS FOR THE ENSUING WEEK.

MON. ...SOCIETY OF ARTS, 8. Cantor Lecture. Dr. Graham, "On the Chemistry of Brewing."
Social Science Association, 8. Mr Arthur Arnold, "On the Municipal Government of the Metropolis."
Society of Engineers, 7½.
Institute of Surveyors, 8. Discussion on the Paper by Mr F. A. Philbrick, entitled "The Lands Clauses Consolidation Acts, with some Suggestions for their Amendment," will be resumed.
Royal Institution, 2. General Monthly Meeting.
Farmers' Club, 5½. Mr. J. J. Mechi, "The Commercial Principle, as applied to Agriculture."
Royal United Service Institute, 8½. Dr. A. Leith Adams, "The Recruiting Question, from a Military and a Medical point of view."
Medical, 8.
Victoria Institute, 8. Mr John Eliot Howard, "The Contrast between Crystallisation and Life."
London Institution, 4.

TUES. ...Civil Engineers, 8. Mr John Birch Paddon, "Description of the Gas Works constructed for the Brighton and Hove General Gas Company, at Portslade, Sussex."
Pathological, 8.
Biblical Archæology, 8½.
Zoological, 8½.
Anthropological Society, 8.
Royal Institution, 3. Professor Rutherford, "On Respiration."

WED. ...SOCIETY OF ARTS, 8. Dr. Dresser, "On Eastern Art, and its Influence on European Manufactures and Taste."
Geological, 8. 1. Professor Ramsay, "On the Physical History of the Valley of the Rhine." 2. Mr. Wm. Topley, "On a Correspondence between some Areas of Upheaval and the Thickness of Subjacent Beds."
Microscopical, 8. Annual Meeting.
Pharmaceutical, 8.
London Institution, 7.
Obstetrical, 8.

THUR. ...Royal Institution, 3. Professor Duncan, "On Palæontology, with Reference to Extinct Animals and the Physical Geography of their Time."
Linnæan, 8. 1. Mr. Parker, "On the Morphology of the Skull in the Picidæ." 2. Mr. H. N. Moseley, "Botany of the Challenger (No. 3)." 3. Surgeon-Major Colvill, "On the Vegetable Productions, &c., of the Province of Baghdad."
Chemical, 8. 1. Dr. Tommasi, "On the Action of Benzyl Chloride on Camphor." 2. Dr. C. R. A. Wright, "On Isomeric Terpenes and their Derivatives"—Part III. On the Essential Oils of Wormwood and Citronella. 3. Dr. H. How, "On Two Coals from Cape Breton, their Cokes and Ashes."
Royal Society Club, 6.
Royal, 8½.
Antiquaries, 8½.

FRI. ...SOCIETY OF ARTS, 8. Indian Section. Dr. Zerffi, "On Indian Art."
Philological, 8.
Royal Institution, 8. Weekly Evening Meeting. 9. Mr. Garrod, "The Heart and the Sphygmograph."
Archæological Institute, 4.

SAT. ...Royal Institution, 3. Prof. G. Croom Robertson, "On Kant's Critical Philosophy."

JOURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, FEBRUARY 6, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

AFRICAN SECTION.

The Committee met on Wednesday, at four o'clock. Present—Vice-Admiral Erasmus Ommanney, C.B., F.R.S. (in the chair), Mr. E. Banner, Mr. Mr. G. P. Badger, Mr. J. C. Blaine, Rear-Admiral Sir J. C. Dalrymple Hay, Bart., C.B., F.R.S., Sir Leopold Heath, Captain Felix Jones, Dr. Kirk, Dr. Mann, Consul Thomas J. Hutchinson, Mr. T. A. Rochussen, Mr. Trelawny Saunders, Mr. P. L. Simmonds, Hon. M. de Roubaix, Mr Alfred Smart, Major E. Smith.

The Committee took into consideration the papers proposed to be read, and settled the same (see "Calendar," page 232).

The following gentlemen were added to the Committee:—Mr. C. W. Eddy, Mr. E. Hutchinson, Lord Alfred Churchill, Mr. Robert White, Mr. G. M. Kiell, Captain Fellowes, R.N., and Colonel Gawler.

TECHNOLOGICAL EXAMINATIONS.

The Programme for the Examinations in the Manufacture of Cloth is now ready, and can be had upon application to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C.

The following donations have been received since the last announcement:—

	£	s.	d.
The Worshipful Company of Clothworkers	10	10	0
The Worshipful Company of Vintners ..	21	0	0

PROCEEDINGS OF THE SOCIETY.

AFRICAN SECTION.

The opening meeting of this section was held on Friday evening last, when the chair was taken by Vice-Admiral Erasmus Ommanney, C.B., F.R.S.

The Chairman, in opening the proceedings, said it might be necessary to explain how the commerce of Africa came before the Society. At the last meeting of the British Association, Mr. Hyde Clarke, and several influential merchants, came to the Geographical Section, and requested that the subject might be taken up. However, it was not thought that that was the proper body to take up the subject, and it was suggested the Society of Arts should bring it before its members. To those who were not members of that Society he might explain, the Society by its charter was bound "to increase the trade of the realm by extending the sphere of commerce, and generally to assist the advancement and development of the same." Faithful to the discharge of its functions, the Council had accordingly established an African section, as had already been so successfully done with regard to India, the object being, in both cases, to bring together those interested in their respective specialities for the purpose of discussion, and by means of the Society's *Journal*, circulating amongst a constituency of 4,000 members, to disseminate information likely to be of service. Besides, all these sections and the committees which were established in connection with them, served as centres for taking action, and as a rallying point for merchants, traders, and others, where they might concert measures for the benefit of trade, and bring their views before the Government when imperial action appeared necessary. The committee had already been organised, consisting of many of the principal merchants in London, and others interested in the cause of Africa. It was impossible to mention Africa without paying a tribute of regret to the memory of the late Dr. Livingstone. He believed a grateful country would ever hold his name in admiration for the work he had done in the cause of humanity and discovery. The present aspect of affairs in Africa afforded an opportune moment for drawing public attention to the prospects open there to commercial enterprise and civilisation, which two objects must always go hand in hand. All the missionaries, and all the books in the world would have no influence in Africa unless accompanied by commerce. Within a very recent period wonderful revolutions had been accomplished by the aid of intrepid explorers, such as the illustrious Livingstone; in fact, a new era was opened by his explorations, which were followed up by a galaxy of heroic men, like Speke, Grant, Burton, Sir Samuel Baker, Stanley, Petherick, and others, all of whom spoke of the fine climate which existed, not unsuited to European constitutions. These noble men, by their indomitable pluck, had left behind them names of imperishable renown; through their efforts unknown Africa had been pierced in many points, the great lake system of the equatorial region had been discovered, and the basin of the Nile waters had been traced. All agreed now, contrary to the view which was taught to many then present in their boyhood, that there was a great field in the interior of Africa for commercial enterprise, besides which it must not be forgotten that there was a noble opportunity for ameliorating the condition of a vast mass of the human race who were now suffering under barbarity, cruelty, ignorance, slavery and heathenism, inhabiting about one-sixth of the terrestrial globe. He ventured to predict that Coomassie would be more easily approached than most people seemed to imagine, and he hoped that when the warrior had done his work he would not leave the country without some traces of his presence, but that that might be done which was proposed about 60 years ago by Bowditch, when a treaty was established with the king to the effect that there should be a resident consul and a road kept open between Coomassie and the coast. He hoped this would now be accomplished, and when that road was opened up commerce would follow. In the kingdom of Ashantee there were hundreds of square miles of country, full of rich products, and with vast towns, which only required the approach of commercial enterprise to be rapidly developed.

The Right. Hon. Sir Bartle Frere, K.C.B., G.C.S.I., delivered the following

INAUGURAL ADDRESS.

When I was asked to prepare an inaugural address for the African Section of the Society for the

Encouragement of Arts, Manufactures, and Commerce, the first question which struck me was, —Why does Africa make so small a figure in the world, either in politics or commerce? Politically speaking, Africa is almost a nonentity. It is a curious feature in her history that there is, in Africa, at this moment, no higher diplomatic agent from any of the great powers of the world than a Consul-General, whose diplomatic title indicates that the court to which he is accredited, however influential, is not of first-class political rank. It was not, as we know, always so. There was a time when Africa gave the materials and implements of civilisation, and afforded the highest pattern of political order to Europe; and at a later period an African power contended with Rome for the Empire of the then known world. It is a curious and useful speculation to trace out the causes why no African potentate now fills any position as a power of the first order in the world.

So also with commerce. We have authentic records of the time when all commerce in Europe was in African or Asiatic hands. How is it that the commerce of Africa has fallen so low that, till very lately, the external trade of the whole continent did not equal that of a third-rate commercial power in Europe, Asia, or America?

It is, as we know, owing to no defect of position. Africa seems centrally placed to trade with all the modern as with the ancient world. No other quarter of the globe is so entirely surrounded with facilities for foreign commerce. Nor are the natural facilities for internal trade less conspicuous. Vast rivers penetrate far into the unknown but fertile and populous interior, and would, in any other quarter of the globe, be covered with boats and steamers. We now know that, instead of being a barren desert, with a few spots of fertile country near the sea shore, Africa consists of several belts, as it were, of fertile soil, each enjoying some peculiarities of climate or position, but all adapted to various kinds of tropical and temperate products, and affording natural facilities of every kind for the materials and processes of commerce.

Let us consider these climatic belts a little more in detail. We know that the belt which intervenes between the Mediterranean and the Southern limits of the Atlas slopes once maintained, and might again at any time maintain, a hardy and civilised population, carrying on a great trade with every part of the world.

The next belt, the Sahara, and the corresponding desert belt, which, south of the equator, is found between the equatorial fertile belt and the Cape Colony, are, it is true, of little value as regards natural products, except in the horses and camels which may be bred on their borders; but the climatic influences of these two belts are by no means inconspicuous in their effects on the productive powers of the countries on either side of them.

The great equatorial region intervenes between these two desert belts, and probably no tract of equal extent in the world offers such natural facilities for commerce; there we find fertile soil, abundant moisture, a teeming population, and a sea-board calculated to add maritime commerce to every form of traffic with the interior.

Lastly, the southern belt, extending from the borders of the southern desert to the Cape of Good Hope, is not only fertile and productive in various forms of animal, vegetable, and mineral wealth, but enjoys one of the best climates in the known world.

As to the other climates of Africa, we may observe that though many of them have an evil name and an almost proverbially bad repute, as regards their effects upon European constitutions, a closer study of their character will show that nature is less to blame than the agency or neglect of mankind. In many parts of the continent, over vast tracts, we find a temperate climate, where extreme heat and cold are alike unknown; with two or three solitary exceptions there is no such thing as perpetual snow or severe winter, whilst the highlands of Ethiopia, Egypt, the Cape, Algiers, and probably many other portions of the continent, evidently are more naturally adapted for human habitation than most parts of Europe.

Then, as regards the people. Millions of them in the north belong to races which have contended with our northern tribes for the supremacy of the temperate zone. Many more belong to races which have left a permanent mark on the history of civilisation and of human improvement; and, even as regards the great mass of the Negro race, we find that, whenever they can be induced to toil, either by compulsion or self-interest, their labour forms a mine of wealth to the employer. How, then, can it be said that in the people of Africa there are to be found any causes for the low position the continent now occupies, politically and commercially, in the world? a position not hers, be it observed, by tradition or nature; but the exact reverse of that which, for at least 4,000 years, she occupied in former ages.

The question is, I think, in every way worthy the attention of the Society for the Encouragement of Arts, Manufactures, and Commerce; I shall not attempt to anticipate the solution which may, I trust, be looked for as a result of the researches of the African section of this Society; but I may be allowed to frame what may be taken as "a provisional or working theory" on the subject, when I submit that the cause will be found capable of being summed up in what I would call a defect of political cohesion. From a variety of causes the elements of African civilisation, however separately promising in themselves, do not combine in the crystallised forms of national existence.

We can but glance at some of the causes of this state of things. Every one of them deserves, and will reward, careful separate investigation. Some, no doubt, are religious, and may at first sight seem out of place in discussions on Arts, Manufactures, and Commerce; yet I venture to think this exclusion from the inquiries of the African Section would be founded on a very narrow view of the question. As regards the Arts, there can be little doubt but that they, at all events, are most intimately connected with the religion of a country—the Pyramids, the paintings and sculptures of the ancient Pharoahs, no less than the mosques and tombs of mediæval and modern Egypt, tell the same story which we find in the history of the Jews, the Assyrians, the Greeks, the Etruscans, and the Romans, that the art of every nation is inseparably connected with its religion.

Manufactures and Commerce may depend upon many other social and political circumstances, yet

here again it will be found that society and the form of political life which promote or depress manufactures and commerce depend more upon religion than many of our modern philosophers are in the habit of teaching us. In Africa, at all events, it will be found a question of vital importance to the social and political condition of the people, whether the religion of the African teaches him a blind worship of the powers of evil and a gross materialism, such as characterise the Fetish worship of the Negro, or whether, with the higher aspirations and purer conceptions of a one great personal Deity, a religion like Mohammedanism inculcates intolerance of other creeds, isolation of the individual worshippers, and devotion to a God of pure force—whether it sanctions polygamy and slavery as universal social peculiarities, affecting the social position, in the one case, of half mankind, in the other of a far greater proportion whose lot it is to labour; or whether, as in the case of Christianity, the doctrine taught, whatever the defects may be in practice, is one of universal brotherhood and good-will, of treatment of all mankind on the same principles as the worshipper would himself be treated, the obligations of a high moral code, and a proximate reckoning for all good and bad deeds done in the flesh before an all-knowing and infinitely just, though infinitely merciful God.

I can only glance at such topics, and recommend the prevalent religions of the people to the study of all interested in the civilisation of Africa, as likely to prove as fruitful of important results as any other inquiry which might seem at first sight more immediately connected with Arts, Manufactures, or Commerce.

Then, again, many of the causes of the present state of Africa are no doubt ethnological, and here is an infinite field for study, which has been already cultivated with much success in other directions by prominent members of your Society. Why have the Turks, the Arabs, the tribes of Barbary and the ancient kingdom of Ethiopia lost their secrets of political combination and rule? What is the defect which everywhere has hitherto seemed to blight the prospects of a civilised Negro Dynasty? We find the great Negro race admirable in every position as servants, capable of affording examples of wonderful fidelity and courage. Negroes have often risen to the highest position as advisers, ministers, generals, and friends of sovereigns. Why can we as yet point to no great conqueror, law-giver, or philosopher of the Negro race? Such inquiries are of the utmost importance to the future of Africa. While everyone can see abundant evidence of capacity for improvement, or of liability to deterioration in mankind, all history and philosophy, especially all modern research, goes to prove that there is no such thing as a really stationary race of human beings. Nor is there anything to prove that a nation which has once occupied a high position among the kingdoms of the earth may not fall from its high estate, and, after forming fresh combinations with fresh races, rise again with a somewhat altered ethnological composition, and again bear rule, and produce teachers and workers for the benefit of all mankind.

As regards the Negro races, we are clearly only at the commencement of that accumulation of ethnological facts which would be a sufficient ground for safe inductions. We know, as yet, very imperfectly the numbers, the position, the languages, and the history of the teeming races of Negroland. It is quite possible that further knowledge and the careful research of the antiquarian, the ethnologist, the philologist, and the physiologist combined, may lead to discoveries regarding the past history of these races not less important than those that have thrown some light on the history of the northern nations of Europe and Asia during the 2,000 years which preceded the Christian era. At any rate, such researches will tend to illustrate the real capabilities of the Negro race, and the best mode of developing and increasing them, regarding which we, as yet, know so little. We in Europe may confess without shame that the most civilised nations of Europe might have made but a poor figure in history, had not Syrians, Egyptians, Persians, Assyrians, Arabs, Phœnicians, and other Oriental races come in contact with them, and in various ways modified their national peculiarities, mental as well as corporeal; and I have no doubt that such ethnological inquiries as the African Section of this Society has in its power to make, may throw a flood of light on many practical questions connected with the improvement of the continent, and may guide, not only the missionary and the statesman, but the merchant and manufacturer, in their dealings with these African races.

Yet more important is the combination of ethnological and religious causes which we may call social and political, and which have acted to depress the once most civilised nations of Africa to a lower level, and to keep in the lowest level of all such a vast assemblage of nations as form the bulk of her population. Here, again, we can but glance at problems, each of which would require a long time for its thorough investigation. Why have we now, as far as we know, no such thing as a permanent indigenous dynasty in Africa? What causes, beyond the obvious ones of polygamy, slavery, and slave trade, have conduced to this result? and by what probable agencies may we hope to see an organised national existence in Africa, such as seems to form so easily, and from such diverse materials, in Europe, Asia, America, and Australia? I need not tell you that without some such sound political organisation as shall give practical protection to life and property, or shall be capable of giving reasonable redress for wrongs, and reasonable protection for rights, Arts, Manufactures, and Commerce can exist only as exotic plants. They cannot be the natural and usual products of the soil; they will flourish in proportion as reasonable freedom, combined with respect for the rights of others, is accorded to the great mass of the nation.

It will be seen, I think, from what we have said, that there will be no lack of work for the members of an African Section. Each, according to his own bent, may take up his own branch of inquiry, and, if conducted in a fairly philosophical spirit, there is none that can fail to be of the highest value. But the task seems so vast and various, that I should be inclined to attempt some limitation of the inquiries to which the section might formally devote itself, without, however, attempting rigidly to exclude anything which relates to the African continent.

In this point of view, I think that the African Section need not at first devote any large portion of its time and attention exclusively to the consideration of the two northern belts to which I have alluded, as lying between the Mediterranean and the southern limits of the great Sahara Desert. The great French nation is directly interested in all inquiries regarding Algiers, and the neighbouring kingdoms of Morocco, Tripoli, and Tunis. All the civilised world is more or less interested in Egypt and its future, and we may congratulate ourselves that the destinies of the country are now in the hands of a ruler who only needs a more independent position, time, and a better financial system, to place Egypt once more in the position of one of the great powers of the earth. It would be useless to shut our eyes to the enormous difficulties of the task which the present ruler of Egypt has undertaken —difficulties political and social—which might well discourage anyone less bent upon carrying out the great designs of the founder of his dynasty. There is one part of his task, however, which links itself on more especially to the subjects which ought to engage the attention of your African Section, and in which I feel no sort of doubt that England may greatly assist in the task so courageously undertaken by the Khedive.

Abjuring all those designs for intermeddling in Asiatic and European affairs which, from the time of the early Pharoahs down to our own, have so frequently tempted the rulers of Egypt to waste their strength in attempts at European or Asiatic conquest, his Highness has turned his attention to the material improvement of his hereditary possessions in the valley of the Nile; and their extension southwards, so far as the basin of the great river, may afford legitimate and practicable grounds for extending the influence of Egypt. His Highness has clearly seen that slavery and the slave-trade are cancers which would eat to the heart of the best devised political system, and, with a courage which cannot be too much praised, he has taken as his agents in a necessary part of his great work two Englishmen, of whose energy and good faith in such a noble work few of their countrymen would venture to doubt. We may admit, with some of the critics of his Highness's policy, that he stands almost alone in the work, and that, with the exception of one or two of his most far-sighted ministers, he finds little sympathy in his undertaking from those around him. I am not at all sure that this is altogether a correct view of the case. If I might reason by analogy, I should say that there are probably many amongst his Highness's subjects who see, as clearly as he does, that while the evils against which his efforts are directed remain uncorrected, there is no hope for the admission of Egypt into what I may call the family circle of civilised nations; and that, however few may now venture to express their opinion of his policy, there must be many who, in their secret hearts, see that if Egypt is ever to take the place of the ancient kingdom of the Pharoahs, and to rank side by side in social and political feeling, as well as in diplomatic language, with the great powers of the world, it can only be after the political reforms which his Highness has at various times begun shall have been effectually carried out, and that foremost amongst such reforms must be placed the abolition of slavery and the slave trade.

As regards the rest of Africa, there are two European powers actually much interested in the future of Africa, and at least three which might any day take a great part in all African questions with infinite advantage to themselves.

First, there is our own nation, which has already vast possessions in Africa, and which I venture to think can never be indifferent to the fate of the rest of the continent, whether it be viewed in a commercial, a moral, a political, or a social aspect.

I need not dilate on the possible future of the great Cape Colony, which may any day rival Australia as one of the most important colonial possessions of the British Empire.

Modern improvements in communication, modern discoveries in geology and other branches of science, are fast welding together the loose elements of a great South African Empire. A fertile soil, an equable climate, great mineral riches, and access to some of the best markets in the world, naturally place South Africa in a very influential position among the colonies which owe their origin to English and Dutch enterprise and industry. The re-discovery of the ancient gold-fields which seem to have supplied gold to the Phœnicians and Arab traders of Solomon's time, and the diamond-fields, will no doubt attract in Africa, as elsewhere, enough, and more than enough, attention from all the enterprising portion of the world's population. But the latest accounts show us that in the coal-fields, which extend at least as far south as the neighbourhood of the colony of Natal, there is a greater and more important source of national wealth, and one more likely to affect the destinies of Africa, than anything yet discovered in those colonies, and I do not know any worthier subject for the attention of the African Section than to collect information regarding and promote the development of fields of coal, which are so placed as to supply for the whole of the African and Indian Seas stores of that material, on which the commerce of the future must mainly depend.

Elsewhere, on the African coast, east and west, England has before her a vast field which cannot fail to interest all who are concerned with Arts, Manufactures, and Commerce. The conditions on the East and West Coasts of Africa are very diverse, but I believe the same principles will be found applicable to both, and that any departure from those principles will not only cause us to miss a great opportunity of advancing the interests of our own nation and of all mankind, but will be a fruitful cause of future national humiliation, and possibly of serious pecuniary loss.

Some observations of mine, addressed to associations in Scotland upon this subject, have been so far misunderstood as to lead to a belief that I advocated an indefinite extension of what it is the fashion to call "equivocal and entangling engagements." So far from this being the case, my great object was, and is, to afford such light as my experience in dealing with similar questions may furnish, to prevent my country being drawn into "equivocal and entangling engagements" which may tempt us to endeavour to escape from them in some way inconsistent with justice and national

honour. I hold that "equivocal and entangling engagements" are only likely to be formed when we neglect our plain duty in dealing with semi-civilised or savage neighbours. Wherever Englishmen go, and I need not remind you they go everywhere, in one capacity or another, there they will form engagements of some kind, and Englishmen at home—as long as they are Englishmen—will determine to protect their countrymen abroad when they do right, and I hope will also resolve to coerce and punish them when they attempt to do wrong. Our Government is not merely the Government of England but of *Englishmen*, wherever they may be. Englishmen, like other mortals, will sometimes do wrong; and I hold it is a pure evasion of our duty to say that when they do wrong in other countries we may leave it to other countries to punish them. We may safely do so wherever there is a civilised government. Wherever there is a semblance of a government which can take care of of itself, there we may safely leave it to that government to punish English wrongdoers; and our only duty in such cases will be to see that our countrymen do not set up any claim to national protection which is inconsistent with the rights of the civilised or semi-civilised nation in which they may be dwelling, trading, or travelling.

But the case is far otherwise when Englishmen go among savage nations who have no means of protecting themselves. It is not necessary to travel to see the enormous influence which the individual Englishman possesses in such countries. You may read the travels of our great discoverers, and see how vast that influence is when it is exercised for good and lawful purposes. It is in part the natural result of superior energy and knowledge, and the influence of such superiority is very great even when exercised for purposes of evil. You hear less of it when the objects aimed at are bad, for such deeds shun the light; but every now and then some tale of African or Polynesian slavery or Chinese Coolie-kidnapping is told, which makes us thoroughly ashamed of abandoned individuals among our own countrymen, and makes us wonder at the enormous power which civilisation has put in the hands of such ruffians. I hope the day is far distant, when we shall as a nation be guilty of the cowardly hypocrisy of saying in such cases, "Am I my brother's keeper?" I believe that, whenever the people of England, of whatever class or party, realise the atrocities which can be committed by half-a-dozen unscrupulous, resolute English ruffians, when they get beyond the reach of our laws and usages, I believe that, without the slightest hesitation, Englishmen, as a body, will insist on the Government using every effort in its power to punish the evil doer, to protect the weak, and to vindicate the character of our national flag; and I feel quite certain that whenever, which God forbid, we become indifferent as a nation to such obligations, men may truly say that they see in us the symptoms of national decay. Nor is the case materially different if the English subjects are of Asiatic extraction, like our friends the Banians, on the eastern coast of Africa, a most valuable class of men in their proper functions, as legitimate traders, but who, like other English subjects, require to be looked after by the English Government, and to be duly punished when they do evil. But the duty of the punishing our countrymen when they do wrong has its correlative duty of protecting them when they do right. Everyone of them has a right to go wherever he is not prohibited by the laws of the country he visits, and to exercise his lawful calling wherever his presence is not an offence against the local laws. It is hardly necessary that I should dwell upon the existence of the duty of our Government to protect our countrymen in the exercise of such rights. It is enough to say that in no case that I know of has it been long ignored with impunity. It might often be a very questionable case, as some of us thought in the case of some of our Chinese wars. The interests involved might often be of apparently small national importance, as in the case of the Abyssinian war; but it is a patent fact that, however small the interest, the English people, as yet, never clearly understand that one of their countrymen has been tyrannically treated by any foreign despot who pertinaciously refuses redress, and who could allege no ground of the infraction of local laws, without the English people, as a body, unanimously requiring their government to protect that Englishman and obtain a redress for his wrongs. Now such Englishmen are at present, as a matter of fact, in the habit of pervading every accessible part of Africa. In so doing they come in contact with potentates in every stage of civilisation, from utter barbarians and men completely ignorant of our power, to men who only require a kind word and intelligible explanation to do all that we require. Hence arises an interminable mass of engagements, "equivocal and embarrassing," if ill-understood and neglected, but sufficiently simple and free from embarrassment if carefully and promptly attended to. The semi-civilised chief rarely understands our power. My doctrine would be to teach it him by friendly communication before the necessity of unfriendly remonstrance arises. He is apt to pay implicit respect to few considerations except those of superior force, when his inclination leads one way and his duty another. Let us show him, before discussions arise between us, that the superior force rests with us and not with him; and that, when we choose to undertake the trouble, we can march through his dominions, with or without his leave. This truth is easily taught, and learnt, if we only take the trouble; and I would always teach it, if possible, by other means than bombardment; though, when the question unhappily comes to the ultima ratio of rulers, I am sensible that there is no safe alternative but to precede negotiations by a decision of the question of which is the strongest.

Now, I believe that all this might be effected, and much more, if we only made a reasonable use of our diplomatic service and consular agencies in connection with these people; and, if, instead of turning our backs on a potentate, and refusing to know anything or care anything about him because he is black or weak, we took pains to let him know all about us and our power, and endeavoured not only to teach him that we were strong, but that we meant justly and kindly towards him and all men. I can answer for it, from long experience, that you will seldom be disappointed by the agency of your countrymen in such matters. I

have tried them scores of times; sometimes when they were little better than half-bearded lads, without better training than a good English home, a good English school, and a good English regiment afford, and I do not recollect ever being disappointed, when they once understood that, as diplomatic agents in dealing with savages, they were expected to be as carefully observant of the duties of an English gentleman as if they were attachés at Paris or St. Petersburg.

Nor is it only with the higher classes of your countrymen that this is the case. I never met an industrious, right-thinking Englishman, knocking about among savages, whether as sailor, settler, or trader, who did not possess much of the same power, and show a willingness to respond to the same calls of national duty.

Of course you may sometimes meet with ill-conditioned individuals and ill-selected agents in diplomacy, as in every other walk of life; but my experience leads me to believe that, when this is the case, you may easily at once see the cause. Either the agent has been obviously ill-selected, or his superiors have shown little interest in what he is doing; but I believe that if you put a consular agent in Africa, or anywhere else, and if you give him plenty to do in looking after and reporting on the country, when he has time to spare from looking after and reporting on his own countrymen; if you promptly notice what he writes, and encourage or admonish him as occasion may require, you will find that you have posted there a tower of national influence and national strength; that such a man will save you from equivocal and entangling engagements, and from many a humiliating position, and not unfrequently from an expensive war; that he will help your trade, and acquire great influence, because he will be recognised as a public benefactor by the rude people among whom he serves. And if it should happen that you should be drawn into hostilities, in that or any neighbouring country, he will essentially aid you to limit your hostilities to what is just and necessary, and when hostilities have ceased, to heal the wounds that you have made. In this, as in all other cases, I hold that the safest plan is to face your responsibilities, and to do your best to bear instead of attempting to abjure or evade them.

I think if you will look into the history of our two latest African difficulties, the Abyssinian and the Ashantee wars, you will find abundant evidence of the truth of what I have advanced; and I feel certain that no one can read the letters which the intelligent correspondents of the daily press write from the coast of Africa, without seeing that all our difficulties and dangers are caused more by our own neglect than by anything inherent in the position. Even the climate, it is clear, is unjustly blamed for much that is due to long standing neglect of sanitary precautions, or to inattention of obvious sanitary rules in selecting a place of settlement. There is no getting out of the difficulty by running away from the coast. It is obviously fertile, and likely to be a good place for trade; and if our flag were hauled down, and the coast utterly abandoned by our Government to-morrow, Englishmen would still go there to trade, to travel, and to preach; they would still be liable to maltreatment by savage potentates, and you would still be liable to have to pay for inglorious, fruitless, but expensive wars, as the price of equivocal and entangling engagements and obligations caused by our neglect of our clear duty to look after, coerce, and protect our people wherever they are led by that love of enterprise and foreign travel which is one great element of our national strength.

It is equally clear that there is no natural difficulty in the situation itself. If Fantees are cowardly and lazy, Kroomen and Ashantees are brave, and capable of sustaining labour. We may, and probably have, got hold of the wrong people and the wrong chiefs, but this is not from lack of better materials, it is simply the result of our own blundering and neglect in days long past; and it is quite clear that you may secure yourselves against loss and humiliation in times to come, if you will only employ men of the stamp you have now got there, give them some power to do good as well as to invade and occupy a hostile country; and if, above all, you will attend to what they write to you, and do what is reasonable in dealing with this, as with an unprofitable hereditary estate, which you cannot in honour either sell or abandon, and the responsibilities of which would still pursue you, even if you did sell or abandon it.

The difficulties are by no means great as compared with those which have been overcome by your countrymen elsewhere, I do not say in India only, but in many parts of Asia, America, and Australia. If you will only consider for a moment how many millions of civilised, well armed, brave, and united Asiatics have been not only conquered but well governed within your own generation, by men not one in ten of whom was above 30 years of age, or had ever been heard of in England, you will, I think, agree with me that there is no insuperable difficulty in dealing with more hundreds of thousands of African negroes than are likely to be brought in contact with us in Western Africa.

It has frequently been pointed out that the state of things on the East Coast of Africa is very different. The climate is better, and there are fewer obstacles to the residence and settlement of Europeans. There are on a great part of the coast settled regular governments, and a great trading class who are our own Indian subjects. It is only necessary to repress the slave trade by sea, to aid the local rulers in good government, and to look carefully after our own subjects. I have no doubt that if we have good consular agents, and give prompt attention to all they do and write, the Eastern Coast will rapidly advance in prosperity, and become a a most valuable field for commerce to India as well as to Europe.

If time admitted I might dilate on the great future connected with the subject of your inquiries which is open to other nations of Europe—to the Germans, the French, and the Italians. But I must say a few words on the subject of the Portuguese dominions in Africa, extending as they do for some 2,000 miles on both coasts, and embracing some of the richest portions of the Continent.

It is no exaggeration to say that in these possessions, Portugal possesses a treasure capable of being as valuable to her as Java is to the Dutch, or India to the English. It is equally true that, in their present state, they are a disgrace to the mother country. Nothing can be better than

the recorded intentions and orders of the Portuguese Government. Few things can be worse than the system as it is administered. It is one, I am assured, of obstruction and corruption in almost every department, and can never be improved till such a sweeping change is effected as shall bring the practices of the Portuguese Colonies into accord with the precepts of the home government. The greater part of the present evils which afflict these fertile provinces may be traced either to slavery and the slave-trade, or their inevitable consequences, the secrecy, the cruelty, and the insensibility to injustice and wrong which are the natural results of the slave trade. Let the Government of Portugal secure to its subjects, black or white, the same freedom which the constitution of Portugal secures to all native-born Portuguese; let trade be freed from the shackles which now confine it, and from the absurdly exorbitant duties which now defeat their own object; let the convicts be confined to special localities, and let the immigration of free settlers be in every way encouraged; let the officials be well-paid and well-selected, so as to be free from all temptations to bribery, and let justice be impartially and promptly administered; let the colonies, in fact, be governed as the Portuguese Government has so often expressed its intention and wish that they should be governed, and I feel certain that they would immediately become a mine of national wealth.

I should hardly venture to make these remarks were I not assured that in the representatives of Portugal now in this country she possesses statesmen capable of appreciating the means whereby a long reproach may be removed from the Portuguese name, and a source of difficulty and expense be converted into a source of national strength.

Time does not admit of my dwelling on the long list of natural products useful in the Arts, Manufactures, and Commerce of other countries, which might be exported to almost any extent from Africa in return for the products and manufactures of other countries.

I would only beg your attention to two facts; one, that some of the most useful African products have become known to us, or at any rate used among us only within the last few years, and that others have been, as it were, rediscovered.

A generation ago we received little in the shape of African raw produce, even from Egypt. The grain and pulse export, which helped to feed Italy and Greece 2,000 years ago, had almost ceased, and the cotton, sugar, and oil-seeds which Egypt now exports so largely, were unknown in our markets. We now know that these and many other tropical and semi-tropical products could be exported to almost any extent from all parts of the coast, if the cultivator could be assured of protection and freedom from slavery. Many of the dyes and gums long known to our druggists as procurable in Africa, have only lately been made known to our great manufacturers, and are but lately coming into wholesale demand. The list is being daily extended, and every scientific traveller who comes from Africa adds to it.

Another fact to be remembered is that our daily experience shows us that there can be no superabundance of such products. Whatever amount of cotton or corn, oils or dyes, timber or textile materials, metals or other products of the earth may be produced, we can consume; or sell to others who will consume them. The days when merchants used to burn their spices, lest there should be a glut of them, are long since past, and the more of all these and other similar products we have, the more we shall be inclined to demand. How to obtain them, improve them, and utilise them will be appropriate subjects in the inquiries of your African Section; but, as regards Africa, it may be necessary to reverse the order in which your inquiries will be conducted. It will be commerce, manufactures, and arts, rather than arts, manufactnres, and commerce; and as regards all of them you will find that, as in every new country, you need the constant aid of intelligent travellers.

It is not, I have often thought, without good reason that the world, and especially the English world, does honour to the explorer, the pioneer of the merchant, and the missionary. He must, as a rule, possess many of the characteristics of a leader of men. He must possess great physical strength and endurance, a strong constitution, acute perceptive faculties, untiring energy, unfailing resource, and not only that power of commanding mankind which is the characteristic of great leaders, but something of that unflinching patience and fortitude in adversity which Pitt used to describe as the one greatest requisite for the minister of a great nation.

I need not remind you in how eminent a degree all these qualities which I have described were united in the great traveller whose loss I fear we must now deplore, as being vouched on such evidence as leaves us scantier ground for hope than on any former occasion.

As a mere discoverer, as one who has opened up new countries to our Arts, Manufactures, and Commerce, his loss could not pass unnoted, for he has done for the objects of this Society service such as few men, save the greatest of inventors and scientific discoverers, are permitted to render.

But Livingstone was not only all that I have described—he was intellectually and morally as perfect a man as ever it has been my fortune to meet, one who formed vast designs for the good of mankind, and placed his hopes of achieving them in no earthly power, but in Him who created the universe and controls the "raging of nations."

Travel and discovery were, in his estimation, but steps in that pursuit of truth for its own sake which he held to be man's fittest homage to the God of truth. He laboured to open a road for civilisation and social order among savage nations, because he knew that in the chaos of barbarism the voice of religion could not be heard. His zeal for religion itself was no fanatical devotion to any formal creed, but an earnest desire to see all men brought to a knowledge of those simple truths which inspired himself, and to conformity with that Divine exemplar whose will was to him the highest law.

In all he did he worked in the same spirit as the great apostles of old, and he has done for civilisation and religion a work which has had few parallels since the days of the early martyrs of our faith. Martyr he was and hero; and we may no more lament him than other heroes who have died in their country's service, or holy men who have enter d into their rest. Let it be ours to do due

honour to his memory, and to enrol him amongst those worthies of our race whose example we may hope will inspire our countrymen to the remotest generations.

DISCUSSION.

Sir Samuel Baker said he had been exceedingly interested with the leading remarks of Sir Bartle Frere, because, in looking forward to the future of any country, it was of course natural to suppose that that future must depend in a great measure upon the history of the past. Now it was somewhat curious that though Africa, or certain portions of it, had been longer known to history than any other portion of the globe, that great cradle of civilisation in northern Africa, Egypt, should now be comparatively weak, and the influence which it exerted in those days should apparently have been lost. However, he thought no one need look far for the cause of this state of things. Sir Bartle Frere had touched on the religious topic, and mentioned a word which to him was always one of horror—Mohammedanism. He believed that, look where one would throughout the world, it would be found that where a country was occupied by Mohammedanism, there was an end of all progress. The grand crash which extinguished the light of science and progress in past ages, in northern Africa, dated from the time of Mohammedan conquest. Not only so, but they invaded Spain, and if it had not been for the battle of Tours, under Charles Martel, it was impossible to say what might have been the fate even of the rest of Europe. Long ages ago extensive trade was carried on by the Egyptians, Phœnicians, Carthaginians, not only with the Greeks and Romans, but even with Cornwall, for tin; the Egyptians being celebrated for the fine linen which they manufactured, and which had never since been equalled. The whole of these industries had now ceased, and the only portion of the population who were at all remarkable for commerce and industry were the Copts, the descendants of ancient Egyptian Christians. Mohammedans were never celebrated but for barren conquest. There was an old Arab proverb, that wherever a Turk set his foot the grass would never grow in his footsteps; and he must say that his own experience led him to concur in the truth of this saying, for wherever the Turkish or Egyptian government, which was all the same, had conquered a country, instead of devoting themselves to developing its prosperity they never for an instant thought of anything but taxation. Turning to the future of Africa, it was necessary to divide it into races, and, passing by the Arabs for the present, he would confine himself to the Negroes. Some declared the Negro to be not only equal to the European, but even superior in many respects; others said he was equal to the European; while a third party asserted he was good for nothing. From his own experience, he thought the Negro was the same now as he ever had been from a time which was prehistoric. Now there were ruins existing even in Mexico which had no history, showing that there had been in former times races there who had been to some extent civilised, since they adopted magnificent forms of architecture, which were so solidly constructed that they had outlived not only the race but its history. The same thing might be found in Egypt; but there was not one chiselled stone—chiselled by a Negro—to be found throughout the of whole Africa, showing, to his mind, that the Negro was exactly the same now as he was thousands of years ago. From this he would draw the conclusion that the future of the Negro race must depend on its contact with and elevation by Europeans. In some parts the Negroes appeared to be very tractable and industrious, and made very good subjects, but there were other tribes who appeared to be untameable, and he thought it just as absurd to produce one Negro as a sample of the whole, as to bring forward any individual European and take him as a specimen of the whole of Englishmen. There were Negroes living in places which would never be of any use to the rest of the world, being complete marshes, and on the other hand there were large races, numbering many millions, living in what might be called the garden of Eden. He referred to that portion of the land which he (Sir Samuel Baker) had now annexed to the dominion of the Viceroy—it was indeed a terrestial paradise. Egypt was a small delta, as was known to everybody, though few took the trouble to examine into her circumstances; still from the most remote times her peculiar geographical position and extraordinary fertility had always made her the object of envy, so that her possession had been frequently contested. In thinking of what her future might be it was necessary to recollect how the country had been developed, even within living memory. England now got from Egypt an enormous quantity of cotton, and that of the very highest quality; yet the growth of cotton was of quite recent date, having been unknown in the time of Mehemet Ali Pasha, the grandfather of the present Viceroy. It was introduced by a French gentleman who had travelled in the Soudan, where it was indigenous, for it would be remembered that Pliny, the historian, spoke of the wool-bearing trees of Ethiopia. Mehemet Ali, when this French gentleman brought some seeds from these wool-bearing trees, with that wonderful perspicuity which characterised him, immediately set to work to form large cotton plantations, and this was the origin of the enormous production which was now taking place in Egypt. When such prodigious results took place in such a small space of time, and from such small beginnings, it was impossible to say what might be done in the future. Judging by the past, if the same encouragement were given to the cultivation of all other products suitable to the country, and if means of communication were provided, Egypt would soon make giant strides towards civilisation. Why were the great mass of the inhabitants of Africa uncivilised? Simply because they were not brought into contact with civilised human beings, and they never would until their country produced something which would be of great commercial value, and which would attract commercial men to them. Then civilised men, passing and repassing, would introduce civilised customs, if they were controlled by a good government, but, as had been said by Sir Bartle Frere, the customs would remain savage unless they were so controlled. The progress of commerce, therefore, under a good government would produce an amount of civilisation which no missionaries could ever hope to do. His experience had led him to be very hopeful in this respect, for he felt it would be perfectly impossible to expect that these countries which had always suffered from a want of government and cohesion could be civilised, unless there was a paternal government established. Even Scotland, less than 300 years ago, was almost in the same state as Central Africa, clan being divided against clan, one lifting the cattle from the other, while cutting one anothers' throats, or stabbing with dirks were little amusements which everybody indulged in. Now this was all changed, and Scotland had even become a place of the greatest attraction for tourists. And so would Africa be in no long time, and not only to tourists but to merchants, when they found that they could retain what they had purchased, and when the native found that he was securely receiving the reward of his labour. When this paternal government was established, and the Viceroy's government was now carried practically almost to the equator, the only thing required was means of transport; for it was perfectly useless for the Viceroy to annex that enormous country in Central Africa unless he was determined to develop it. He was, however, very hopeful of Egyptian development, as the Viceroy had now employed Colonel Gordon to succeed himself, and he had perfect confidence that that gentleman would do all that was possible, and

he trusted that the English Government would do a little more than they usually did, and support the Viceroy a little, and give him some encouragement to continue the employment of Englishmen to carry on this great work which they had begun. The reason why Englishmen carried such great weight in Africa, as had been described by Sir Bartle Frere, was this, that the natives had learnt to believe that everything an Englishman said was true. Before they met our countrymen they did not know what truth was, but he often found that they described an Englishmen to him, from having known Speke and Grant, as people with one tongue. The few Englishmen they had known having heen gentlemen, they were certain of their honourable conduct, and intentions, and had perfect confidence that whatever an Englishman told them would come to pass, and therefore they depended upon him. Having established this good foundation, it was to be hoped that Englishmen would continue their good work. All successful commercial enterprise must depend, first, on the productions of the country, and, secondly, on the means of transport; for if there were a mountain of gold and no means of transport it would be perfectly worthless. The fertility of the ground was beyond all question, for not only did cotton flourish there in the greatest perfection, but he had introduced most European vegetables, which throve wonderfully, some having become almost weeds. There were also several varieties of fibre worth about the same price as hemp and flax, and the supply of ivory in the interior seemed inexhaustible. There were also various dyes, and in fact a great variety of products which were as yet unknown. His idea always was, as the Nile is navigable to Gondokoro, and some way above, to carry up steamers as far as the navigable portion of the Nile which flowed from the Albert Nyanza, and in fact there was one steamer already launched on the Nile, and another ready in sections only waiting for the camels to carry it, and place it upon the lake. Now it appeared that the Albert Nyanza Lake was about 350 miles long, and from a recent debate at the Geographical Society, it appeared that there was a water connection through with the Tanganyika. If that proved to he navigable, there would be steam communication in a direct line for more than 700 miles, and this would do more to open up the civilisation of Central Africa than anything which could he conceived. The presence of one steamer would do more than a hundred missionaries. The people regarded the steamer now on the river as the most extraordinary wonder in the world, and were waiting with the utmost impatience the placing of the other one upon the lake. The climate in those regions was very favourable to Europeans, in fact neither himself, Lady Baker, or his nephew were ill, and out of 212 soldiers they only lost one in a year and a half. The elevation was about 4,000 miles above the sea, and the soil heing most fertile, all that was required for good trade was merchandise, merchants, and good steam navigation. In conclusion, he would only say that what little he had done was very little compared with what had been done hy Livingstone. It was useless for him to add anything to what had been so eloquently said by Sir Bartle Frere, on the melancholy news which had just reached them. They all knew the character of Livingstone, but no one who had not travelled in Africa could appreciate what he had gone through, for the miseries and difficulties to be borne in such a country when stricken with sickness—all which Livingstone had gone through in perfect solitude for many years—were something beyond conception. There was one point with regard to the sad news, which he did not think had been appreciated or even noticed by the public, hut which was the greatest possible proof of the enormous influence which he possessed over the Africans, viz. that his people were now bringing home the body of their master. In all his travels in Africa, he had never known such a thing to be done; it was quite enough to do generally to make them carry you alive, and it was the greatest possible proof of their devotion that they were now so faithfully bringing home the corpse of him whom they had served so long and faithfully.

Mr. Hyde Clarke said that although they had that evening successfully inaugurated the African Section of the Society with a statesmanlike discourse of Sir Bartle Frere, it must not be imagined the African labours and associations of the Society were thus limited. Last year a remarkable paper was read on West Africa by Mr. Pope Hennessy, who had distinguished himself as a governor in three regions of the globe, and who cast lustre on this Society as having been a member of its staff. It was impossible, too, on hearing the eloquent tribute paid by Sir Bartle to Livingstone, to omit that their great fellow-countryman had stood in that room and, before many now present, addressed the Society. Mr. Davenport pointed out to him that, besides other passages in the *Journal*, in December, 1856, Livingstone delivered a very interesting address on the habits of the elephant, on the occasion of a paper on the "Ivory of Commerce" by another remarkable man, Prof. Owen.* In listening to Livingstone and in conversation with him, he (Mr. Clarke), in common with others, was struck hy the strangeness of his pronunciation, for which the Doctor apologised, and which testified for how many years and how completely he had identified himself with the natives of Africa among whom he had lived, and to whom he devoted himself. Sir Bartle Frere had justly referred to the practical importance of studying the ethnological relations of Africa, to the investigation of which Livingstone had sacrificed himself, if we wanted to determine the possibility of effectively promoting the improvement of the African races. In fact, we must learn better than we do now their various ethnological relations, if we wish to ascertain their capabilities and our own hopes of success. Such, too, was the opinion of the hero who was now contending with the Ashantee kingdom, and even in the anxieties of sickness and the labours of war the mind of Sir Garnet Wolseley was not unmindful of subjects which some might think theoretical or trivial, but which, in the minds of true statesmen, were of real import. He had just received the following letter, written to him from the front of the advance by the General's directions:—

Head Quarters, Yancoomassie,
December 28th, 1873.

Sir,—I am directed by his Excellency Sir Garnet Wolseley to acknowledge the receipt of your letter, and to thank you for the interest you show in the expedition under his orders, and the tribes of this coast. It has been a subject of considerable regret to his Excellency that none of the scientific societies should have thought it worth while to send any *savants* to a country entirely unexplored as regards many of the fields of research now so deeply interesting all civilised nations.

A somewhat curious piece of word-coining, which has fallen under our notice here, may interest you in connection with the broader aspects of the subject of which you write. The Ashantees having experience of our rockets only as they come to them in destructive form at the end of their journey, call them by the sound they make, "Schou-schou," or something of the kind. The Fantees, on the other hand, adopt bodily into their language our own names for those things which they have not seen before. Thus to the Houssa or the Fantee, in speaking to one another, our rockets are named rockets, while their enemies call them schou-schou.

It is possible that as war has not been in savage times an uncommon condition of mankind, analogous causes for different names having been adopted by different nations may have been not unfrequent in the past. You will know whether the case is an illustration of a rule often noted already, or whether it may suggest to you any fresh cause, concurrent with many others, for the existence of these words in kindred languages which appear to have no common root. You will understand that as we are now actually moving to the front for active operations, his Excellency's time is somewhat too fully occupied to enter very elaborately into these exceedingly interesting questions; but should he find any opportunity for availing himself of your suggestions, he will certainly use it.

I am, Sir, your obedient servant,
F. Maurice, Lieut. R.A.,
Private Secretary.

Hyde Clarke, Esq.,
32, St. George's-square, S.W.

It required no apology to follow Sir Bartle's lead, and to support his views by bringing forward facts which, as

* See *Journal*, vol. v.

they were new, might receive none the less attention. Race was by some considered all-important in the matter, and that, as the people were black and would remain black, there was nothing more to be said. Such was not the issue contemplated by one who had governed millions of mankind, as Sir Bartle had. Race was only one ethnological standard, and in the point under consideration other influences were no less to be regarded. Take, for instance, language. They well knew the Basques of Spain and France; they are a very respectable people with a respectable language, and so are the Lesghians of the Caucasus. He called attention, however, to the fact that these languages were allied with the languages of our neighbours, our allies, and our enemies in West Africa, with those of the Houssa, the Ashantee, the Fantee, the Kossa, the Kru, the Mandingo, the Bambarra, the Fulah, and many other interesting and not the least advanced races of that region. If we seek further we find these languages allied with the Kolarians, the Kol, the Santhali, Uraon, Mundala, &c., of our empire in Central India. The Ashantee had relations with the Korean to the north of China so remarkable that, at such great distance, the numerals were almost identical. There were also relations with American languages. He did not, however, propose to consider remarkable or scientific peculiarities affecting languages; although the comparison of the Bambarra and Houssa languages, for instance, with the Basque and others was extended and incontrovertible. He first of all called their attention to the circumstance that, while we had the same stocks of language in black populations in Africa and India—originating doubtless in the prehistoric periods—so we had them in two white populations in Spain and Caucasia. This was an encouragement, in Sir Bartle Frere's sense, to efforts for advancement. There was, however, another remarkable and significant peculiarity. These populations speaking a like language, the Vasco-Kolarian populations, had in all ages been able to carry on contests with the great powers. Thus, the Biscayans had fought with the Romans, and assailed the Spaniards even now, the Koreans had kept off the English, the Americans, and the French; the Lesghians, under the name of Avars and Huns, helped in the destruction of the Roman empire, and leading hordes of Ugrians from Nepaul, had founded Hungary, where their blood may yet linger; while as the followers of Schamyl they carried on the Circassian contest against Russia. The Santhals had risen in one great rebellion, and threatened us last year with another. Of Ashantee and its neighbours it was not needful to speak in detail. These populations of West Africa, black as they were, had qualities well worthy of observation, for they showed that mental qualities were transmitted through thousands of years as well as physical, and when the physical influences had almost ceased, thus attesting in this domain of human nature the energy of mind over matter. If, then, we wished to promote civilisation, and to extend Arts, Manufactures, and Commerce among the nations, and really to subdue Ashantee by making its people prosperous, we could do so with hope by diffusing among them our own advanced civilisation. We must not leave them under the influence of a civilisation which, dating from the pre-historic period, had only placed them on a higher level than other savages, and endowed them with better arts and organisation, but which had still left them without those advantages which it was to be hoped would be obtained by the careful study of the subject in the philosophic and practical spirit inculcated by Sir Bartle Frere, and by the application of the measures which this committee of the Society of Arts would be able to mature for Africa—West, East, and South.

The Rev. Mr. Waller, whilst he feared there was only too much ground for giving credence to the news received as to the death of Dr. Livingstone, suggested that means should be taken to bring to this country his faithful servant Chuma, whom he knew very well, having been with Dr. Livingstone when this boy was liberated from the slavers. He had since received a good English education in Bombay, after which he returned to Africa, and had followed his master through every step of his long journey, and was now probably at the head of the mournful cavalcade which was bringing his chief's remains to the coast. Knowing, as he did, the thorough truthfulness and honesty of this young man, he thought it was of the greatest importance that he should be brought to England, as there was no doubt that he would be able to narrate facts which otherwise might be lost for ever. Within the last two hours he had been with Dr. Livingstone's daughter, who desired him to say how sincerely she hoped this would be done, and he hoped yet to see this young man brought into communication with the African Section.

Mr. Consul T. J. Hutchinson, F.R.G.S., said he perfectly agreed with Sir Bartle Frere as to the necessity of introducing commerce and civilisation into Africa, and was glad of that opportunity of stating some of the results of his observations during ten years' residence on the West Coast. It was not his intention to cast any imputation on the mode in which the West African colonies were managed by the Government, but he believed the colonial establishments at Cape Coast, Gambia, and Sierra Leone were originally instituted with the intention of protecting British trade. How far they had done that it was not his business to inquire. He had been on the West Coast from 1850 to 1861, and remembered on one occasion being called upon by a body of supercargoes to arbitrate betweeen them and some native chiefs at Bonny, upon some squabble which had arisen. It so happened, fortunately, that a man-of-war came in just at the time, so that he was able to go over immediately to the scene of the dispute, and the whole affair was settled directly; this little palaver, as it was called, involved British property to the amount of millions of pounds worth. During the five years of his consulship, exports of palm oil exceeded 25,000 to 30,000 tons per year, which, at the price then ruling at Liverpool, of £48 per ton, exceeded a million and a quarter of money. During the same time, according to the statistics obtained from the Colonial-office, the trade from the Gold Coast, both export and import, only amounted to a little more than a quarter of a million. So that where there was nothing but a Consul and a man-of-war to protect the trade, there was ten times as much commerce as where there was an immense colonial station. He believed there were considerable ethnological differences between the Negroes of the West Coast and those of the East Coast and Central Africa. Some time ago Sir Bartle Frere recommended that Consuls should be established all over the East Coast, but it must be remembered that Consuls on the West Coast could not hold the same position, either from the diplomatic, or the commercial point of view, as on the East, for the simple reason that a Consulate on the West Coast, depending upon moral force, without a man-of-war, simply resolved itself into a moral farce. It was unnecessary to say what an immense amount of *prestige* was obtained by the mere presence of one of her Majesty's steamers visiting the rivers, and there was no doubt that what Sir Samuel Baker said with reference to the natives of Central Africa was equally or more applicable to those on the West Coast, "nothing could bring them within the bounds of civilisation but the stern discipline of conquest, annexation, and an unceasing despotic rule." On the subject of annexation he should give no opinion, but his experience taught him that, in order to make our position at all safe on the West Coast, it was necessary to let the natives know what Sir Bartle Frere said, who were to be masters there, and whose ideas were to be the dominant ones. He believed it to be a great mistake to place any faith in treaties, or what they call "signing books," with the West African tribes—for they will do this to carry out trade regulations, or to sell

their grandmothers, with the whole of their family, if paid for it, and just as likely to be faithless to the "book" in one case as the other. What was wanted was a system of Consuls, supported by men-of war, to give that material support without which commerce could not prosper.

A vote of thanks was then passed to Sir Bartle Frere, Sir Samuel Baker, and Admiral Ommaney.

NINTH ORDINARY MEETING.

Wednesday, February 4th, 1874; the Rev. Dr. FREDERICK GEORGE LEE in the chair.

The following candidates were proposed for election as members of the Society:—

Bigwood, James, M.A., 115, City-road, E.C.
Cooper, John Bucknall, Belle Vue-house, Shrewsbury.
Darby, Charles E., Brymbo Iron Works, near Wrexham.
Eyre, G. L. P., 1, John-street, Bedford-row, W.C.
Hadwick, Joseph Epton, Forest-gate School, West Ham, E.
Harman, Henry W., Messrs. Fairbairn and Co., Manchester.
Hutchinson, Edward, Church Missionary Society, 15, Salisbury-square, E.C.
Jeffreys, John, 2, Grove-terrace, Chesnut-grove, Balham, Surrey.
Jones, Edwin, J.P., Mayor of Southampton, Woodlands, Bassett, Southampton.
Lee, Sir Edward, Exhibition-palace, Dublin.
Lyttle, William Alexander, B.A., Woodstock-lodge, the Grove, Hammersmith, W.
Price, James, F.R.G.S., 35, Chepstow-place, Bayswater, W.
Pritchard, Edward, Borough Surveyor, Warwick.

The following candidates were ballotted for and duly elected members of the Society:—

Branson, William Powell, 155, Fenchurch-street, E.C.
Brook, William B., New-inn, Strand, W.C.
Dagg, Thomas William, C.E., 72, Wilson-street, Derby.
Kearsley, Robert, High-street, Ripon.
Leeman, George, M.P., York, and Deans's-yard, Westminster, S.W.
Leigh, Joseph, Marple, Cheshire.
Moses, G. B., Greystone, Dalton-in-Furness.
Perks, Benjamin, 10, Markham-square, Chelsea, S.W.
Ross, John, Stockton-on-Tees.

The Paper read was:—

EASTERN ART, AND ITS INFLUENCE ON EUROPEAN MANUFACTURES AND TASTE.

By Dr. Chr. Dresser, F.L.S.

You have done me the honour of requesting that I read to you a paper on "Eastern Art, and its Influence on European Manufactures and Taste," and in so doing I am sure that you have looked to my making such remarks as will induce our national advancement, both in art and in commerce, rather than to my saying complimentary things, which might or might not be rigidly true.

In this paper I am not going to act the part of certain special correspondents, who, while last year in Vienna, reviewed the various works in which art was applied to useful objects, and lavished praise on English works simply because they were English, while in the departments under consideration we were in some instances shamefully beaten by foreign competitors.

How far censure should be passed on the correspondents themselves who acted thus it is difficult to say, for if a man has to write of the art merits of the various exhibits, of the excellence of manufacturing processes, of the dress of a princess, the habits of a people, the price of a dinner, the quality of wines, the music at the opera—in fact, of everything, from a shoeblack to a Shah, a button to a coronet, a three-legged stool to an ivory throne, how can he possibly criticise with fairness the works of which he has to write?

Our correspondents are men of letters, and some of them are gifted with marvellous powers of description, but others who are less gifted criticise where they should only describe, or mete out praise where censure should be given, and thus they do a gross injustice to the manufacturer whose works are reviewed, and seriously stand in the way of national progress.

I am now speaking of honourable men, who, through pardonable ignorance, do harm while seeking to do good, and not of those whose reports can be influenced by the nature of the treatment received at the exhibitor's hands. Men whose comments can be changed in character, and who give repeated notices in return for repeated acknowledgments, are only to be condemned as altogether unfitted to use the important power which they hold in their hands.

In this paper I shall express my opinions freely, with the view of aiding the cause of national progress, and I am sure that, even if my frankness gives pain in some cases, you would rather receive from me a candid statement of my feelings than words of flattery, which should induce you blindly to imagine that we are foremost in manufactures in which we are actually far behind.

In commencing our considerations of Eastern art, I must ask you to notice that in the design of an art-work we have, first, the construction of the object, and then its ornamentation; in other words, we have first its formation and then its beautification, but the consideration of structure precedes that of beauty. Structure concerns itself with utility, and not especially with beauty; if an object which is intended to meet utilitarian ends is, when formed, beautiful, the structuralist says, so much the better, but if it is verily ugly he cares not, for he is a utilitarian only; but on the other hand the artist cares too little about usefulness, he making the production of beauty his first if not his only care.

The ornamentalist should stand between the pure artist on the one side and the utilitarian on the other, and should join them together. He should be an artist in every sense of the word, yet he should be a utilitarian also. He should be able to perceive the utmost delicacies and refinements of artistic forms, yet he should value that which is useful for the very sake of its usefulness.

I have no sympathy with those who regard a utilitarian object as of value only as it has art-qualities—despising its usefulness, and I am equally without sympathy with those who value an object which is beautiful simply on account of its usefulness—despising its beauty. Let us have objects which are useful, but let them be beautiful also.

In this utilitarian age, and in this practical country, there is less danger of our having art

works of a useless character than there is of our having useful works which are uncomely in form. The latter finds expression in the new bridge which we have just placed over the Thames at Wandsworth, the railway bridges at Cannon-street and Charing-cross, and the exterior of the Great Northern Railway Station. These are excellent illustrations of objects which are at the same eminently useful and superlatively ugly. Yet why they could not be both useful and beautiful no one can see. Mr. Page, whose bridges are more artistic than those of any other engineer that I know, will tell you that this may be so with bridges; and we well know that there is no incompatibility between beauty and utility in building. Surface decoration might do much to redeem the exterior of the Great Northern Railway Station from its present ugliness, and colour and simple agencies might mitigate the offensiveness of the bridges; but at the very outset works should be so constructed as to be to the utmost degree useful, and yet at the same time beautiful.

We have now set up a standard by which we may judge of the merits of works of art-industry. Thus we shall ask, are they useful? and then, are they beautiful? If we have to consider a jug, a tea-pot, a coal-box, a chair, a fender, or a door-knob, we shall in each case first inquire whether the work is useful, and then, whether it is beautiful. And if it fail in either quality we shall regard it as imperfectly answering the end of its creation, for by its beauty it should give pleasure, while it is at the same time perfectly meeting a utilitarian want.

I shall now subject one or two Eastern objects to this double test, in order that we notice the manner in which they meet required wants; and first I shall take a Japanese kettle.

The kettles which I have here are from the Vienna Exhibition, and formed part of that very interesting collection of objects sent by the Tycoon's Government to Austria during the past year, an exhibit which must be regarded as of the highest interest to Europeans generally, and to those in particular who have the sagacity to perceive what is beautiful and what is new, and to apply the knowledge gained to the advancement of our own industries.

To take one kettle first, we notice that its "body" consists of a flattened spheroid, and thus resembles in shape a common cheese, with its edges rounded. This body is formed of thin, rough bronze, one-half of which is covered with little rounded eminences which thickly and regularly cover its surface. The handle of the kettle is of smooth bronze, and so is the lid, but the lid is inlaid with silver in a manner that gives to it much beauty. In many respects we have here a typical kettle—a kettle typical in its utility and typical in its beauty—for notice. Where the kettle is to come in contact with the fire it is formed of rough and unfinished metal, the heating surface is increased materially by the excrescences; and those parts of the kettle which are to be touched by the hands—as the handle and the lid—are smooth and pleasant to the feel.

But the kettle is also beautiful. Its shape is good, the protrusions of its surface give to it beauty as well as increase its utility, and the ornament on the handle and on the lid is consistent in character, appropriate as a method of enrichment, and exactly what is necessary to render the kettle, what Keats would term, "a thing of beauty and a joy for ever." I have here two other Japanese kettles which differ from the last, chiefly in having a sheet of metal surrounding the lower portion of the body, and spreading from it as a bell-shaped member, while the body is, in one case, without any tubercular excrescences, and in the other it is furnished with them. Here we have the heating surface increased by the lower portion of the body consisting of double metal, the one thickness forming its lower part, and the other surrounding this like a sort of petticoat and projecting from it so as to enclose hot air. The lid and the handle, however, are smooth and beautiful, as in the last illustration.

It is curious that while the kettle is an object in use in every house in the land, we have to go to Japan to learn how to make one as it should be made. But we are a pig-headed, self-opinionated people, who blindly persist in our ignorance. We do not give thought to what we do, but insist upon doing those things which our fathers did, just as our fathers did them.

From Wolverhampton our kettles chiefly come, yet to what Wolverhampton manufacturer could I say, "You do not know how to make a kettle," without subjecting myself to severe reproof. Yet it is a fact that none of them know how to make this common object as it should be made. Where is the English kettle, I ask, which has utilitarian qualities comparable with those of the Japanese example; and where can we find kettles with art qualities equal with those works under consideration? We could excuse the want of artistic beauty to an extent, as we are only now becoming alive to our ignorance in matters of taste; but with humility I say that we, with our boasted utilitarianism, cannot construct a common kettle rightly as a merely useful object.

I must give one other example of what I may term utilitarian fitness, but with this example I must content myself. Here is a Turkish water vessel, which was shown in the very interesting and important Turkish court in the Vienna Exhibition. The body of this vessel is somewhat egg-shaped, but downwards it is continued as a tapering foot, which is rough with perforations; upwards it terminates with three small necks, which are surmounted by a small funnel-shaped member. From the upper part of the egg-shaped body a small spout protrudes in an upward direction, and opposite to the spout is a handle, which is also small; in the funnel-shaped orifice there is a piece of clay, which is perforated with small holes, and the whole vessel is porous.

If a water vessel is well constructed, we can from it discern much of the character of the people who made it, and of the nature of the country from whence it came, but without going into this matter let us consider the Turkish water vessel which we have just noticed. This vessel is so placed in a pond or river that it is covered with water to a height anything less than that of the top of the spout. The rough and elongated foot is stuck in the mud at the bottom, and thus it is prevented from floating, and from altering its position. The body being porous permits the water to percolate through it; hence the vessel acts as a filter as well as

a water vessel; the funnel-shaped member allows of water which has been poured from the vessel and is not required for present use being returned to it; and the clay grating prevents the ingress of insects, which are numerous in a hot country; while the porosity of the vessel, which causes it to act as a filter when collecting water, assists in keeping the water cool when the vessel is in the house, by encouraging evaporation. To me it appears that we have here a vessel of the utmost utilitarian value, yet it is beautiful; but while beautiful it is so thoroughly and obviously adapted to the performance of a certain work, that from our merely seeing it we could at once safely assert that water was bad in those parts of Turkey where such vessels are in use, and that it was collected from ponds or rivers by such vessels.

Time is so limited that I cannot multiply examples, but what I have said leads us to perceive that there are actually people now living who know as much, and even more, respecting certain matters than we English do, strange as this may appear. My dear friends, if we are to continue to hold a permanent place as a manufacturing people, we must step down from that haughty pinnacle of self-esteem on which we have so often placed ourselves during recent years, and be content both to learn from others who are better informed than ourselves, and to carefully reconsider such requirements as we flatter ourselves we have wisely met for centuries.

I like to apply facts just as we learn them, for even useful knowledge is useless unless applied with the view of meeting our wants. I will, therefore, ask you to follow me in considering what a common domestic article should be, say a common coal-box, and here we shall work out the utilitarian idea.

We cannot refer to what we usually see around us with the view of gaining an answer to our inquiries respecting this object of every-day use, for some are formed of iron, some of wood, some have one shape, some another, some are like helmets, some are like shells; some, while formed of iron, are yet so painted as to imitate wood; some are ornamented with photographs, some with engravings, and some with bad ornaments, but, with the exception of a few of the wooden coal-boxes, all are bad, while many violate every principle of utility and beauty.

A coal-box should be so formed that the shovel with which the coal is to be removed from it should find resistance at a point easily reached, and the coal should always be found at this point; the box should stand securely, and be carried with as much ease as possible; also, the material of which it is formed should be suitable, and it should be used with economy, and in the most simple and befitting manner.

To me the coal-box which I have here sketched meets the case. It is formed of wood, which is an appropriate material, as coals do not make a great noise when placed in or taken from a vessel formed of this material; the shovel meets with resistance at the lower angle, and here the coals are always found, however few they may be; the box stands steadily, and could be carried easily, and the wood is used in the most simple manner, and with the utmost economy.

If we would but take every object that we employ in daily life singly, and consider the wants that it is intended to meet, the material at our command for its formation, and the simplest, most natural, and most economical method of using the material, we should certainly soon arrive at an improved class of domestic utensils.

Having achieved the production of what is useful, let us seek also to realise beauty. A few chamfers, a little carving, or a small amount of painted ornament is all that is necessary in order that our coal-box become an object of beauty as well as of usefulness. A mere crest on the lid, or a pair of well-hammered hinges, is all that is necessary as the ornamentation of such a work.

I must now dismiss this part of our subject with these brief considerations; but in doing so, I ask you, the buyers of common objects, to join me in considering the utility and beauty of whatever you purchase; and I earnestly beseech you, as gentlemen desirous of national advancement, to bestow your patronage on what is both useful and beautiful.

Structurally, more than half our chairs, tables, and couches are wrong, for they are formed upon principles which are absurd when wood is the material of which they are made; and the wood is cut across the grain, hence the maximum amount of weakness is obtained with the greatest expenditure of material. We hang our curtains upon a pole, or rod, which is necessary in order to their support, and then we hide the rod with absurd vallances, which are alike without utility and beauty. We have one set of fire-irons for show, and another for use, as though fire-irons were ornaments merely, or objects worthy of special regard. Why not have one set of knives on the dinner-table for use, and one set for ornament? Why not have seats to sit on, and seats to look at (I fear that some have this exquisite arrangement)? Why not have books to read and books for show? Absurdities such as these must be done away with, and utility and beauty must be characteristic of every object.

Let me call your attention to an opportunity of showing our ignorance, which we rarely, if ever, fail to avail ourselves of. If we wish to place a handle on a vessel, we generally place it at the top of that vessel, no matter where the spout may be or what its nature; and thus we often make the use of the object as difficult as if it were twice or, in some cases, four times as heavy as it is, on the principle that a pound may balance a hundred-weight on the steel-yard. If I take a common vessel from Roumania or European Turkey, I find that the handle is correctly placed low down, whereas we perist in placing the handle and spout in the most stupid and inconsistent relation to each other, and in blindly ignoring the scientific knowledge which is open to us.*

This manifestation of ignorance, those that I have previously noticed, and many others that I might mention, all testify to the persistence with which we cling to ignorance, and they are due to gross want of knowledge on the part of many, if not most, of our manufacturers, and to their want of enterprise in not calling to their assistance men

* Dr. Dresser here demonstrated on the black-board the law involved, but it is difficult to convey the principle in words without diagrams. It is fully set forth in "The Principles of Decorative Design," by the author.

of larger information than themselves. Not one manufacturer in twenty has any scientific knowledge, and yet, probably, scientific knowledge would enable him to construct his work, or utilise his material, in a manner that he, in his present ignorance, cannot possibly understand; and not one in fifty has the least knowledge of art, while pattern is the agent that gives value to his goods. I have often marvelled at the ignorance, of both science and art, manifested by manufacturers who employ scientific processes as a means of applying art to their goods; and I could name an instance of a firm that has an annual "turn over" of millions—yes, I am right in using the plural—and which lives by the patterns wrought upon its goods, and yet which looks upon its designers with such contempt that it has to vent its feelings by heaping ignominy upon them. These down-trodden artists cannot use the same staircase with the commonest of the clerks, but enter and leave with the "mill hands;" and although art works are stored in the factory, the designers cannot be trusted to look at them, while a library has yet been opened for the workmen. What can possibly result from such treatment of men who should be educated gentlemen but the utter degradation of art? Gentlemen, will you not join me in a protest against such a state of things, for such is common; and will you not assist me in bringing before the people articles which are at the same time new, useful, and beautiful? I labour, gentlemen, often unknown and without pay, to aid our art progress. Many here can testify that I frequently, when on business in provincial towns, write for the local press on subjects pertaining to their art industries, but unless you join me in an effort at improvement little can be done.

Leaving our considerations of utility, and passing to those of beauty only, I must call attention to the fact that much of what we regard as Eastern ornament is more than mere ornament, inasmuch as it is the expression of a poetic thought, or of a beautiful idea. I have here a Japanese dress, the beauty of which will, I imagine, be admitted by all present. In my judgment it was the finest piece of fabric shown in the Vienna Exhibition, and this is saying much. The pattern of this rare dress consists of many-coloured flowers and butterflies, arranged irregularly upon a cloth-of-gold ground. The flowers are not shaded, but are treated as flat ornaments, and are thus befitting decorations of a flat surface. The butterflies are also flatly treated, and are intermingled with the flowers in a most harmonious manner. It is not, however, simply the colour-harmony that I wish to call your attention to, perfect as it is; nor the beauty of the drawing, excellent though it be; nor the consistent treatment of the flowers and flies, although this is worthy of special study—but to the thought realised in the work, namely—summer. No one can look upon this beautiful dress without feeling the influence of the sunny ground, of the profusion of richly coloured bloom, of the gay and glorious insects which appear to hover over the flowers, and the influences make us feel that it is summer while we gaze. The very insects appear to be sunning themselves, the blooms appear radiant with light, and the whole aspect is that of a bed of flowers, where ten thousand blossoms vie with the most gorgeous of flies, both striving to emit the largest share of radiance, and beauty, and light, and yet all this is achieved without any violation of the most rigid art-principles. But by the employment of truthful means more can always be achieved than by resorting to falsehood. No merely imitative treatment of flowers could possibly convey the thought of summer so well as this conventional treatment does, and here we are pleased with the consistency of the means employed, while, if the rendering had been naturalistic, we should have been offended by inapropriateness.

On a Cloissonné bowl from China, which was shown in the Vienna Exhibition, were three ornamental panels, situated amidst intricate and characteristic ornaments. In one of these panels was a conventionally-treated spray of the apricot, in another was the sacred bean, and in a third was the chrysanthemum. These sprays not only formed a pleasant contrast with the purely ideal ornaments, but conveyed to the minds of the people for whom the work was made, a poetic thought—the apricot typified spring, the sacred bean summer, and the chrysanthemum autumn, and, besides this, the apricot is, to both the Chinese and the Japanese, the emblem of beauty. The bean is sacred—Buddha sitting in the flower—and the chrysanthemum is imperial. This vase was beautiful, its ornamentation was in every way consistent; the panels in which the flower groups were wrought were not of architectural character, but were truly ornamental divisions of the surface, and it conveyed to the mind the thought of spring and of beauty, or of beauty spring; of summer and of God—for to them Buddha is God—and of autumn and the imperial power, and to these people, whose ruler was the child of the sun, imperial power means much.

Everywhere in Japanese works we have the stork occurring. Here is a bowl, on the back of which we have delineated, in the most artistic and vigorous manner, a storm at sea. The crested waves roll and break, and the clouds come near to the waters. But there is more than a mere storm portrayed here, for the stork is the emblem, with the Japanese, of long life, and the thought here set forth is that life may be long although storms and troubles occur; for there is a power protecting which can sustain and save in the midst of the tempest.

Then we have storks in the clouds; and who, I ask, can draw clouds like the Japanese? But the scene thus portrayed is of the celestial hunting grounds, where length of life meets with continued enjoyment. But thoughts, yea, beautiful thoughts, are so common in Eastern art that I could go on for hours revealing them.

On one of the Japanese kettles of which I have spoken is a dragon bathing in the element which the kettle is supposed to contain, and lashing it into a state of violent ebullition. The drawing of this scene is most vigorous, and the composition is, as a whole, beautiful, while it symbolises and gives mythical pleasure in the most charming manner to the boiling of water. One of the other kettles is ornamented with clouds; thus, the steam rising from the water is poetically treated. But I must not longer continue my illustrations of this part of my subject.

We now perceive that one great beauty of

Oriental ornament is its poetical significance. What is art without poetry? An ornamental form is as a mere solitary word of a language; a line is as a letter of an alphabet. What use are letters unless they make words? and what use are words without they make sentences? and what use are sentences unless they convey ideas? Ornamental forms should make compositions which speak of the knowledge of the draughtsman, of his perception of refinement, of his power over colour. This they should always do, but they may do more; they may remind us of the dell where the blue bells grow, they may tell of the fading year, they may call up thoughts of joy and of spring, of evening and of shade, or of ten thousand welcome ideas, or emotions of the soul; and all this they may do without violating the simplest canons of art.

I object strongly to the poverty of the mode in which art is taught at the South Kensington Museum Schools, for they there give no instruction in the poetry of ornament; no knowledge of the speaking power of decorative forms; in fact, no insight into the higher qualities of ornament, while much of the information — information which would lead the student to think as well as to draw, information which would give him interest in his work, and remove much of the drudgery of learning—might be given while the tyro was taking his first lessons in drawing. These schools teach the student to draw, but they do not teach him to think, they raise pictorial artists, possibly, but they do not rear ornamentists. Why, I ask, is not the teaching reformed, and brought into harmony with so important a museum as that which we have in Kensington, and why is not the South Kensington Museum itself rendered more useful? The labels should set forth useful knowledge, and surely I do not seek too much when I ask for photographs of all the beautiful objects which the museum contains. Every one cannot come to London to see the museum, and we all want at times to refer to special examples in our houses. Why, I ask, cannot every object be photographed, and why cannot these photographs be sold at low prices? The South Kensington Museum, as matters now stand, is chargeable to an extent with monopolising art treasures which, though paid for by the nation as a whole, can only be consulted by those resident in London. This charge is not removed by the fact that there is a small travelling museum which goes from place to place. The museum has been founded for the good of the nation, and not for the advantage of any special district. I say then, that as a collection of things must be located somewhere, we are bound to do all that we possibly can to render its contents useful to every person who acknowledges our nationality, and to seek to render our museums in the highest degree useful to every member of the community. I hope that the time will soon come when every town in England will have its own museum, and this the Society which I have now the honour of addressing is actively seeking to bring about; but if every town had its own museum, the necessity for our copying the works of art which are stored in the central and larger museums, and of selling these cheaply to any individual who desires to possess them, would remain.

To return to my subject, how am I to apply the principles gathered from a consideration of the poetry or sentiments of art? Where can I look for any analogous expression in English productions? If we set aside ecclesiastical ornaments, with their direct symbolism, what do we produce that conveys a beautiful thought or a welcome idea? If Elkingtons' want a shield or a vase with any significance, they resort to figures, never for one moment supposing that ideas can be set forth by ornament, by flowers, by insects, by beasts, by stars, moon, and sun. We have yet, notwithstanding our vaunted progress, much, yea, very much, to learn before we shall in any way approach in spirit the excellent examples which we everywhere find in Eastern ornament.

May I now ask that you join me in inquiring into the manner in which art spread from one country to another in ancient times, and into the way in which the ornament of one country influenced that of another. I will not say that all decorative art has had its rise in Persia, but this I do say—that much, if not most, of the best surface ornament which the world has seen can be traced to a Persian source, and recent opportunities of study of which I have been able to avail myself, have shown me that more of the ornaments of different countries certainly have had a Persian origin than I could previously have supposed.

In ancient Persian decorations and manuscripts clouds were drawn in a particular manner as ornaments, and thus drawn they were freely used in Persian decorative compositions. Now this particular and characteristic treatment of clouds is curious and of marked character. There is no mistaking it, for its individuality of treatment is obvious. I need scarcely draw your attention to the resemblance between the Persian clouds and those at present, and in times long past, drawn by the Japanese and Chinese, and especially by the former; I have seen examples of Japanese cloud-drawing which are almost identical with the Persian clouds now produced, but these examples are not accessible to me at the present time; yet in the illustrations before us we find clouds drawn in the same manner and with the same spirit, and with sufficient resemblance to each other to indicate the common origin of both methods of treatment.

It is impossible that I enter fully on the present occasion into the inquiry which I have now raised, for an opinion can only be formed after much research, and after the most careful observation of detail, yet I must give one or two illustrations of the position which I have set up. Persian art is obviously the parent of the Arabian, but it is also the source of Alhambraic and Turkish art; and these three latter styles of ornament bear the same relation to the Persian that a dialect does to a language, in other words, they are mere dialectic modifications of the Persian. The architecture of the Moors, of the Turks, and of the Arabians, is also similar to that of the Persians; and both in the forms of arch employed, in the mode of construction, and in the plan of ornamentation, there are striking resemblances between them all.

Byzantine ornament was the result of a union between the Roman and the Arabian, and in decorative features the Eastern element was dominant.

The flat ornament employed during the reign

of Gothic architecture has never been equal with that employed by oriental nations, beautiful though it was. Gothic architecture was most noble, but Gothic ornament was often feeble, and in some cases it was even wrong in character; it was wrong when it employed a structural setting-out, buttressed members, and so on. This comparative feebleness of the ornament, when contrasted with the architecture, would go to show that from the East came surface ornament, for just as its employment was removed from the source from which it sprang, so it would naturally become weak in character.

There is a striking resemblance between the ornament found in the gold back-grounds of the pre-Raphaelite paintings and Persian decorations; and these back-ground ornaments, although copied and re-copied after the time of the Renaissance, owe their origin to a much earlier date; by the ignorant, however, they are sometimes regarded Italian Renaissance productions.

A form of ornament intermediate between the Persian and this flat Gothic (or Prussian-Gothic as it is often called) prevailed till recently on the native fabrics of Morocco. A drawing, which is a copy of a piece of hand-work of this character, is before us. The Moors are a stationary, or, perhaps, a retrograde people. They have long since ceased to invent even ornaments, and are now losing their arts. I believe that these ornaments, which are semi-Persian, were procured from the Moors when they held possession in Europe, and that through them much of best flat Gothic ornament has come from the East.

I cannot refrain from noticing that we are indebted to Eastern ornament and to Eastern ideas for much that we are apt to regard as of mediæval origin. The "nimbus" is not peculiar to Christian saints, for I find that the oldest "gods" of Japan have this adjunct to the head. The mother and child occur in almost every mythology, and the infant standing in the vesica-shape—or mouth of the womb—has been drawn by almost every people, and in every style of art, as an expression of the source of life. The winged heads, or cherubim, I have recently discovered in old Persian ornaments; and the rosary, or string of beads, is, like circumcision, common to many ages and many faiths. I mention these things in order to show that much that we might at first regard as the outgrowth of a particular system, people, or age, may, by early origin, have become common to many countries, and associated with dissimilar religions.

This fact is also curious that most styles of ornament have features which are, or were, intended as the representatives of fire. The "tongue of fire" is Christian, but we have it used in Japan also, and nearly all Siamese ornament is so obviously flamboyant, that we need no one to tell us of its origin. Persian ornament has an embattled form, which has been copied by the Arabians, Turks, and Moors, and to this day this ornament is called fire in Morocco. The Japanese terminate many of their sacred objects—bells, &c.—with a ball surrounded by flames. Were I to judge from a consideration of ornament only, I should say that all mankind at first worshipped fire, and I should make the Siamese worshippers of the lambent flame up to a comparatively late date. I should also say that the Persians, in departing from this faith, became believers in the existence of vague monsters which rent the heavens in the storm, disturbed the waters of the ocean, breathed forth lightnings, and snorted thunders—a faith which passed from Persia to China and Japan. It was Persia, I believe, that created the dragon, which the Chinese and Japanese so often and so cleverly delineate, only the Persian reptile has cloven hoofs, while that of China and Japan has claws, four or five, according as it is imperial or plebeian.

Ornament has been a power in many lands. It has aided religion, education, and superstition. The Egyptians taught an illiterate people through their ornaments, and to this day the origin of Egyptian architecture, and the mode in which the Egyptians formed their early houses, is as apparent in the temples on the banks of the Nile as if the record had been made by words; for every column is a bundle of lotus lilies, of papyrus reeds, or of palm branches, and the cords, or withs, with which they were tied together, is as visible in the stone antitype as it was in the bundle of plants which formed the type.

The Persians, Chinese, Japanese, Indians, and many other peoples have taught religion by ornament—have conveyed the idea of the glory of a monarchy by the decorations of palaces, and have kept the people in awe by art magnificence, where the sword might have failed were there no pageantry of art to subdue.

I have said sufficient to show that art has been powerful as a means of influencing the opinions and feelings of many nations (but mark, its influence may, like that of words, be either good or bad—if false, it will aid falsity, if true, it will induce truthfulness). I have also reminded you that three styles of ornament, at least, which have become typical of nations and peoples have had their origin in one style, or, in other words, that from a consideration of one style of ornament three nations have borrowed ideas which they have, after mental digestion and assimilation, produced anew as a style of decoration characteristic of their own feelings and ideas. I have shown you that there is reason to believe that all peoples were at one time fire worshippers, and were thus associated together, and that an imaginative faith which followed this primitive religion was common to Persia, China, and Japan; also that these nations all draw clouds in a curious and characteristic manner, and that they must consequently have held some sort of intercourse one with the other. I have shown you that symbols and customs which are often regarded as purely Christian and Mosaic are common to other faiths and other peoples. I have given an illustration, which all can understand, of the manner in which ornament and architecture may reveal historic facts, by referring to an Egyptian column; thus you can see how I reach my conclusions; and I have shown you that much ornament has obviously risen from a desire to copy Persian examples. I have thus made good my position, and have illustrated it, that most of the best flat ornament that the world has seen has, directly or indirectly, come from Persia.

Having now considered Eastern art, and having noticed its characteristic qualities as well as the manner in which the art of one nation has in times past been derived from, or been influenced by, the

art of another nation, we have to consider its influence on European taste and manufactures.

No one could pass through the Vienna Exhibition of last year without being struck with the fact that the best works in carpets, in hangings, in china, in enamel wares, in coloured domestic glass, in wall-papers, and in metal work, were Eastern in character.

The finest European carpet in the Exhibition was by P. Haas and Son, of Vienna, and its pattern consisted of the richest Arabian ornament. The ground was of cloth-of-gold, the ornament was a rich silk pile, and, owing to the height of the pile and the closeness of the ornament, the gold was perfectly protected from the feet. But what we have especially to notice in this exceptional carpet is the fact that the pattern, which was beautiful in colour, beautiful in composition, beautiful in drawing, was Arabian in character.

P. Haas and Son had other carpets in the Exhibition, but the best of these were, without exception, of Oriental aspect. I might name as a notable example of excellent Persian ornament, a carpet by this firm which hung in the central transept, and had a yellow ground.

On the British side the best carpet shown was perhaps one by Messrs. Templeton, of Glasgow, in the Chinese style, yet it was not extraordinary for its merits; and this is certain that all that had merits were possessed of qualities which are common to most Eastern works.

If we pass from carpets to fictile manufactures it is still the same, for what is good is here also, in most cases, Oriental in character. Minton's best vases are copies of the Cloissonné enamels of China, or of old Persian works; and nearly every object shown at Vienna by the Royal Porcelain Works of Worcester which was valuable for its ornamental effect, was a mere re-cast of Japanese lacquer-ware examples.

I do not accuse these two great firms of producing servile copies of Eastern works which were just expressions of other methods of production, and suitable works for formation in other materials only, for they have not done so. They have gathered from the East examples, which to them have been suggestive, and after carefully contemplating foreign works, and ascertaining the sources of their beauty, they have adapted the ideas to a new material and to a new method of work. These two manufacturers, however, in some cases, come a little too near the models from which they have worked; and because the productions in ivory porcelain by the Worcester Works are further removed in character from the examples studied, while they yet produce a like amount of beauty with them, I think them better than those of Minton's works which are derived from the Cloissonné examples.

It is with France as it is with us, for the best works shown by the French in Vienna were also Eastern in character, the beautiful Arabian dishes, ewers, &c., by Parvillée, the Parisian potter, were worthy of the highest commendation, yet they were, without a single exception, based on Arabian models, and the ornament employed upon them was of the purest kind. T. Deck, of Paris, also made a large display of his peculiar ware, which consisted of works either Chinese, Japanese, Persian, or Arabian in kind, but in this display we sought in vain those rare art qualities which were discoverable in the works of Parvillée. Collinot, of Paris, also showed works after the manner of the Persians, but these were less worthy of special study.

Notice especially the works of Parvillée, for they are to me truly artistic, yet they resemble no pre-existing earthenware with which I am acquainted. The forms of the vessels are Arabian, the ornament is also Arabian, and of the best, but the general aspect of the works is new. This is just as things should be. We must gather knowledge from every source which is open to us, but we must not be copyists, or merely servile imitators; on the contrary, from the fulness of our knowledge we must seek to produce what is new, and what is accordant with the spirit of the times in which we live; but what we do produce must reveal our knowledge of the ornament of past ages.

It would be wrong of me to omit from a paper like the present a mention of the beautiful manufactures in enamelled glass of M. Brocard, of Paris, for these are excellent. Here we have an art which I may say is new to Europe, and which has been derived from a consideration of those quaint Arabian and Persian lamps which during recent years have been added to our museums. I am well aware that vessels of enamelled glass have long been made in Austria and other countries, but even the best of these are so inartistic and poor in effect, when compared with those of which I now speak, that I think I am justified in regarding the works of M. Brocard as a new manufacture—they are to us new in style, quaint in character, and artistic in effect.

Here we have an old and beautiful eastern manufacture brought to Europe, and just as it was desirable that we try to reproduce the glass of which our old cathedral windows are formed, so is it expedient that valuable manufacturing processes be adopted by us. No one who visited Vienna during the past year could fail to be struck with the beautiful works in damascened metal, and in enamel wares, exhibited by the two great French manufacturers, M. Christofle, and M. Barbédienne, for their works were simply superb. The enamel wares by Christofle were artistic, poetical, refined, and new in character, and so also were those of Barbédienne; in the latter the ornament was more vigorous, in the former most graceful; but in both very beautiful.

The damascened works exhibited by these two manufacturers, and especially by Christofle, were scarcely less beautiful than the enamel wares, for they, too, were quaint in aspect, new in effect, and beautiful—they were true art works.

What I wish to call special attention to, is not simply the existence of these works, nor even their art merits, but the fact that these various and beautiful objects have, one and all, resulted from a consideration of oriental works. M. Christofle sent a man to China to ascertain how Cloissonné enamels were made, and the result of the enterprise is seen in the modern French works. But mark, while Christofle's enamels are made by the same process as the Chinese, they are altogether new in character—they are French enamels, and not Chinese—they have not, however, the mere prettiness which characterises many French works,

but are true developments of a noble form of art. Barbédienne prepares his enamels in a different way, but he merely adopts the Arabian or Persian method instead of the Chinese; yet his works are not Persian, nor are they Arabian, for they, too, are French, but they are excellent and good.

The damascened wares of Christofle are even of newer character than the enamels, and have resulted from a consideration of Indian, Arabian, and Japanese works. In feeling they are chiefly Japanese; in method of work they are more Indian. Silver, gold (both orange and lemon) and a black metal are inlayed in copper-bronze with great taste, and thus we again have a new art derived from a consideration of the works of Oriental nations.

Need I say more, and call your attention to the fact that the best curtain stuffs have an Eastern aspect; that the striped shawls are copies of Oriental fabrics; that the bernouse, which has been so much worn by ladies, is an African dress? Or need I remind you that it was the Eastern objects which were so eagerly sought, and so much prized, at the Vienna Exhibition? Here is the fact, then, before us. The Eastern objects, but especially those from Japan, Persia, China, and India, are, as works of art industry, far superior to similar works by ourselves in almost every department of manufacture; and our works appear, in a great measure, to have excellent qualities just in proportion as they reveal Oriental characters.

I do not, of course, speak of excellencies of manufacture, for England is in advance of the world in this respect. I speak of art qualities only, and here, as the Vienna Exhibition clearly showed, we were far behind certain European nations, and altogether distanced by the Oriental peoples, even if we have recently made extraordinary advancement in knowledge of art.

It will be said that the reason of this is obvious. Eastern works result from hand labour, while ours result from mechanical processes. This is the case, but the fact of special interest to us is this, that labour is so cheap in some countries that a work which bears the impress of thought, and of refined art feeling, can be made, sent thousands of miles, and after passing through various hands, by which its price is increased fourfold, can yet be sold at the same price as our manufactures, thus competing successfully with them for English patronage.

Look at the thousands of Japanese trays that are now coming into our markets (and who would not prefer one of these artistic works to a Birmingham production?), and they are cheaper even here in England than our own manufactures. Look at the hundreds of rugs that are now finding their way into English houses; and so long as these art works can be bought at prices equal with, or not much higher than, that of the miserable rugs which we English produce, they will sell. We have Japanese objects of all kinds flooding our markets, including silks. China has recommenced to manufacture its Cloissonné enamels because of the European demand; even brass trays are coming to England from Turkey. Yet this is not like bringing coals to Newcastle, for the Oriental work is artistic, while the Birmingham production is usually utterly ugly. So long as we can meet our desire for art objects only by importing foreign works we shall continue to spend our money abroad, and thus, in a sense, impoverish our own nation. Until we can produce objects which are as beautiful and as cheap as those which we bring from foreign countries, we shall have foreign goods in our markets. Does it not strike you as manufacturers, that every object of Eastern make which is sold in our country prevents the sale of a British-made article, and that the money that you might have is going into the pocket of the foreigner? We must earnestly seek to make our works beautiful as well as useful, so that they may be cherished for their art worth. It is a fact that we are now losing our carpet trade, of which we have had almost a monopoly for many years, and that far-off Persia is now sending us carpeting to be sold by the yard, as well as hundreds of splendid rugs? Nations which have long been as if dead, are springing into commercial life, and are becoming active competitors with us for the world's trade.

These facts are known to us. We are also aware that much might have been learned from the careful consideration of the art-objects shown by various nations at Vienna last year, yet our Government had no reports prepared which should faithfully set forth our true position as competing manufacturers, and thus we lost a most precious opportunity of aiding national progress, while the Americans, more alive to their interests than we are to ours, made great efforts, and spent much money, in order to possess themselves of information which might tend to aid her advance in the industrial arts. Up to two years since we made the carpets used in America. Now it makes its own. I have had the honour of preparing for the American Government a report on design, or pattern, as applied to objects and to houses, with a view to their decoration. What use are International Exhibitions unless we are to compare the progress made by each nation with that made by ourselves,—unless we can perceive our shortcomings, observe the progress of others, learn from what we see, and stimulate each other to further exertions? And surely it is the duty of every Government to aid its people in every possible way in achieving further advancement.

I am not a prognosticator of evil, but I do feel strongly that, unless we do in the future very differently in many respects from what we have done in the near past, we shall see other nations taking from us those industries on which we have prided ourselves, as other peoples are advancing more rapidly than we are.

Gentlemen, that nation is wise which draws to itself the greatest amount of wealth with the least expenditure of material. The same clay that can be formed into a flower-pot, worth the fractional part of a penny, may be shaped as a tazza or a vase, worth fifty or a hundred pounds. I submit to you that art is the means whereby a nation may most advantageously draw to itself wealth, for it can ennoble matter to an indefinite degree, and give to material which is almost worthless a value greater than that of even silver or of gold.

But while this is the case, we English are slow to learn from the examples which we have before us, and we neglect to avail ourselves of opportunities which offer. How did our exhibits in enamels and silver-wares compare with the French things shown in Vienna? With the exception of one or two great, yet semi-sculptorial, works by

the Messrs. Elkington, we were shamefully beaten. To our disgrace be it said that Austria was before us for enterprise in the manufacture of carpets, while we have been the producers of floor-coverings for the world, but that day is passing I fear; and I feel especially humbled on this matter, for I induced an English firm to try and imitate the silk rugs of India, but after various frivolous attempts it was said that it could not be done; and, disregarding the fact that the most beautiful rugs of India are formed of this material, and that the task which we had set ourselves had thus been accomplished, effort was abandoned, and no result was achieved, yet Messrs. P. Haas and Son, of Vienna, had a magnificent silk carpet of their own manufacture in the Exhibition; and who, I ask, in England could rival the works of Christofle, Barbedienne, Brocard, or many others that I might name? I fear that we must simply confess that at present we cannot do so; and to how many new art-manufactures can we point as having arisen amongst us recently as the result of our intercourse with Eastern nations? Scarcely to one; while the French can show several, if not many.

To me it appears that we at the present moment want men who can make kettles like the Japanese; men who can form baskets like this same people; men who, instead of making those insufferably ugly objects which constitute "Tunbridge ware," will be content to learn from the similar productions of India and of Persia; men who can make trays of brass or of wood instead of the miserable productions of Birmingham; men who can make a bird-cage that will in any way compare with similar works from Japan; men who can make rugs like the Persians, Indians, and Moors. I submit to you that it is to the East that we must go for suggestions in art manufactures and ornament.

Our opportunities of studying Japanese objects of high art quality will soon be greatly increased, but, pray, let us make use of them. The Japanese, being convinced that their character as a manufacturing people was suffering from the fact that only the commonest wares were exported from their country, have arranged for the preparation of a number of objects of superior quality, to which they will affix a stamp indicative of their excellence. These articles will be exported to England and other countries; and through the kind assistance of Mr. Philip Cunliffe Owen these have been secured to the Alexandra Palace Company, who have arranged to become the sole consignees of these better goods in England. These Japanese objects will be shown and offered for sale at a Japanese village in the Alexandra Park, and this village, which Sir Edward Lee and myself had the honour of suggesting that the company should prepare, is now in course of erection by Japanese workmen at Muswell-hill.

But, mark, I am no advocate of imitations, for the imitation is sure to be inferior to the thing imitated—but we may borrow ideas. The Egyptians drew with power, thus impressing their character as a people on their decorative forms. The Greeks drew with grace, but they were a people of great refinement; yet while our feelings have little in common with those of the Egyptians, and while our wants are not as those of the Greeks, we may yet borrow the idea of power from the former and of grace from the latter; and just as the Arabians, Turks, and Moors got their surface ornament from Persia, so we may borrow from Eastern nations, and by gathering up valuable suggestions from all, develop a style which shall be new in character and yet at the same time an expression of our knowledge of all past ornament.

But before we can take a leading place amongst the nations of the world as the producers of art objects, our manufacturers must put forth new enterprise, and, disregarding those contemptible thieves who are ever on the alert to pirate new patterns, and undersell the original producer by saving the cost of the design, they must put forth special efforts towards further advancement. Our schools of art must be remodelled, so as to become truly "schools of design," as they were first intended to be. The people must be taught that all the objects stored in the South Kensington Museum are not meritorious as art-works, and that much of the decoration of the various rooms violates every principle discoverable in the works of every Oriental people and age. Instead, then, of transferring the authority of the South Kensington Museum to the British Museum trustees, who would not only be without individual responsibility, but who form, I imagine, a body of respectable gentlemen, devoid alike of special art knowledge and of the wants of our vast manufacturing interest, and with that gentlemanly mannerism which would forbid energetic, business-like action,—instead, I say, of transferring the authority of the Kensington Museum to these gentlemen, let us infuse into it new life, with the view of aiding our art-manufactures in their onward progress; but I am bound to say that I think that much more than is now done could be done with the vast annual grant which is made to the South Kensington establishment, and even with a much less sum, were that sum but expended in the most advantageous manner.

I have now, gentlemen, spoken of Eastern objects from a utilitarian point of view, and we have seen that we may learn while considering them; I have spoken of Oriental works as art-objects, and in poetry of expression, and consistency of treatment they are in advance of our similar productions. I have shown you the manner in which ancient nations derived styles of ornament from other nations, and how the French have recently derived fresh manufactures and new style of ornament from Eastern examples. I think, then that we clearly see that Oriental art has materially influenced, and that it still is influencing, European taste and manufactures. To me it appears that this influence is highly favourable, and that if we were quick in perceiving novelties, cunning in appropriating ideas, and clever at giving newness to old forms, we might derive the greatest possible advantages from considering and collecting Oriental examples.

DISCUSSION.

Mr. Ford dissented from the remarks of Dr. Dresser with regard to the ugliness of the structure of the bridges which cross the Thames, observing that, as he had mentioned in praiseworthy terms the bridges of Mr. Page, it rather implied there were no others worthy of

commendation, whereas the structure recently erected at Battersea was a noteworthy exception, and of most beautiful design. As regards the praise which had been bestowed on Japanese and Oriental work, specimens or illustrations of which were exhibited, it must not be forgotten that very much of the Oriental work which had been praised was now utterly discarded by us, especially the jumbling of colours, as was seen in the Japanese gown.

Mr. Christian Mast, remarking on the observations of Dr. Dresser as to the origin of Oriental art, thought that religion was really at the bottom of all high art, and that was the cause of different kinds of art being represented in different countries. Mosaic art clearly had reference to the Mosaic religion. They could not have produced a style of art like the Greeks, who were taught to honour men, and which resulted in their producing the most beautiful forms of a beautiful idea, as exemplified in their fine statues, which were the most perfect creations of beauty the world had seen. The same observation would apply to the Christian art, as seen in the Gothic architecture, in which our cathedrals were constructed. His opinion was that the perfect art of the Greeks, and the art of the Moors, and the Gothic art, could never be surpassed. They were perfection. He agreed with Dr. Dresser, that our object must be to learn from the East and to endeavour to reproduce from our own midst a new art, and not to imitate. The whole nation must work at it; and if the religions of the nations of old led them to progress in art, so it would be amongst ourselves, for religion was the primary cause of a higher degree being attained in art.

Dr. Heinemann, having been to Vienna, and paid special attention to the works of art, could bear testimony to the correctness of the observations of Dr. Dresser. Not only England, but Germany, was also persuaded that there was very much to be learnt from Eastern art. In almost all the books of art, especially in those giving a history of painting, it was stated that the infant standing in the vesica shape, was of Christian origin. He thought it was not of Christian origin, but could be traced to other sources. Even the cross, the symbol of the Christian religion, had nothing to do with Christianity, so far as its origin was concerned.

Mr. Pearsall ventured to suggest that the lecturer should on another occasion give an account of the works of English manufacture and art which were introduced into the East, of those which were successful and those which were rejected, for there were always two sides to a question. We had sent art productions to the East, and it would be very satisfactory to English capitalists to know what works go to Eastern countries, why they go, and why they were esteemed. In Eastern countries, where the Mohammedan religion prevailed, the precepts of the Koran were carried into ordinary life, and the people were not permitted to make a representation of any living thing, and therefore everything was distorted or converted, or conventionally represented, and was not a liberal representation at all. They were not allowed to give a direct representation of nature, save those of royalty, the sun, and so forth; and even certain colours were tabooed. English ladies in Constantinople had been laughed at and been subject to annoyance for opening a green umbrella, green being a sacred colour. It was necessary, therefore, for the English manufacturer to have some knowledge of what would be acceptable; for what was the use of attempting to design a thing for the East, which, though it might be beautiful to our eyes, would be of no use. In illustration of the lack of English art, which was suited to Eastern tastes, he instanced the difficulty which had been experienced by the English Government in the selection of suitable presents which it was desirous of making to certain Eastern persons at the close of the Crimean war, owing to the great difficulty of obtaining suitable designs. Eastern people had prejudices which must be consulted, and it was necessary to avoid hurting them.

The Chairman said it became his duty, as it certainly was his pleasure, to convey the thanks of the meeting to Dr. Dresser, for his most interesting, able, learned, conclusive, and argumentative paper. One point seemed to have been brought out with great clearness, both by the lecturer and by those who had spoken, the intimate connection of religion with art, not only with ecclesiastical architecture, but with things of domestic manufacture. The greatest poems ever written were religious poems. The most important buildings were erected for purposes of religion, whether in Egypt, or in Persia, in India, or in our own country. And he was quite sure that the style of architecture which was most agreeable, most remarkable, and he might say the most telling, was what he might reasonably call the Christian style—the Gothic. This had been revived in the present day, and he saw no chance whatever of our arriving at any kind of composite style. Of all the styles of architecture, we were returning to that which was peculiarly English, essentially Christian, and inherently beautiful. He would defy any one to point out any building in London, notwithstanding its deficiencies, which so attracted the foreigner as the Houses of Parliament. It was a delight to look upon, though he was perfectly certain we should have even a finer specimen of that kind of architecture in the new law courts.

Dr. Dresser, in replying, said he had expected to receive a severe criticism on his paper, but was agreeably mistaken. He did not think Mr. Ford had quite comprehended his remarks as to the ugliness of certain bridges; but he still maintained that many engineering structures were insufferably ugly. Engineers had no taste as a rule, and the manifestion of an ignorance in this respect our engineers were continually thrusting upon us, till it was absolutely painful. But he did not see how it was possible for them to become acquainted with the laws of beauty and utility, for it seemed to him that a lifetime was almost necessary to learn his part—the laws of beauty. As to the remark that we had done much for the East, by sending our manufactures out there, he would ask, what had we done for India compared with what they had done for us. We derived a vast number of most valuable hints from the East. But what had we done for them? We had established schools of art in Calcutta, Bombay, and certain other places, and what was the result? In the Exhibition of 1862 were to be seen carpets manufactured in India by those who had been taught in our art schools, which, being exhibited by the side of native manufactures, were an utter national disgrace to us. We had done a vast deal to vitiate their taste, but he denied that we had done one single thing to raise them in a knowledge of decorative art. Instead of spending money in establishing such schools, he would rather spend money in studying under those native artists, who, he contended, were the greatest ornamentists in the world. From a utilitarian point of view, he certainly admitted we were, as manufacturers, the first in the world. He would observe that in Persia they frequently used figures and represented living objects, such as the human figure, beasts, and so on; and, although the Koran did not allow it, it was continually done. As to the remarks of the Chairman, he would say that Christian art was essentially heathen. He was prepared to demonstrate that the nimbus came from fire worship, and he could trace it all through from its origin. He was prepared to show that the vesica shape had its origin in heathen religion, that the winged cherub also was of heathen origin, and that the cross was a symbol in Egypt. Indeed he would even go so far to say that every Christian symbol was of Pagan origin, and that Christianity, as it united classic and Gothic architecture, adopted all those forms which it found already prepared, and which were suitable as peculiarily striking expressions of the new faith. And he was also prepared to show that it adopted all those implements which were peculiarly striking as symbols. It was a subject

which had for 25 years occupied his attention, and he felt himself prepared to prove it, and that the very best flat ornaments of the world have resulted from fire worship.

A vote of thanks to the Chairman closed the proceedings.

CANTOR LECTURES.

The second lecture of the second course of Cantor Lectures for the session, "On the Chemistry of Brewing," by Dr. CHARLES GRAHAM (University College, London), was delivered on Monday evening, December 15th, 1873, as follows:—

At our last meeting we made ourselves acquainted with some of the main properties of cellulose, starch, and dextrine, bodies which are called by chemists, for the sake of convenience, carbo-hydrates, inasmuch as they contain carbon, and at the same time hydrogen and oxygen, not existing as water, but in the same proportions in which they do exist in water. We found also two other members of that series, so important to the brewer, viz., cane sugar and grape sugar, which differ from the others in having more of the elements of water, the grape sugar having the most, and cane sugar being in that respect intermediate between starch and grape sugar. We found, and I was particularly anxious to direct your attention to that point, that cellulose was not acted upon by moisture or by heat, but yet as we find it to exist in woody fibre, it rapidly decays under the influence of moisture and heat; and I pointed out to you that this was due to the powerful degrading influence of the albuminous matters associated with the carbo-hydrates in the composition of the woody fibre. And I pointed out to you that, in the presence of moisture and of absorbed air, wood rapidly degenerates and breaks up, forming a number of intermediate products, the final products, of course, being carbonic acid and water. I then pointed out to you the very serious source of danger that this was to the brewer, and suggested that, in the first place, the moisture should be driven out of the wood, and that, in the second, the albuminous matter should be as it were coagulated by heat, and I proposed you should do that by means of melted paraffine wax. So many of those who were present last Monday evening have asked me with reference to the details of this process, that I will briefly explain them again. If you take some wood, and carefully dry it beforehand, and then afterwards, while it is still hot, at a temperature of about 230° to 240° Fah., immerse it in molten paraffine wax, at a temperature of about 250°, you will find in process of time that the air will be driven out completely, and the molten paraffine wax will take its place. Those brewers who have large cooperages may, with very great advantage, make use of an iron cylinder, connected with an exhaust pump, worked, of course, by an engine; and if they were to carry on this experiment much in the same way as wood is creosoted, they would be able to obtain, on account of the vacuum produced in that way, a greater saturation of the wood. This method of preserving wood has the advantage, first of all, of driving out the moisture; secondly, of destroying the active energy of albuminous matter; and, thirdly, of excluding all extraneous impurities.

Now, before passing on to other matters which we have to discuss, there is one point which I forgot to mention in reference to the conversion of the starch into grape sugar. I pointed out to you that woody fibre could be readily converted into dextrine, or British gum, and also into grape sugar; indeed, a friend of mine was so kind as to prepare some grape sugar from sawdust. But not only can grape sugar be prepared from woody fibre, but it is prepared on a large scale from starch; indeed, that is the only good artificial plan that we yet know of. I pointed out to you the admirable process carried on by one of the saccharine companies in London, who make grape sugar from starch, but I forgot at that time to point out to you a very glaring example of the interference of the excise-laws with commerce. Before it is evaporated down in the vacuum pans it is, of course, in the form of a liquid, and here, on the table, we have specimens of pale, amber-coloured, and dark saccharine, the latter being used for porter brewing. Now, it costs these two companies—the Maubré Company and the Brewers' Saccharine Company—a very great deal, first, from the expensive plant necessary, and, secondly, from the coal and workmanship, to get rid of the water; and the reason of this is that the excise will not, I am informed, permit the brewer to use sugar artificially brought in, in a liquid condition. The consequence is that much expense has to be incurred in order to get rid of the water, and then, when the brewer has paid for that extra expense, he again adds the water to it. The solid saccharine, which is used for the purpose of assisting the brewer in the preparation of beer, contains about 80 to 85 per cent. of grape sugar. These liquid extracts here on the table contain about 41 per cent., and are, therefore, even stronger than the brewer requires.

I pass on now to the subject which calls us together this evening, viz., the process of malting, or the artificial germination of grain. I have here a representation of a section of the grain, or rather caryopsis, of barley, and here is also a split bean. This bean is coloured pink, and in the corresponding drawing of the barley there is a very small portion coloured pink. Let us consider for a moment, from a physiological point of view, the caryopsis of the barley. We have inside this testa a large amount of starchy matter, which is called by botanists albumen. At the base of this starchy matter is the young embryo of the future plant. In this other drawing of the bean, you will find that there is none of this starchy matter, in other words, when you split a bean or a pea you find nothing inside except the embryo, with its two large fleshy leaves or cotyledons; there is no starch. However, so far as the chemico-physiological conditions are concerned, the fleshy cotyledons serve the same purpose in nature which the starchy matter of the so-called albuminous seeds does, so that whether they be "albuminous," as in the case of barley, or "exalbuminous," as in the case of the bean, there is stored up there matter for future use. Now if we moisten the seed of the barley or of the bean, we shall find, provided we have a moderate amount of heat, that it will gradually swell, presently the skin will burst, and at the lower end the radicle or small rootlet will gradually protrude. After that has taken place there is from the upper surface of this embryo here a gradual prolongation of the plumule of the young plant. In this particular drawing it is represented as having got about two-thirds of the way, and there is a little swelling here, to indicate the bulging out which is caused by the growth of the young plumule. The two embryonic rootlets, which would have been shown had there been several other drawings, have gradually produced roots, which you see curved up at the bottom. The important points to consider about the process which is represented there are the following:—First of all, we find the young seed gets warm; we find also the young seed gives out carbonic acid, and we find gradually that the so-called albumen, or the starchy matter of the cotyledons, is gradually used up and consumed; in other words, the young plant is in this stage of its existence, really not yet hatched, but is still, from a chemical point of view, a young animal. It is very much like a chick in the ordinary egg; and Gärtner, the physiologist, who first of all gave the term albumen to this starchy matter surrounding the young embryo, was perfectly right from a physiological point of view to so call it, since it serves the same function which the white of an egg does to the young embryo inside a common hen's egg. It is a store of food laid

up there by the parent. It gradually diminishes, and as it diminishes, the young plant, or young animal, gradually increases in bulk. Finally, the plumule bursts through the upper end, and in process of time comes in contact with the atmosphere. It then opens young leaves, and the rootlets having meanwhile ramified in the soil, they are able, by their joint action, to carry on the process which has been started by the parent; in other words, they are able. much like a chick, to earn their own living. You must bear in mind that in this process all that is needed is a small amount of moisture and a small amount of heat, because barley, as you know, grows perfectly well in cold countries, even in the north of Scotland, and does not require tropical heat for the purpose of its growth; therefore a moderate quantity of heat is all that is necessary; and it requires air and some moisture. If you were to consult any practical farmer, he would tell you, as regards the germination of the seed, that the worst way to make it grow well is to drown it. Let us for a moment consider what is done by the maltster. In the first place, the maltster must carefully select his grain. It is not worth our while here to discuss other kinds of grain except barley, because, practically, the English limit themselves to barley in the preparation of beer. The maltster has his own technical rules for distinguishing between good and bad barley for his particular purpose. But the main point, to sum it up from a chemical point of view, is that he takes care to have as much starch as possible, and as little albumen as possible. In other words, the starch is the point that he looks to as being the valuable constituent of the barley, and not the albumen, because even the richest barleys have more albumen than the brewer requires. Now these barleys are grown best on light soils. On heavy soils cereals generally contain more gluten or albuminous matters than upon light soils. Then, supposing he has selected a good sample of starchy barley, the next point is that he throws it into a large cistern containing a great deal of water, called the steep. In so doing he gets rid of the dust, dirt, and other extraneous matters which he does not require. Then he allows it to remain in this steep for a considerable period of time; the law, indeed, insists that he shall allow it to remain there for 50 hours at least. Now, what takes place there? In the first place, the grain swells much as it would in the soil; it absorbs water, which dissolves some of the albuminous matter, some of the so-called diastase, and, owing to the solution of the albuminous bodies, a change is set up—a degradation or a breaking down of albuminous matter goes on; and, following on that degradation, there is at the same time a conversion of the insoluble starch (which is of no use to the young plant, for it requires soluble food) into soluble dextrine, and also glucose. As time goes on, the water in the steep gradually dissolves out, not only the colouring matter from the husk of the testa, but also some of the soluble albuminous matters, and, at the same time, some of the soluble dextrine and glucose which is formed. I dare say many of you know much more about malting than I do, and, therefore, you well know that the water in which the grain has been lying for many hours becomes darker and darker in colour; in other words, it contains dextrine, glucose, and soluble albumen. It froths when poured from one vessel to another, and there is a slow, putrefactive fermentation set up; and in warm weather it produces a most unpleasant smell. For 50 hours, at any rate, according to law, it must remain drowned in water; and it seems to me strange, coming to the subject merely as a chemist, that in the artificial germination of grain we should set about to do that which any practical farmer would condemn, namely, to drown the grain for so long a time. And not only to drown it, but, at the same time, dissolve many valuable parts of the grain itself. However, that is not all. I told you that a putrefactive fermentation is set up, lactic acid is produced, and if you take a piece of blue litmus paper, and dip that into your steep water, you will find it becomes more and more red, according to the time during which the grain has been standing in the steep. That seems to me not to be the best way of moistening the grain. I know, of course, that the exciseman stands in the way, but then we must make him get out of the way if we find it necessary to make an alteration in the process.

After the grain has been lying in steep some time—at least 50 hours, and sometimes longer, depending on the nature of the grain, the temperature, the weather, and the softness or hardness of the water—it is removed into the couch. Before I follow it into the couch, I will point out to you the plans which are used abroad. First of all as to the Bavarian plan. There they do not use a couch at all. The English maltster, from my theoretical point of view, acts unwisely, but the German maltster acts still more so, for he steeps it for at least three days; he soaks it and saturates it, but at the same time he does take care that there shall be a constant removal of the water, and although a lactic acid and putrefactive fermentation is set up, still the products are rapidly removed. In that point he is correct, but still he saturates for a period of three days at the least, in order to get the grain excessively soft. In Bohemia they use what I conceive is a better plan; they steep the grain for twenty hours, and after it is thoroughly well-saturated with water, they throw it out into a flat couch, not very thick, where it is allowed to dry. After it has remained for about twenty-four hours it is then thrown back again into the steeping cistern, and is saturated by running water for about six or eight hours, varying according to the time of year. In Vienna, I believe, Dreher, who manufactures such an enormous quantity of beer, uses a modification of the English plan. As to the time of this moistening period, the rules which are observed, as I understand, by maltsters both abroad and at home, are, that before it be removed the skin should be easily removed from the testa; the grain should bend when pressed upon the nail, and when it is taken between the thumb and finger, and pressed longitudinally, there should be no pricking of the skin. The Germans carry it on further, and continue it until such time as on pressing the grain the future root easily protrudes.

The next part of the process in England is to throw it into the couch where it is measured. In the couch the water is drained off, and the exciseman takes the bulk at this period, because we have adopted a plan of taking the measure of the malt at the time when it contains the greatest amount of water, in order to make the brewer pay most for it. Foreign maltsters are not taxed in the same way. In the greater part of Germany they are taxed upon the produced malt, and not upon the wet or saturated barley.

The next process is to spread the malt on the floor. In the couch the germination has already set up, the temperature has risen, carbonic acid is produced, and there is already a vegetative process going on very rapidly. It is then thrown out on the floor, in order partly to arrest this, and partly to carry it on more conveniently. As regards the temperature of the floor, in Holland it is, I believe, about 53° Fah., that being about the lowest I can find. In our own country the temperature is about 60° Fah.; but in Bavaria, where, as in other respects I shall have to point out, they take ample precaution to carry on the fermentation process at a low temperature, still, as regards this point, they have, following mere practical rules, adopted a temperature of about 70°, in some cases even as high as 75°. I cannot caution those of you who are practical maltsters or brewers too strongly against the employment of a high temperature, no matter whether it be in the malting or fermenting processes. As regards this question of temperature of the floors, the English are decidedly right, and the Bavarians are decidedly wrong. As to the time on the floor, that varies very much with the time of year, and the nature of the grain itself. As a rule, in Germany, they carry out the process

in seven days from the steeping, and at the end of the the seventh day they commence to dry it. In our own country it may vary from eight to ten, twelve, or even fourteen days, according to the temperature.

As regards the chemical examination of the changes which take place in the germinating process, I have a few words to say. I pointed out to you, with reference to the germination of barley, that carbonic acid is produced, air is absorbed, and, consequently, therefore, air is essential to the germination of the grain. A certain amount of heat is essential; and we have seen that about 60° is a very good temperature for the purpose. Owing to the absorption of oxygen, some of the gluten or albuminous matter in the grain becomes oxidised, broken down, and degraded, and while it does so it forms a number of products which are not yet known to chemists, intermediate products some of them, having, apparently, the power to build up, while others have simply the power to break down. A portion of the albuminous matter is completely burnt, and the albumen of the barley actually supplies a portion of the carbonic acid. Now, as regards the absorption of air, I dare say some of you, at least, may be interested; in fact, we are all practically interested in the process of making bread. We all like good bread, and, putting aside the Aërated Bread Company, let us take the old-fashioned way of making bread, by what is called the panification process. There is no point more essential to obtain good bread than thorough kneading. You must thoroughly work your dough so as to include as much air as possible. And why? The object of including so much air is not that the air by its expansion may afterwards raise the bread, but that it may attack the soluble albuminous bodies, and break them down, so that they may be enabled to convert the insoluble starch into soluble dextrine and glucose, with the production, at the same time, of carbonic acid. And it is a fact that bread, when fermented, is light, and contains a good deal of dextrine, and, were it not for the high temperature, it would also contain alcohol. The alcohol, however, is distilled off in the process of baking.

Now this process of germination is attended with loss. I mentioned how carbonic acid is produced. Not only is the albuminous matter oxidised to that state, at least a portion of it, but there is also an oxidisation of the starchy matter itself. In addition to that we have a production of the rootlet, which I may mention is a distinct loss, because the maltster has to get rid of that to prevent its absorbing moisture; and we may consider that the plumule formed is also so much loss. Now, if you will look at these diagrams they will show you the composition of an average sample of barley. They are taken from the elaborate researches of Oudemans, the Dutch chemist. He found the composition of barley to be 65 per cent. starch, 5½ dextrine, 3 gluten, which is soluble in alcohol but insoluble in water, and which contains as much as 1·9 (the diastase of Payen) of soluble albuminous bodies which are not coagulated by heat. In addition to these soluble bodies, we have 9·3 of insoluble gluten, 2·5 of fatty bodies, and 9·4 of woody fibre. In this diagram here, also taken from the researches of Oudemans, we have the composition of air-dried barley and air-dried malt. He represents that the particular sample of barley he worked at (a portion of which he malted), contained originally 67 per cent. of starch, which, after the germinating process, was reduced to 58. There was, however, a slight increase of dextrine, from 5·2 to 8, and a slight quantity of sugar was formed, about 5 per cent., but the woody fibre was greatly increased, from 9·6 up to 14. I shall now draw your attention to the action of kiln drying.

In Belgium they put a stop to germination as soon as it has got far enough, by the process of drying simply in air. Now, as regards the rules which are adapted by maltsters in our country in order to determine how far the germinating process ought to be allowed to go, their rule is that the plumule shall have grown up under the husk about two-thirds to three-fourths of the length of the grain. That is the English rule, and it is a very admirable one, because it is practically found that a friability of the starchy matter takes place, *pari passu*, with the length of the plumule. The foreign maltsters judge by the length of the rootlet. As regards that point of difference, I think one has a better guide from the length of the plumule than the length of the root.

The Belgians dry the malt by air, and so in some cases do the North Germans. Perhaps some of you may remember the drawing in one of our illustrated newspapers of a number of Germans in Berlin sitting down drinking Weiss beer, that is the white beer made with air-dried malt. To my taste it has a very raw, uncooked sort of flavour, but some people, not only in Berlin, but also in Magdeburg and elsewhere, are excessively fond of it. It is obtained not only from air-dried malt, but sometimes from a mixture of air-dried malt and raw grain. The worst characteristic of it is that it does not keep well, and that it has none of that pleasant, empyreumatic flavour which kiln-dried malt has. With respect to the advantages of kiln-drying, it stops the germination completely, it increases the amount of dextrine, and at the same time produces a number of bodies that one classes under the name of empyreumatic products. They are bodies produced by the artificial breaking up, owing to a high temperature, of starchy and albuminous compounds. And these substances are found to have considerable effect in the preservation of beer, in other words, the soluble albuminous matter in secondary fermentation is not so able to carry on further decomposition as when it is not present. Another advantage of kiln-drying is that it diminishes the amount of soluble albuminous matters. When I come to speak of the question of mashing I shall have occasion to point out to you that so large an amount of soluble albuminous bodies as are indicated in that diagram are really not necessary for the mashing process. The best and greatest advantage is that it removes that disagreeable peculiarity which I characterised just now under the term rawness. The beer produced from kiln-dried malt has just the same advantage over air-dried malt which a cooked potato has over a raw one.

As regards the action of heat upon these organic bodies, I must draw your attention to a fact which, of course, all of you know, but still it is as well that it should again be repeated, namely, that in the presence of moisture starchy bodies and saccharine bodies, and also the albuminous, are much more easily broken up than when moisture is not present. In other words, if they be dry, a higher temperature is required to produce as much decomposition as is produced by a low temperature when moisture is present. It therefore follows that, in order to apply the artificial drying, which is done in a kiln, we ought previously, as much as possible, to get rid of the great bulk of moisture which is there, and which still remains there, in the English system. This, of course, may be readily done by imitating some of the Continental maltsters, who, after the germination has gone on far enough, place their malt on the upper floors, where it is exposed to a current of air passing over it. In that way the rootlet is rapidly withered, the germination stopped, and the grain or malt is rapidly dried. In our country the malt is placed on the kiln excessively thick, and I shall have occasion presently to go into that question. The Germans, after having put it on the floor, place it on an upper kiln at a temperature of about 100° Fah., and after it has remained there about five hours, it is let down to a lower kiln, at a temperature of about 160° Fah. to 167° Fah. Now, too sudden a heat produces what is called a hardening, or vitrifaction, of the starchy or dextrine matter; on the other hand, a too low heat does not give some of the advantages of the kiln-drying process, because it leaves the grain with moisture, and still very liable to absorb more, and containing a larger quantity of the destructive albuminous constituents, and less of the empyreumatic bodies. So

that this question of kiln-drying is excessively important. As regards colour, if you previously dry your malt, you may obtain, at a temperature of 145° Fah. to 150° Fah. a perfectly pale malt. Of course, if you wish to obtain amber, or brown, you must heat it somewhat more. High-coloured malts, of course, have some advantage over pale-coloured. In the first place, there is more dextrine produced, and in the second place, more of the albuminous matters are rendered insoluble; lastly, there is more colour. When this is carried to a very high point, as is done in the manufacture of English porter, this of course is a matter of great importance, because it not only fulfils the conditions which the consumer requires, but by the advantages which the high colour presents, it—like charity—covers a multitude of sins. It is much more easy to work with a high-dried malt than with a very low-dried malt. As regards the thickness on the floor, it seems to me, from what I have seen, that the usual thickness in England is far too great. I have seen it 12 and 18 inches thick, and sometimes even thicker still—thick and wet. Now, so long as you keep barley in a very moist condition, at a high temperature—and 80°, 90°, and 100° Fah. are high temperatures—so long do you keep up the conditions necessary for the production of acid; and I never yet examined a sample of malt dried in that way which did not contain much acid. Not only do I consider the thickness too great, but I even consider, and there I am not so confident, because it is an engineering question, one kiln floor to be bad. In the first place I consider it bad, because your malt must be thicker, and because it is more difficult to regulate the heat than when you have two, and also because it is more difficult to get rid of the moisture, then lastly, because more time is required, and instead of the process being finished in a few hours it takes some three or four days, sometimes even more. The advantages which two floors present are very evident. In the first place it enables you to have your malt thinner, it enables you to regulate your temperature better, and to regulate it in two distinct stages by having a lower temperature in the higher floor, and a higher temperature in the lower one. You may say, "Oh, we get rid of this difficulty with reference to the thickness and the moisture by repeated turning." I say you do not. The more you turn the malt the more you shut in the moisture, because it is the upper layers that get wet, and after the lower ones get a little dry you turn up the layer which is dry, and so the dry malt gets wet again, and this has to go on for several days. Many maltsters, in order to overcome this difficulty, say that they do it slowly, and one cannot conduct the process too slowly, providing simply dry air at a low temperature was used; but you must bear in mind all this time the malt is submitting to the putrefactive action going on, due to the solution and the oxidation of the albuminous matter. If you would only look upon it from my point of view, you will see that this process, by which you have wet malt, and very thick—and I have seen it 18 inches, and there are very many cases in which it is one foot thick—you would see that you must have a long time, and hence there must be a greater amount and continuance of this putrefactive action set up. I shall have occasion to refer to this again, when I come to speak of the method of examining malt. Now as to the use of the thermometer. I do not mean to say there is no malt kiln where you cannot find this instrument, but still I do not remember ever having seen a thermometer in a malt kiln. I remember not long ago going on to a kiln floor somewhere in Great Britain—I will not mention where—and as I sunk nearly to the knees in wet, hot malt, I remarked to the foreman who was conducting the operation, "This seems a little thick;" he answered "Yes, it is a little." "What temperature is it at?" "Oh, I don't know." Being somewhat astonished, I said "Do you not know the temperature at the top or the bottom?" He then told me that he judged of the heat by thrusting his hand in, and that when he could just thrust it in, and then slowly take it out, without loss of time, he considered that the temperature was high enough. I then looked at his rough and ready thermometer, and found it to be a very horny one. I had doubts as to the accuracy of the instrument. Besides, he forgot—or knew not—that moist heat is much hotter than dry heat; that is, that it heats much more rapidly than dry heat, much in the same way as a moist cold day feels much colder than a hard, frosty day, although the latter may be many degrees colder. That is another source of inaccuracy, but the thermometer is not deceived by either of these accidents; it tells you the temperature accurately. You may say that, after all, he may have been an exception, and very many carry on the process more accurately. I have some numbers here which will show you that there is an alarming amount of discrepancy with reference to temperature. On December 6th, some malt was laid upon a floor; on the 8th the temperature on the upper floor at the surface was 112° Fah.; on the 9th, 112° Fah.; and on the 12th, 118° Fah. In two other other cases where the temperature was taken, the thermometer being put down to the bottom of the malt, in one case it was 150° Fah., and in the other 190° Fah. In another case, on the first day, the temperature was 86° Fah., on the second 96° Fah., on the third 100° Fah., and on the fourth 112° Fah. In another example, after 62 hours, the temperature was 103° Fah; after 68 hours, it had run up suddenly to 131° Fah.; and after 86 hours, when it ought to have been still hotter, it had gone down to 88° Fah. Still, the various maltsters were using their hands.

Now, as regards the question of fuel, there has been very much said about the English maltster using coke and coal. In England, as you know, by the excessively simple contrivance of malt-kilns where there is no apparatus at all, except a brazier at the bottom, they employ coal and coke—some coal, but mainly coke; and, of course, by the combustion of this they obtain not only carbonic acid but also sulphur; and in the case where they are using a portion of coal they obtain also creosote and other matters. We have had within the last few days a sufficient practical experience of the effect of the products of combustion of coke and coal. I dare say most of you suffered in your eyes as much as I when the smoke came down and kept us for three days in the middle of a huge chimney. Our eyes were much affected by the fog, and so were our lungs. But what was it that acted upon the eyes? Not carbonic acid, not even chiefly sulphuric acid, but mainly the creosote that was suspended in the fog. So far from considering the English plan of allowing the products of combustion to go directly through these kiln tiles a bad one, I consider it is an advantage. It smokes the barley, which, like a Finnon haddock, keeps the better for it. This empyreumatic creosote action is continued in the after process of mashing and fermentation, and I therefore think that, so far from the foreigners being justified in abusing the rough way in which the English maltster works, I think they deserve praise. In Germany and Norway, where they use the products directly, they only supply hardwood; and where they use coke or coal they do not allow the products of combustion to come in contact with the malt, but heat the air, and by means of the heated air they dry the malt. I have here a very complicated gridiron sort of arrangement shown in this drawing, representing a German malt-house with a portion of a brewery, and you will find the upper kiln floor has a temperature of 30° R. or about 100° Fah., and the lower floor is about 60° R., or about 167° Fah. There is another drawing, showing the arrangement in section, and those who are at all interested in the matter may obtain a much more connected and accurate description of the German system from Mr. Scamell, who has not only very kindly prepared these drawings, but has also consented to assist me in describing the engineering details.

As regards the chemical changes produced by the kiln-drying process, if you look at this diagram again, and compare it with what you have seen before, you will notice that if the temperature be low the amount of starch is 58, whereas if the temperature be much higher it is reduced to 47, but at the same time there is an increase of dextrine. Now I told you at our last meeting that dextrine was prepared on a large scale by the torrification or heating of starch. The grape sugar is slightly increased, and the amount of woody fibre is also slightly increased. The amount of albuminous matters, compared with dry malt, decreases considerably as compared with air-dried malt. You see there is a reduction of about 3·2 per cent., whereas where the malt, which has previously been fully dried, is heated to a higher temperature, there is no further reduction of the albuminous compounds; so that the colouring matters produced in pale malt are mainly due to the decomposition of the soluble albuminous bodies, and the colouring matter produced in amber malts, and in the dark brown malts used by the porter brewer, are mainly due to a decomposition of the saccharine and amylaceous constituents of the malt. The air-dried malt which is employed abroad has all the disadvantages which I mentioned before, but it still has advantages over this heating process, inasmuch as it attenuates better. The modification that I should propose to any one who is inclined to make use of that system of making "Weiss bier," would be rather to dry the malt at a low temperature, and then to mix it, not with raw grain, as the Continental brewers do, but with slightly kiln-dried grain, in order to obtain those empyreumatic qualities which are so valuable.

As regards the examination of malt, one may divide it into two main classes; first of all, the physical examination, and, secondly, the chemical. As regards the physical, I am indebted to many friends, who are practical men, for suggestions, and probably I may have forgotten some of the best rules, because it is not a point I am myself strong upon. However, as regards the physical appearance, the grain should be full, plump, clean-skinned, and the plumule should be about two-thirds of the length of the grain. It is a good plan to take 100 distinct seeds, and examine how far the plumule has grown; and if you find there is more than 5 per cent. which have projected, that of course is an indication that there has been a waste of material. If, on the other hand, you find more than 5 per cent. which have been inefficiently germinated, that of course is also rather an approach to mixing raw grain with malt. The next rule is, that when broken the starch should be loose, friable, and cretaceous; that is to say, when broken it should make a white mark, like a piece of chalk, if drawn along a black surface. It should be crisp to the teeth, and should have a sweet, empyreumatic flavour. Then, lastly, there should be no vitrified appearance when broken, because the vitrified appearance is either due to too sudden heating, or to the barley having been grown upon too rich a soil, being too rich in albumen, or to having employed mixed seed which did not germinate equally. If you take 100 seeds—this is an old German rule, but, I believe, has been long known in England also—and throw them into water, and just stir them about, if the malt be good, not more than five should sink. If more than 5 per cent. sink, then the malt is not good. I will just try this experiment before you with a sample of malt, and you see that only three corns have gone to the bottom; according to that rule, therefore, the malt ought to be good.

As regards the chemical examination of malt, I must ask you to forgive me for using French weights and measures, because one more readily obtains vessels which have a definite relation to each other and to weights, under the metric system, than when we employ the absurd English weights and measures. If you take 50 grammes of malt—a gramme being equal to about 15·432 grains—and powder them, and place them in a beaker glass such as this, and add to the powdered malt 300 cubic centimetres—that is 300 grammes—of cold water, and then gradually heat that up through a period of half-an-hour to 140°—145° Fah., you will come to the best converting temperature. After it has reached that temperature it should be kept so for one hour, and then it should be heated up somewhat rapidly, so that at the end of the next half-hour, making two hours altogether, it may have come to the boiling point. Finally, you should boil it five minutes. After that you should filter it through filter paper, and so soon as it has passed through you should wash it with boiling water. You should do that until such time as the half-litre, which is 500 cubic centimetres, has filled up to the mark indicated on every half-litre flask. When you have that solution you are able to proceed to the different chemical tests. You will bear in mind that in such a solution you have now got an extract of 50 grammes in 500 grammes of water—therefore 10 per cent. The insoluble matter should then be placed in an air bath, such as this, with a lamp underneath, where it should be heated for two and a half or three hours to a temperature of 110° C.—230° Fah., and after that you may weigh it, and that will give you the per-centage of draff, the amount of insoluble matter. As regards the determination of glucose, or grape sugar, and dextrine, the process is as follows:—If you take from this solution, containing 50 grammes of extract to 500 grammes of water, 50 cubic centimetres, which is readily measured by such a pipette or tube as this, and then put that into a 500 cubic centimetre flask, then add 450 cubic centimetres, you will have altogether 500 cubic centimetres of liquid, in which you have got 50 cubic centimetres of your concentrated solution. The next part of the process is one that I fear I cannot show you, not only because it would take some little time, but because you could not see it at that distance. This is a tube in which one pours this diluted solution; it is graduated into one-tenths of cubic centimetres, and at the bottom there is a little glass stopcock, which works very truly. These are made at Bonn, by Geissler. What is called Fehling's solution is made by dissolving 34·64 grammes of sulphate of copper in 200 cubic centimetres of water. Then add to that 173 grammes of pure Rochelle salt, which is a double tartrate of soda and potash, and then finally add to that 480 cubic centimetres of caustic soda solution, at a specific gravity of 1·14; and lastly, make that up to one litre with water; there is in this burette here a solution of this kind. The next process is to heat it. I have taken 10 cubic centimetres of the copper solution, and I must tell you that this quantity is equal to ·05 grm. of grape sugar; that is to say, the ·05 grm. of grape sugar reduces the oxide of copper in 10 cubic centimetres of this solution down to the state of suboxide, and a precipitate is produced, and the blue colour of the liquid is destroyed. Those who wish to have a little more insight into the matter, perhaps, will give five minutes after the lecture, and I will explain it more fully. If this be finished, that only gives the amount of glucose, and the next question is how much dextrine is there. This is done by taking 25 cubic centimetres of this concentrated solution we first made, and diluting it down to 200, and adding 4 cubic centimetres of oil of vitriol, and then boiling the whole for two hours, to convert the dextrine into glucose; then it is made up to 250 cubic centimetres, and when used in the same way with Fehling's solution it gives the total amount of glucose and dextrine.

You may say this is all very complicated, but I dare say many of you, the first time you took the density of a wort, or made a determination of what is called the original gravity of beer, found them also rather complicated. I can assure you that after a couple of hours' work you will find it go perfectly smoothly; it only seems difficult for the first minute or two; still, however, many of you may not have the means by which

you can determine the dextrine and glucose in this very accurate but still somewhat complicated way, and I will therefore point out a way by which you can get at them. It is rather a rough way, but still it gives some idea. Practical brewers will say they can take the specific gravity when it is cooled down to a proper temperature, and look at the tables, but, unfortunately, that method gives very inaccurate results, because the density is due to many things besides dextrine and sugar. A much more accurate way is to make the solution, as I have mentioned, of 50 grammes of malt made up to 500 with water, then to take a known quantity, 25 cubic centimetres, which will contain 2½ grammes; evaporate to dryness; then dry it at 220°-230° Fah. for one hour. That will give the total solid extract if you weigh the residue, and deduct the weight of the vessel, the remainder, multiplied by forty, will give the per-centage of solid extract. So far as regards a simple way of determining the grape sugar and dextrine, if you now take 25 cubic centimetres of your extract, and add to that about 150 cubic centimetres of strong spirits of wine, you will be able to precipitate the whole of the dextrine; and, in addition to that, you will precipitate most of the albumen. It will not filter in this condition, the precipitate being so fine, but if you shake it up with animal charcoal for a few minutes you will find it will filter perfectly well; then put it into a glass vessel or into a platinum vessel and evaporate off the alcohol, the more economical method would be to distil it off in a flask, and then afterwards wash out the contents of the flask much in the same way as you do in determining the original gravity of beer. If what is left in the platinum vessel is evaporated to dryness, and heated for one or two hours to 105° or 110° C. (about 220°—230° Fah.), that gives you the weight or per-centage of grape sugar in your extract. Now, then, if you take the per-centage of grape sugar thus obtained from the total, that would give you the amount of dextrine. There must, however, be this correction made, that the total extract is not altogether grape sugar and dextrine. I have found, by repeated experiment, there is, roughly speaking, about two per cent. of albuminous matters and salts, so that if you deduct from the total solid extract the weight of glucose, you have got by this process, and then about two per cent. more, it will give you the per-centage of dextrine. Of course this is not so accurate as the employment of the more scientific but complicated one.

There is, finally, another point:—Before you throw away your extract, I would recommend you to determine the acidity in the infusion, and that is best done by employing a standard solution of soda or ammonia. I have not time now to explain the details of preparing that, but it is exceedingly simple. You take a standard solution of soda or ammonia, and add that until you obtain a perfectly neutral tint with this litmus paper. When red litmus paper is put into a solution that is neutral, it remains red, if it be put into a solution which is alkaline it becomes blue, whereas, on the other hand, a blue paper, if placed into a solution which is at all acid, becomes red. This is a testing apparatus which every brewer should have constantly in his pocket for testing every stage in the malting, mashing, fermenting, and every other process. If you make use of such a test as that you can readily determine how many cubic centimetres of your alkaline liquid of known strength is necessary to neutralise the acidity, which is mainly due to the lactic acid in your mashed malt, and in that way you may readily calculate the per-centage of fixed acid. Now, I may tell you that there is very much to be learned from the determination of the acidity of the infusion. I do not mean merely the total acidity of the hot mashed product, but also of the cold infusion, and therefore you should also make that determination of the cold infusion. I am told by a gentleman, Mr. Thomas Pooley, who has had very great experience in testing malts, that if there be much difference between the amount in the cold infusion and in the hot you may be sure that the malt is likely in the after processes to keep on producing more and more lactic acid. As to the maximum amount which ought to be permitted, I should say about 0·2 to 0·3 per cent. only should be allowed. Finally, as it is important to know how much water there is in your malt; that is easily determined by crushing up some of the malt—say 5 or 10 grains—drying it at 110° C., and in that way you will determine the water. So, by these methods one has got the water determined, the insoluble matter, or draff, determined, the glucose determined, and the dextrine determined, and as regards the amount of soluble albuminous matter you may make a rough guess by making use of a solution of tannin or of acetate of lead.

Composition of Barley (Dried) (Oudemans).

Starch	65·7
Dextrine	5·5
Gluten, insoluble in water, soluble in alcohol	0·3
Soluble albuminous bodies (coagulable by heat)	0·3
,, ,, (not coagulable)	1·9
Albuminous bodies (insoluble in water or in alcohol	9·3
Fatty substances	2·5
Cellulose	9·4
Ash	3·1
Water	0·0
Loss, &c.	2·0
	100·0

Composition of Barley and Malt (Oudemans).

	Barley.	Malt.		
	air dried.	air dried	kiln dried. (pale)	kiln dried. (amber)
Produce of torrefaction	0·0	0·0	7·8	14·0
Dextrine	5·6	8·0	6·6	10·2
Starch	67·0	58·1	58·6	47·6
Sugar	0·0	0·5	0·7	0·9
Cellulose	9·6	14·4	10·8	11·5
Albuminous substances	12·1	13·6	10·4	10·5
Fatty ditto	2·6	2·2	2·4	2·6
Ash, &c.	3·1	3·2	2·7	2·7
	100·0	100·0	100·0	100·0

Albuminous Compounds in Barley and Malt (Oudemans).

	Barley.	Malt.
Gluten, soluble in alcohol	0·28	0·34
Albuminous substances, coagulable by heat	0·28	0·45
Do., not coagulable	1·55	2·08
Insoluble albumen	7·59	6·23
	9·70	9·10

The metrical system has just been adopted in Germany for the measurement of distances. The official papers have published the order which decrees that henceforth the kilometre shall replace the Prussian mile.

The traffic receipts on railways in the United Kingdom amounted, for the year 1873, to £54,071,514, against £50,066,134 for the year 1872, showing an increase of £4,005,380.

Among recent discoveries of valuable minerals in Australia is that of iron in the form of magnetic iron, and brown hematite at Wallerawaug, Victoria, in close proximity to limestone, fire-clay, coal, and a railway station.

It is proposed to excavate a tunnel, 4,000 ft. long, through King's Mountain, Kentucky, for railroad purposes.

Measures are being taken by the Japanese Government for the development of their coal mines.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

The second meeting of the Committee for Ethnology was held at the Royal Albert-hall on the 23rd January, Dr. Mouat in the chair. Dr. Leitner's offer to lend his large and valuable collection was accepted by the Committee.

The third meeting of the Committee for Civil and Mechanical Engineering was held on the 26th January, Sir J. Coode in the chair. The applications for exhibiting machinery were considered and spaces allotted.

The fourth meeting of the Committee for Sanitary Apparatus was held on the 27th January, Dr. Hardwicke in the chair. The best method of obtaining a supply of sewage for the machines that will be shown in operation was considered, and spaces were allotted to various applicants.

The fifth meeting of the Sub-Committee for Building Contrivances and Materials was held on the 28th January, Col. Gallwey, R.E., in the chair. Allotments of space for machinery were made, and the scheme of experiments on strength of materials was further considered.

The fifth meeting of the Committee for Leather, Saddlery, and Harness, was held on the 29th January, Mr. H. H. Flemming in the chair. Spaces were allotted for machinery.

The Committee for the Representation of Modern Lace met at the Royal Albert-hall on the 30th January. The applications received up to date were reported to the Committee. The Committee was also informed that the Nottingham Chamber of Commerce has undertaken to represent the machine-made laces produced at Nottingham, and that some of the machines used would be exhibited in operation.

The Committee for Promoting the Loan Exhibition of Lace, made before 1815, held its first meeting at the Royal Albert-hall on the 4th February. The following ladies were present:—The Lady Chesham, the Lady Hamilton Gordon, the Hon. Mrs. Welby, the Lady Lindsay, Mrs. Alfred Morrison, Mrs. Bury Palliser, and Mrs. H. Reeve. Mr. A. S. Cole acted as honorary secretary. Mr. H. H. Cole, R.E., attended on behalf of the Exhibition executive. Various recommendations were made for forming a collection of ancient lace, and it was agreed to consider at a future time the appointment of a sub-committee of ladies, who should themselves arrange the lace.

The following are the Rules for the reception of wine at the Royal Albert Hall, during the Exhibition of 1874:—

1. Exhibitors should deposit their wines in the space allotted to them in the cellars between February 15th and March 31st.
2. Wines will be received in the cellars between the above-mentioned dates, from 8 a.m. to 4 p.m.
3. The entrance to the cellars is on the west side of the Royal Albert Hall.
4. Each exhibitor must bring his own men for moving cases, casks, &c., down steps, and along the passages to their space in the cellars; but an exhibition officer will be present to register the reception of wines.
5. The officer of her Majesty's Customs will arrange with each exhibitor as to the payment of duty on all wine deposited in the cellars.
6. During the period of the Exhibition, exhibitors will be allowed to replenish their stock, but no wine can then be moved into the cellars after 11 a.m.
7. No exhibitor will be admitted without a pass; and passes for workmen to fit up spaces must be obtained from the offices of the Annual International Exhibitions.

H. M. Commissioners state, with regard to the exhibition and tasting of wines in the vaults of the Royal Albert Hall, that the wine exhibition is not made for the purposes of show, but to enable wines to be tasted with due convenience both to the public and to the exhibitor. The Board of Management have, therefore, determined that there shall be a separate charge of sixpence per visitor entering this division of the exhibition. In fixing this charge the Board reserve to themselves the right of raising it, if found to be necessary.

EXHIBITIONS.

International Exhibition at Geneva.—According to the *Builder*, there will be an International Exhibition at Geneva next year. The building will include a huge dome, to be the largest of its kind, and a special feature will be a colossal column in the interior, from which visitors will have a bird's-eye view of the whole of the Exhibition, and a panorama of Lake Leman, the mountains of the Jura, the Swiss Alps, and Mont Blanc. The Exhibition will be close to the lake, and piers will project into the water. On these will be erected summer-houses and refreshment-rooms.

NATIONAL TRAINING SCHOOL FOR MUSIC.

A meeting was held in the Mayor's Parlour at the Town-hall of Manchester, on the 29th January, 1874, with a view to establishing a branch school of music in Manchester, to be connected with the National Training School for Music, the first stone of which was laid at Kensington in December of last year by the Duke of Edinburgh. Sir JOSEPH HERON presided in the absence of the Mayor.

Mr. H. Cole, C.B., explained the objects sought to be attained. He said that the National Training School was intended to supply the want in this country of a National Training in Music, to be as good as given by the Conservatoires of the Continent. The question had been discussed for upwards of ten years, and at different times it was thought that the Royal Academy of Music would be re-organised and re-formed so as to meet this deficiency. These ideas, however, were not realised, and there was nothing for it but to start this National Training School on its own basis. The building, which was now in course of erection, was adjacent to the Albert Hall, and there would also be accommodation afforded in the great hall and amphitheatre of the hall for the work of the school. There would be in the school about thirty practising-rooms. The building would take probably about a year to construct. A great point was to interest the whole of England in the work. It was proposed that from time to time persons of musical genius should be found out by examinations, and that they should be sent to this school to receive systematic instruction extending probably over a period of five years. Entrance was to be by competition, and the cost of instruction, based upon data obtained from the foreign schools, including all the expenses of the school, would average about 40 per year for each student. It was hoped that the public would come forward to help this work, and the object of the present preliminary meeting was to find out if there were

in Manchester gentlemen who would form a provisional committee, to be in correspondence with the Society of Arts. The notion was that each county and district in England should find out its people of talent, and that large centres, such as Manchester, Leeds, Birmingham, Nottingham, Liverpool, and other places, should form branches, and that individuals in the different localities should found scholarships. Sir Titus Salt had put down £1,000 to found a Saltaire scholarship, and the Queen, the Prince of Wales, and the Duke of Edinburgh, and some of the large companies of the metropolis had also expressed their willingness to found scholarships. It was hoped that 300 scholarships would be founded, and that 300 gentleman would come forward with £1,000 each for this purpose to help music and hand their names down to posterity as public benefactors. He thought it might be possible to find ten gentlemen in Manchester who would so put down their names. The promoters of the scheme would, if this could not be fully done, be satisfied with something less. They would require at least something equivalent to 300 contributions of £250 each, which would carry on the instruction of the students for the period of five years. The students must engage after their admission that they would remain to receive the instruction necessary. He saw considerable advantage in Owens College being the centre of this part of the country, and a national training school for music being connected with the College. He had reason to think, unofficially, that the College was quite disposed to make itself the centre of musical instruction in Manchester.

In the course of a discussion which took place,

Principal Greenwood said that there was in Manchester and around it a great deal of musical talent, which only waited for culture to find for itself a place in the public estimation. What they wanted was a sufficiently established endowed chair of music.

Mr. Cole explained, in reply to questions, that it would not be necessary for all students who went from Manchester to the training school to pass through Owens College. The subjects of instruction would include vocal and instrumental music, declamation, reading, and speaking. The students would not live in the building, and the £40 per annum would not include maintenance and lodging. With regard to the question of State aid, the promoters were founding this institution as an experiment for at least five years, with the avowed intention of training the public mind and the Government to the opinion that music should be recognised as a part of public education.

On the motion of **Mr. E. S. Heywood**, seconded by **Mr. C. Sever**, a committee, which included the names of Sir J. Whitworth, Mr. Ashton, Principal Greenwood, Mr. J. F. Bridge, Mr. J. Slagg, jun., Mr. Houldsworth, the Rev. Clementi Smith, Mr. H. Cheetham, Mr. E. S. Heywood, and Mr. C. Sever, with power to add to their number, was formed, to co-operate with the London committee in carrying out the scheme. Mr. Duffield was requested to act as honorary secretary.

In acknowledging a vote of thanks, **Mr. Cole** said that he had brought harder work to a successful issue without so much encouragement as he now obtained. He had helped to begin the building of the Albert Hall, which had cost £200,000. Mr. C. J. Freake had agreed to take the risk of expending from £15,000 to £20,000 in the school, in the hope that the country would take the work in hand at a future time, and offers of assistance had been received from many distinguished persons.

A vote of thanks to the Chairman concluded the proceedings.

The quantity of iron made in the Charleroi district in 1842 was 20,000 tons. In 1852 the corresponding total was 37,326 tons; in 1862 it had grown to 112,290 tons; and in 1872 it was estimated at 250,000 tons.

SERICICULTURE IN QUEENSLAND.

The *Brisbane Courier* gives the following account of a Queensland silk-growing establishment, under the direction of Mr. Coote :—

"In 1870 Mr. Coote first sowed some seeds of the *Morus alba*, obtained from Mr. Fenwick, who, we believe, was the importer. This was the small commencement of operations. In 1871 he planted about three hundred rooted trees of various specimens of mulberry, and succeeded in bringing out from the 'grain,' or eggs, a small quantity of the three varieties of worms known as the white, green, and yellow Japanese. Still further progressing, in the following year (1872) Mr. Coote planted out about 6,000 cuttings from the trees raised in the two previous years, and obtained from the moths about 120 ounces of grain. Of the latter, 80 ounces were sent for distribution as samples to France, Italy and California, Mr. Coote, after rejecting the inferior, retaining about 20 ounces for himself. This year (1873) there are more than 4,500 trees in vigorous growth, and 18,000 healthy-looking cuttings, covering an area of about 14 acres of plantation. The number of trees will be increased, as opportunity offers, until 40.000 are in growth. Traversing the whole planted area, every tree appeared to be in full vigour, every variety thriving in a most satisfactory manner. There are fourteen varieties in all, including the *Morus alba*, *Morus multicaulis*, *Morus indica*, the rose-leaved small leaved Italian, oak-leaved Japanese, and several others, all growing in rich luxuriance, notwithstanding the long absence of rain and the thirsty character of the soil.

"This season, Mr. Coote hopes to send to Europe about 1,400 ounces of grain in all, and a few bales of cocoons, the quantity produced being only limited by the quantity of leaves available for the insatiable worms. There are three growths, namely (1)—The *Univoltine* (annual), white, green, and yellow, of which the grain is available for export; (2)—*Bivoltine* (twice a year) of which the grain is not available for export, but the silk is very fine; and (3)—the *Trivoltine* (three times a year), the silk from which has a fine, strong yellow tint. Altogether, at the time of our visit, Mr. Coote had something like 500,000 worms in various stages of growth, ranging from the mere mite just emerging from the egg, to the full-grown seuior, anxious to spin his cocoon.

The magnanerie (or worm-room) is primitive enough in construction, being built principally of bark and saplings, but it answers the purpose admirably, and is kept remarkably clean and sweet. The building is 52 feet long by 24 feet broad, and is so arranged internally as to be available for nearly 500 trays, 2 ft. 4 in. by 1 ft. 6 in., besides providing room for storing the cocoons, and laying the grain as well. The eaves project very considerably on each side, and the upper part of the gable ends and sides are closed in with fine netting, affording an abundance of ventilation. The trays are all laid on swing racks, so placed to avoid the incursions of insects. The leaves intended for feeding the worms are carefully gathered, and cut up by hand before being placed in the trays, but Mr. Coote intends to try what a small, sharp, chaff-cutting machine will do. By very simple contrivances, and the exercise of method, the whole establishment is conducted. Every tray of cocoons is labelled and dated, so that there can be no mistake as to the age of the chrysalis. In the absence of the proper spinning trays for the worms, Mr. Coote hit upon the happy expedient of using inverted chip pill-boxes, and thousands of them are spread out in the magnanerie, all occupied by busy tenants. When the spinning process is over, the cocoon is removed, and the box used over again.

"Mr. Coote has determined upon adopting the winding process, and a machine for that purpose—the first ever imported into Australia—has arrived in the colony by the *Decapolis*, and he hopes, in a few years, to advance as steadily towards the foundation of a reeling establishment, as he has already towards the building up of a producing one. With a little improvement in the machinery for cutting the leaves, and getting the worms into their laying boxes, Mr. Coote believes that the labour of six intelligent, steady, and industrious people would be ample for 20 ounces of grain, and the employment would be most suitable to females.

"Most satisfactory sales of grain have already been effected by Mr. Coote, and he declares that after all that has been written, and all that he has read, his short experience teaches him that Queensland possesses one of the finest climates in the world for sericiculture. He hopes in the next three years to extend the production tenfold, and has laid out his plans accordingly. The grain from Italy which Mr. Daintree and Sir Daniel Cooper are sending out by the next mail steamer, is, we understand, to be handed over to Mr. Coote by Mr. Bernays upon its arrival, on specific conditions. Another shed, or magnanerie, will be erected for its special accommodation, so as to avoid the possibility of infection, and we do not think a wiser course could have been pursued. The object of sending out the grain was doubtless to ascertain whether it could not be turned to commercial profit, and this end would certainly not have been accomplished by distributing it amongst a host of amateurs"

There now seems to be some probability of the rich iron mines of the island of Elba being worked on a far larger scale than they have hitherto been conducted, as a convention has just been signed between the Minister of Finance and a society of Italian capitalists for leasing these mines from the Government for a term of 30 years.

THE TUSSAH SILKWORM.

A pamphlet* has recently been published by Captain Coussmaker, of Bombay, who appears to have devoted some of his leisure hours to watching the habits of this insect, and endeavouring to collect all possible information relative to its cultivation. For the whole line of jungle country between Tanna and Ankola, a distance of 330 miles, he found this worm, and at three other stations, Sataia, Kohdapoor and Dharwar, he successfully reared it. The pamphlet describes the insect in its various stages, and the best means the author has learned of rearing it; also the best methods of reeling, weaving, and bleaching the silk. The author quotes both the scientific and native names of the different trees on which the worm feeds.

This worm, when forming its cocoon, not only draws two or three leaves together, to form a sort of shelter, but makes a loop of silk round the stem, and attaches the leaves and cocoon to the branch by this silken loop, so that, should the leaves become detached from the branch, the cocoon still remains protected by the leaves as an outside covering, and securely, though loosely, attached to the tree.

Capt. Coussmaker describes the process as follows:—

The cocoons are oval in shape, silvery-white or yellow in colour, irregularly reticulated with a coarse, reddish silk. In size they vary very much, some being as large as 2 in. long and $1\frac{1}{5}$ in. in diameter, and others again as small as $1\frac{1}{6}$ in. by $\frac{5}{6}$ in.; outside they are somewhat rough, but inside they are hard, smooth, and glossy. According to Dr. Shortt, of Madras, the average weight of the chrysalis is 130 grs.; of the cocoon containing the chrysalis, 150 grs.; of the empty cocoon, 20 grs., and of the silk when reeled off, 12 grs. It is very interesting to watch the caterpillar forming the cocoon, and a knowledge of the *modus operandi* is essential to the person who reels off the silk, in order to enable him to obtain the greatest length possible at one time. The caterpillar has two kinds of silk; that which it spins is reddish, and of this the pedicle and outside network, or cradle of the cocoon, is made. This silk consists of several threads of different lengths, but the other kind is generally unbroken from beginning to end. It is of a very delicate shade of fawn, nearly white, beautifully glossy and elastic, and being spun from a double spinnaret, consists of two fibres, which for the most part adhere together when the silk is being reeled off. The different lengths of the threads of the two kinds of silk are to be accounted for as follows—the caterpiller, when about to form its cocoon, brings two or three leaves together, attaching them with short lengths of the red silk in a few places, so as to make a rough kind of house, inside of which it attaches a few threads here and there, so as to make a cradle of coarse network; then it begins to make the pedicle, or cable, which shall support the cocoon when the leaves shrivel up and fall away from the twig. In making the pedicle, the caterpillar, firmly grasping the twig with its membranaeeous feet, sways its body backwards and forwards as far round the twig as it can reach, and back again, attaching its silk thread over thread, and in this way soon completes a strong dark-red cord along the twig, and in a ring round it. Sometimes while making this, a misgiving crosses its mind that the cradle is not strong enough, or is losing its shape, so it hurries down—if such an expression can be applied to a caterpillar of its size and make—turns itself round and round in the cradle, putting a thread here and there as may be required, and, arching its body, with a muscular effort gives the proper oval shape to it. This way of working fully accounts for the many separate lengths of red silk which are found when the pedicle and cradle are thoroughly dissolved. The cradle once made and attached to the pedicle by many of the threads which have from time to time been carried down into the network, the caterpillar begins to make the cocoon proper of the fawn-coloured silk. This silk is spun off by the same motion of swaying from side to side, but with a much more contracted motion, and thus in layers of loops overlapping one another is the wall of the cocoon built up. There are four or six lines of loops in the circumference of the cocoon, and as they all meet at the top and bottom, where they are simply stuck together with a peculiar kind of gum, the mere dissolving of this causes them to fly apart, and thereby make an opening for the moth to get out. After the caterpillar has spun a layer of silk thick enough to conceal itself, it discharges some kind of gum or cement, thick and white like plaster of Paris, and then, with the muscular action alluded to before, it causes this gum to thoroughly permeate the whole cocoon and solidify the wall. In this manner it goes on, spinning layer after layer of loops and cementing them all together until the whole of its silk is exhausted, and the wall of the cocoon becomes so hard that it requires a sharp penknife to cut through it. The chrysalis now is safe from birds, but squirrels, rats, and a few insects do manage to gnaw their way into the cocoon. The amount of silk contained in one of these cocoons may be roughly estimated as over half a mile of the fawn-coloured kind; for I once succeeded in getting 16 grs. reeled off one single cocoon in an unbroken double thread. This is more than four times the weight of silk procurable from the common silkworm, which, according to Count Dandolo, is $3\frac{84}{100}$ grs., and is in length half a mile. I have repeatedly tested single fibres of Tussur silk, and find that it is about three times as strong as the common silk, and also that it is about three times as thick, for the ordinary weaving thread contains three times more fibres of common silk than it does of Tussur silk. If, therefore, the weight of the Tussur silk in the cocoon be taken as only three times as much as that of the ordinary silk, the length of fibre in both cocoons will, I imagine, prove to be about the same. The ring at the end of the pedicle which has been spun round the twig is a most necessary provision of nature, for it often happens that either the caterpillar has been unable to attach its cocoon to a leaf, or that, during the long time the cocoon remains unburst in the tree, the leaf or leaves to which the cocoon was at first attached become separated from it, and then the cocoon hangs suspended from the twig like a berry. As a rule, there are certainly two crops in the year; the moths of the first batch come out in about four or six weeks after the first lot of worms (which come out at the commencement of the rains) have spun; those of the second batch remain quiescent until the rains begin again, that is to say, until May. As this entails the chrysalis remaining in the cocoon as long as eight months, exposed to the hottest sun and occasional thunderstorms, the cocoon had need to be made of a hard, impenetrable material. So indestructible is it, that Bheels, and other tribes which live in the jungles, use the cocoon as an extinguisher to the bamboo tube in which they keep the "Falita" or cotton-rope tinder, used by them for lighting their tobacco and the slow matches of the matchlocks The cocoon is also cut into a long spiral band, and used for binding the barrel of the matchlock to the stock, being, as the natives say, unaffected by either water or fire.

The Tussah silks of China are now largely used, and although these silks can never hope to rival those of the silkworm proper, fashion, which can do much to make or mar, is now giving a helping hand to all Tussahs, as the fabrics exhibited at the International Exhibition last year fully prove.

* The Tussah Silkworm. By Capt. E. Coussmaker. London. E. and F. N. Spon.

THE UNWHOLESOMENESS OF CAST-IRON STOVES.

MM. Morin, Payen, Deville, Bernard, Bussey, and Rémy, have been commissioned by the French Academy to investigate this subject. Experiments were instituted with stoves of cast and wrought-iron, using soft coals, with the view of learning under what condition stoves of metal become unhealthy, through the presence of carbonic acid and carbonic oxide, in the rooms heated by them. The result of two experiments—one with dry air, the other with moist—are given in the report. Rabbits were made to breathe the air passing over stoves of cast and wrought-iron heated to redness, and afterwards chemical examination of the blood of the animals was made, to ascertain the presence of carbonic oxide. The following words are used in giving the results of the experiments:—"If the summary of the experiments made upon rabbits does not permit us to fix with any precision the proportions of carbonic oxide absorbed by their blood, nor that of the oxygen which has been expelled from it, the results all agree to show that the use of stoves of cast-iron, heated to a red heat, causes in the blood, by the presence of carbonic oxide, a gas eminently poisonous, changes whose repetition may become dangerous; while the same method of investigation has not revealed analogous effects when the heat has been produced from stoves of wrought or sheet-iron." In experiments made prior to the above, Morin came to the conclusion that with surfaces of wrought-iron heated to a red heat carbonic oxide is produced, his experiments showing that the passage of the air over cast and wrought-iron heated to redness causes the development of carbonic oxide to an extent noticeably greater in the case of cast-iron than in that of wrought. In presenting the conclusions or results of the entire series of experiments made upon stoves of cast and wrought-iron during the year, the commission reports as follows:—"The carbonic oxide, whose presence has been proved when stoves of cast-iron are used, may arise from several different causes; 1st. The permeability of the stove by that gas, which will pass from the interior of the fire-pot to the exterior. 2nd. The direct action of the oxygen of the iron upon the carbon of the cast-iron heated to

redness. 3rd. The decomposition of carbonic acid contained in the air by its contact with metal heated to redness. 4th. The influence of the organic dust naturally contained in the air." Another very important conclusion is arrived at by the commission—viz., that all stoves and heating apparatus of cast-iron, and even those of wrought-iron, should be lined with fire-brick, or other substance, so as to prevent them from attaining a red heat. In America, where stoves are generally used, and more anthracite than soft coal is burnt, the subject has long attracted attention; but from the recent rise in the price of fuel in England, and the probable large introduction of stoves for the sake of economy, a reference to it here may not be without its use. No more prominent cause of disease in families exists than such devices for burning anthracite coals in cast-iron stoves, not provided with good fire-brick linings.—*Practical Magazine.*

CORRESPONDENCE.

PROFESSOR ANSTED'S ACCOUNT OF A RECENT VISIT TO THE COAL AND IRON FIELDS OF VIRGINIA.

Sir,—I trust you will afford me an opportunity of amending a few errors that have crept into the otherwise very accurate report of what I said in the discussion that followed Professor D. F. Ansted's "Account of a Recent Visit to the Coal and Iron Fields of Virginia." I also crave permission to add a few details in explanation.

What I really said with regard to the Kanawha Valley was that it was 600 feet above sea level, and not 60 feet, as stated.

The eastern terminus of the Chesapeake and Ohio Railway will ultimately bo fixed at Newport News, in Hampton Roads.

The aggregate thickness of the coal seams in the heart of the coal-fields (that is to say, near Hawks' Nest Station, on the Chesapeake and Ohio Railway) I stated to be over 60 feet. I find, however, from a diagram and notes kindly lent to me by Professor Ansted, that above the sandstone in this part of the coal-fields of West Virginia there are not less than 22 workable seams of three feet and upwards in thickness, disposed in the following order, reckoning upwards from the sandstone, namely, *a*, 3 ft.; *b*, 10 ft.; *c*, 3 ft.; *d*, 8 ft.; *e*, 6 ft.; *f*, 4 ft.; *g*, 6 ft.; *h*, 8 ft.; *i*, 3 ft.; *k*, 3 ft.; *l*, 3 ft.; *m*, 5 ft.; *n*, 10 ft.; *o*, 12 ft.; *p*, 7 ft.; *q*, 4 ft.; *r*, 10 ft.; *s*, 3 ft.; *t*, 3 ft.; *u*, 9 ft.; *v*, 7 ft.; *w*, 4 ft.; making an aggregate of 128 feet. What I wish to explain is, that it is only the thicker of these seams and those most easily accessible, that are workable at a profit at present, and place these in contrast with the thin seams of 20 inches which are worked to a profit in Yorkshire and Lancashire, even from very great depths, on account of the superior quality of the coal.

I have been made to say that the inland navigation opened up by the communication of the Kanawha River with the great system of rivers formed by the Ohio and Mississippi, and their numerous tributaries, extending nearly from the great lakes in the North to the Gulf of Mexico in the South, was 200,000 miles, instead of 20,000 miles, as it may be approximately stated.

I may add that the present price for mineral rights only of coal lands in the best parts of the Cumberland basin, which were sold before the opening of the railway, as in Virginia, at from 10 dols. to 20 dols. per acre, now range from 2,000 dols. to 3,000 dols. per acre, and there is no reason to doubt that in course of years the Kanawha coal-fields will be equally valuable.

The question of the injury that is likely to result to the iron trade of this country through competition with the iron manufacturing districts of the United States I termed a serious, not a "solemn" subject.

Instead of saying there was "plenty of capital in America ready to be invested in anything really good, but the difficulty was to be safe," I should have said, "that there were many admirable opportunities for the investment of capital in the United States, but that the good things were so readily and quickly caught up by American capitalists, that it was a difficult thing for English capitalists who have not been on the spot to ascertain in time what were safe and desirable, and what otherwise, of those speculations that were brought to England."

For "at present the demand in America was greater than the supply," read "at present the demand for iron and coal in America was greater than the supply." The sentence that immediately follows this should be read thus:—"He did not think it would ever be profitable to import coal from America, but every ton of finished iron exported represented a consumption of three or four tons of coal at home, and if the raw material (pig-iron) could be imported from America, the demand upon English collieries would be very materially lessened, which would tend to cheapen coal."

What I actually said, or intended to say, in concluding my remarks, was as follows:—"So great is the demand in America for coal and iron, that, stimulated by the present high prices, iron works are now in course of erection in many places, and there is no doubt that the large home trade now springing up has already occasioned great loss of trade to England."

The dip of the coals throughout the coal-fields of West Virginia is on a gentle incline towards the west, and those seams that appear high up on the mountain slopes, on the east side of the coal-field—for example, on Big Sewell Mountain—are deep down below the surface, or water level, at Charleston, on the west side.

On the east side of the coal-field, in order to send the produce of the seams to market, the practice is to convey the coal down the steep hill side, by an inclined plane, to the water or railway level (which are almost identical, as in America railways, for the most part, follow the sinuosities of the rivers and run along the rivers' banks); while in the west, the coal from the same seam could only be won by mining, as in England, being far below the surface. I consider that it is on coal lands, in the centre of the West Virginia coal-fields, that operations may be carried out with the greatest profit, because the outcrop of the coal seams on the hill sides, being nearest to the water level, causes the coal, which is of the best quality, to be won at the least possible cost.

I apologise for the length of my letter, and I may add that, probably any inaccuracies in your version of my remarks are due to the fact that, in addition to labouring under the inconvenience of a bad cold, I spoke too rapidly and indistinctly to enable your reporter to catch my meaning in all cases.—I am, &c.,

Antonio Brady,
Chairman of Meeting.

INDIAN TEAS.

Sir,—In the first letter of the correspondence on Indian teas, published in your last issue, I read that a dealer can purchase 100 chests of China tea, but that Indian teas run in lots of 2, 6, 8, or 20 chests. I enclose you a catalogue of between 700 and 800 chests of Indian tea, from the district of Darjeeling, offered for sale this day; you will see the same contains lots of 106, 92, 86, 80, 68, 67, &c., chests. These teas are the produce of one company's gardens, and they have thousands of chests to follow. Some Darjeeling tea sold at auction on the 2nd instant, fetched 3s. 7d. per pound (in bond), so they do not appear to be novices, or require much instruction from China, which might result in adulteration. I can hear of no adulterated Indian tea, and am sceptical as to the catalogue and sample referred to.—I am, &c.

Samuel Ward.

February 4, 1874.

LAURIUM MINES.

Sir,—In reply to the animadversions of your correspondent, Professor Ansted, upon the notice of the Laurium mines, contained in a former number of your *Journal*, I have to inform you that his opinions are directly at variance with the statements made by her Britannic Majesty's Consul at Athens, Mr. Merlin, who has treated of this subject not only in the report from which this *resumé* was taken, but also in his former accounts of the trade of Continental Greece. Consul Merlin appears to have given the subject very careful attention, as may be inferred from the perusal of these reports, and it is to be presumed that his information is reliable.—I am, &c.

The Writer of the Notice.

SWAN RIVER MAHOGANY.

Sir,—Your correspondent, Mr. Alexander, of Edinburgh, is perfectly correct in his description of the qualities of the general run of Australian gum trees, as so called, which are hard, heavy, of unsightly grain, and all of a dirty white tinge, but that gentleman, or his friends, can scarcely be aware of the great variety of that peculiar species of *Eucalyptus* commonly called Swan River mahogany, or red wood, only known in that district, where it is found both hard and soft, with straight, curly, satin, and knotty grain, some of the latter possessing great beauty, and the hardest not harder than true Spanish. The argument that its hardness precludes its employment in fine cabinet work has no foundation in fact, because the much harder rose, as well as many other well-known woods, have been in common use for that purpose for years. It has never yet been exported in quantities sufficient for fair trial, as the settlement has ever been, and still is in a very backward state. Indeed it was very nearly extinguished, and abandoned before its second year was out, from causes which I could readily explain, having resided there from its first start in 1829 until 1839. Several varieties of gum trees have been exported at times from Sydney, Adelaide, and Melbourne; but I know of no exportation of timber from Swan River, especially of its peculiar trees of the so-called mahogany, &c.—I am, &c.

Henry W. Reveley.

Reading.

PATENTS AND CO-OPERATION.

Sir,—I fear such letters as that of "H. W. R.," in your last issue, are only likely to set class against class, an object, I presume, not desired by the Society of Arts. There is only too much of that feeling abroad at present, and does not need any addition. If the rich tradesman treats the poor gentleman in the manner mentioned, the poor gentleman should treat the rich tradesman with the contempt he deserves.—I am, &c.,

W. E. Bartlett.

8, King William-street, City,
London, Feb. 4, 1874.

NOTES ON BOOKS.

The Royal Horticultural Society, as it is, and as it might be. By G. F. Wilson, F.R.A.

Under this title, Mr. G. F. Wilson, F.R.S., who is well-known as a scientific and ardent practical horticulturist, has issued a small pamphlet, consisting mainly of correspondence which has already appeared in the journals specially devoted to such subjects. In the interests of science, and with the hope of aiding the progress of practical horticulture, he advocates a reconstruction of the Royal Horticultural Society on an enlarged basis, by means of reduction of the subscription to a guinea, so as to bring within its sphere of interest the large body of amateur and professional horticulturists now widely spread over the country. He also urges that the operations of the Society should be devoted to the promotion of scientific and practical horticulture, by retaining the Chiswick Gardens for this purpose, and relinquishing the Kensington Gardens to the Commissioners of 1851, the ground landlords reserving only the privilege of holding shows there on a limited number of specified days in the season.

Sicily and its Wines. By B. Rainsford.

This is a short pamphlet intended to attract the notice of the public to a new source of wine-supply. Sicilian wines, except Marsala, and that seldom in its natural state, are but little known in this country at present; but it is stated that some of the produce of the island, now principally retained for home consumption, is well worth exportation.

GENERAL NOTES.

British Museum.—The *Athenæum* states that the trustees of the British Museum have agreed to resign their patronage into the hands of the Government. The staff of the Museum comprises about 400 persons, of all grades.

Technical Instruction.—At the recent meeting of Trades Unions at Sheffield, Mr. Owen (Hanley) moved that the Congress believes that the time has come when the working men throughout the country should take up the question of technical education, with a view of improving their skill, and that schools for that purpose be established. This was unanimously carried. If the working men desire to secure for technical instruction all the advantages that they ought to have, they should petition, and move their members to support the views of the Society of Arts in asking for a Minister of Education, to be responsible for all museums bearing on technical instruction.

City Companies and Technical Education.—The Company of Coachmakers and Coach Harness-makers offer for the year 1874 the following prizes for competition among persons engaged in the trade of coach-making, being clerks, foremen, workmen, or apprentices, natives of the United Kingdom of Great Britain and Ireland, or any British Colony:—For freehand or mechanical drawing, applicable to carriages or parts of carriages, or the ornamentation thereof—1st prize, the Company's Silver Medal and £3; 2nd prize, the Company's Bronze Medal and £2. For Practical Mechanics—1st prize, the Company's Silver Medal; 2nd prize, the Company's Bronze Medal. For drawings of Carriages or parts of Carriages to the scale of one inch to the foot—1st prize, the Company's Silver Medal and £3; 2nd prize, the Company's Silver Medal and £2; 3rd prize, the Company's Bronze Medal and £1. Also in the examination in the technology of carriage-building, to be held by the Society of Arts—1st prize, the Company's Silver Medal and £3; 2nd prize, the Company's Bronze Medal and £2; 3rd prize, the Company's Bronze Medal and £1.

American Patents.—The number of American patents granted since 1836 is about 140,000. The number of applications for patents has steadily increased from year to year, until it now averages from 20,000 to 21,000 per annum, and the number of patents granted annually is from 13,000 to 15,000. To perform the work of examining this large number of applications, the corps of expert examiners has been increased from time to time until it now numbers about 100; twenty-four principal examiners, and the same number of first, second, and third assistant examiners, together with a special examiner of trade marks and also of interferences. The clerical force has been correspondingly increased, so that the officials of all grades now employed in the office may be stated in round numbers as about 500. It should be remembered, when comparing the number of English and American patents, that in the States many designs, &c., are patented which are only registered with us.

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

The following arrangements have been made:—

February 11.—"On Type Printing Machinery, with suggestions thereon." By the Rev. Arthur Rigg, M.A.

February 18.—"On Thrift as the Outdoor Relief Test." By G. C. T. Bartley, Esq. On this evening the Right Hon. the Earl of Derby will preside.

February 25.—"On a New System of Cultivating the Potato, with a view to Augment Productiveness and Prevent Disease." By Shirley Hibberd, Esq.

March 4.—"On Bells, and Modern Improvements for Chiming and Carillons." By George Lund, Esq.

March 11.—"On the Manufacture of Cocoa." By John Holm, Esq.

March 18.—"On the Channel Tunnel." By William Hawes, Esq., F.G.S.

March 25.—"On the London International Exhibition of 1874." By Henry Hardy Cole, Esq., Lieut. R.E.

Indian Section.

The following arrangements have been made for Friday evenings during February and March:—

February 6.—"On Indian Art." By Dr. Zerffi. On this evening Major-General Sir Vincent Eyre, C.B., K.C.S.I., will preside.

March 13.—Dr. Leitner, Principal of the Government College of Lahore, will give an account of the Races of Dardistan (north-west of Cashmere), discovered by him.

African Section.

These meetings are arranged for Tuesday evenings, at 8 o'clock, and the following arrangements for papers have been made:—

February 17.—"On the Present Aspects of Africa, with Reference to the Development of Civilised Trade with the Interior." By Trelawny Saunders, Esq.

March 3.—"On the General Features of West African Trade from Senegal to St. Paul de Loanda." By Consul Thomas J. Hutchinson, F.R.G.S.

March 17.—"Remarks on the Geographical and Physical Character of the Diamond Fields of South Africa." By the Honourable Theophilus Shepston, Secretary for Native Affairs in Natal. Communicated and explained by Dr. Mann.

Chemical Section.

The following papers will be read in this section:

March 6.—"On the Paraffin Industry." By Frederick Field, Esq., F.R.S.

March 20.—"On Anthracene and Alizarine." By Dr. Versmann.

April 10.—"On some Recent Processes for the Manufacture of Soda." By C. W. Vincent, Esq., F.C.S.

April 24.—"On Pyrites, as a source of Sulphur, Copper, and Iron." By Dr. C. R. A. Wright, F.C.S.

May 8.—"On Sugar Refining, with special reference to Finzel's Sugar Crystals." By Dr. Griffin.

May 22.—"On the Manufacture of Chlorine." By W. Weldon, Esq., F.C.S.

CANTOR LECTURES.

The second course is on the "Chemistry of Brewing," by Dr. Charles Graham (University College, London), and consists of seven Lectures, the remaining four of which will be given as follows:—

Lecture IV.—February 9th, 1874.

On Boiling. Hops, their properties and uses.

Lecture V.—February 16th, 1874.

On Fermentation. (Primary.)

Lecture VI.—February 23rd, 1874.

On Fermentation. (Secondary.)

Lecture VII.—March 2nd, 1874.

The Beer of the Future.

A third course "On Carbon and Certain Compounds of Carbon treated in reference to Heating and Illuminating Purposes," will also be given during the Session, by Professor Barff, M.A. Further particulars will be given in the *Journal*.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...SOCIETY OF ARTS, 8. Cantor Lecture. Dr. Graham "On the Chemistry of Brewing."
British Architects, 8.
Medical, 8.
London Institution, 4.
Royal Geographical, 8½. 1. Dr. S. W. Bushell, "Journey outside the Great Wall of China." 2. Mr. Geo. Phillip, "Notices of Southern Mangi (China)."
Social Science Association, 8. Mr. Gill Dowdeswell, Q.C., "On the Rules of Practice and Procedure to be framed under the Judicature Act of 1873."

Tues. ...Medical and Chirurgical, 8½.
Civil Engineers, 8. Mr. B B. Stoney, "On the Construction of Harbour and Marine Works with Artificial Blocks of Concrete of large size."
Photographic, 8. Annual Meeting.
Anthropological Institute, 8. 1. Consul Hutchinson, "Explorations among Ancient Burial Grounds, chiefly on the sea-coast valleys, of Peru" (Part II.) 2. Messrs. C. F. Tyrwhitt Drake and A. W. Franks, "Skulls and Implements from Palestine."
Royal Colonial, 8. (At the House of the Society of Arts.) Sir Richard Graves MacDonnell, "Our Relations with the Ashantee and other West African Tribes."
Royal Institution, 3. Professor Rutherford, "On Respiration."

Wed....SOCIETY OF ARTS, 8. Rev. Arthur Rigg, "On Type Printing Machinery, with suggestions thereon."
Graphic, 8.
Royal Literary Fund, 3.
Royal Society of Literature, 4½.
Archæological Association, 8.

Thur....Royal, 8½.
Antiquaries, 8½.
Royal Society Club, 6.
Mathematical, 8.
Royal Institution, 3. Professor Duncan, "On Palæontology, with Reference to Extinct Animals and the Physical Geography of their Time."
Society for Encouragement of Fine Arts, 8. Dr. Zerffi, "Darwinism in Art."

Fri ......Astronomical, 3. Annual Meeting.
Royal Institution, 8. Weekly Evening Meeting. 9. Dr. Doran, "On the Opponents of Shakespeare."
Royal United Service Institute, 3. Staff Surgeon-Major J. D. Macdonald, "Ventilation of Ships, especially of Low Freeboard, and Hospital Ships."
Quekett Club, 8.
Clinical, 8½.
Literary and Artistic, 7.

Sat......Royal Botanic, 3¾.
Royal Institution, 3. Mr. R. Bosworth Smith, "On Mohammed and Mohammedanism."

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FRIDAY, FEBRUARY 13, 1874.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

NATIONAL TRAINING SCHOOL FOR MUSIC.

A meeting of the Committee was held on Thursday, the 5th instant, at the Royal Albert Hall. The Committee took into consideration the formation of local committees for the object of procuring scholarships, and made preliminary arrangements for commencing this work in some of the principal provincial towns.

ECONOMICAL USE OF FUEL.

The testing rooms for the trial of the stoves sent in to compete for the Society's prizes are now finished, and the experiments have already commenced. Due notice will be sent to exhibitors of the date when their stoves must be fixed for testing.

TECHNOLOGICAL EXAMINATIONS.

The Programme for the Examinations in the Manufacture of Cloth is now ready, and can be had upon application to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

A meeting of this Section was held on February 6th, Major-General Sir Vincent Eyre, C.B., K.C.S.I., in the chair.

The Chairman, in introducing Dr. Zerffi to the meeting, said, considering that the happiness of so many millions in India depended upon the use or abuse of English power in that country, it behoved all to use their utmost diligence to obtain accurate information regarding the past and present of that vast country, and these considerations pressed more particularly at a crisis like the present, when the large districts of Behar and Bengal were threatened with a terrible famine, jeopardising the lives of many millions. Although the paper would probably deal more with the past than the present, he could not doubt that it would throw an important and interesting light upon the history and characteristics of the people of India, and might have an important bearing on our dealings with them, especially in connection with their arts, manufactures, and commerce, upon which their prosperity so much depended.

Dr. Zerffi then delivered an address:—

ON INDIAN ART.

In approaching the subject of Indian Art, we would do well to bear in mind the words of John Stuart Mill, who observed that if Christians would teach infidels to be just to Christianity, they should themselves be just to infidelity; for it was impossible to treat art without paying some attention to religion. We must shake off that tendency of isolation which caused us to shrink from the labour of acquiring a thorough knowledge of the principles and customs of others, for alone, by so doing, could we attain that objective mind which must necessarily be brought to the consideration of their works. Our first duty, then, in studying Indian Art, was to acquaint ourselves with the nature of the country generally, for the influences of climate and vegetation were reflected in works of art. Geographically ignorant of the country, we could not learn to know the people inhabiting it. In the vast triangular peninsula, stretching from the Himalaya mountains into the Indian Ocean, an undoubtedly home-sprung civilisation had been developed. The Indians of the higher castes were of the same race as ourselves, *i.e.*, Aryans, and had not only furnished us with language, but also with philosophical principles digested by them at a period when we were still tattooing ourselves. In studying the works of these people, therefore, we were in reality occupying ourselves with the productions of our own ancestors. Evidences of the marvellous civilisation attained by the Indians were afforded by the Scriptures and by Greek records. Solomon had obtained gold, jewels, peacocks, and apes from India, and the conquest of the empire had been the cherished object of the ambitious Alexander the Great. From India the Arabs had brought their wonderful tales and mystic systems. This was not surprising, for it was natural that the home of the myrtle, the lotus, the cocoa-nut tree, and, above all, of the wonderful banyan, should be at the same time the abode of the magical and marvellous. The tiger, elephant and peacock, excited emotions of terror and wonder, whilst the abundance of gold and precious stones was calculated to astonish the mind and impress it with a sense of the infinite wonders of creation. From impressions thus received, the thinking Indians had formed their ideas of the origin of all things. Their first conceptions of the creative forces were Ether, in which all things existed; Water, which fertilised the earth; and Fire, or heat, which generated life. After a time men became sensible of the want of some concrete signs or forms to represent these abstractions, hence they began to be artistic, and symbols were introduced. These symbols were

composed of the simplest geometrical forms; plants, animals, and men being used at a much later period. We trace this development in art ornamentation and decoration which only then began when men felt the necessity of finding expression for their religious ideas. Siva, or fire, has been represented by a triangle resting on its base; Vishnu, or water, by a triangle resting on its apex; and Brahma, or ether, by a combination of the two. The latter was the symbol of what we erroneously called the Destroyer; the proper expression being the Transformer, for the Indians did not believe in the destruction of anything once created. By degrees these simple signs had proved insufficient, and grotesque images took their place for the people had begun to forget the elevated ideas which had given them birth. The priesthood had then composed incarnations, illustrations of which were before us, and finding that these monsters gave them a powerful hold on the imaginations of the masses, they peopled heaven and earth with them. In this manner the mythologies of the Indians, Egyptians, Greeks, and all nations had been developed. We next reached the period of the laws of Manu, which had been succeeded by that of the two great epic poems of India, the Ramâyâna and the Mahâbhârata, of which the former was the older. The extraordinary length of these productions showed the influence on the mind of the poet, and the luxuriant nature surrounding him. He saw everywhere in Indian poetry and art evidences of the struggle against the crushing influence of matter, which poets and artists strove in vain to combat. This explained the grotesque character of the representations of their divinities, which they had intended to render sublime, being, in fact, animated by the same ideas which had originally been expressed in simple geometrical signs. In their desire to express the power and might of their divinities, they had multiplied the heads and arms of the figures; and in the endeavour to express the inexpressible and incomprehensible in concrete forms had produced mere caricatures. We ought, however, not to ridicule these works, but to study them, and endeavour to ascertain the ideas they were intended to represent. The artist who had produced the figures had intended to honour the divinity, and his work had been grotesque because the whole of the nature surrounding him was grotesque, and rendered him blind to correct proportions. The four-handed figure of Dhoorga, balancing decapitated heads on her fingers, represented the same abstract conception as the Pallas Athênê of the Greeks. In the Sama Vida the diatonic scale was mentioned as seven nymphs, Sâchâ, Risshabhâ, Gândhârâ, Madhyamâ, Panchamâ, Dhairatâ, and Nihada, the first syllables of whose names gave sa, ri, ga, ma, pa, dha, ni; or with the Persians, in the Indian style, da, re, mi, fa, sa, la, be. The scale, therefore, which had been introduced to us in the eleventh century, do, re, mi, fa, sol, la, to which Lemaire, in 1684, added the si, was due neither to Pythagoras nor to the Benedictine monk Arezzo. If we turned to the descriptions of the Divinity in the Ramâyâna, we found that nothing could surpass their refined feeling. The Ramâyâna commenced with an address from Rama to the Supreme Being, in the following words:—

"O Thou, whom threefold might and splendour veil,
Maker, Preserver, and Destroyer, hail!
Thy gaze surveys this world from clime to clime,
Thyself immeasurable in space or time;
To no corrupt desires, no passions prone,
Unconquered Conqueror, infinite, unknown;
Though in one form Thou veil'st thy might divine,
Still, at Thy pleasure, every form is thine.
Pure crystals thus prismatic hues assume,
As varying lights and varying tints illume;
Men think thee absent, Thou art ever near:
Pitying those sorrows which Thou ne'er canst fear;
Unsordid penance Thou alone canst pay,
Unchanged, unchanging—old, without decay;
Thou know'st all things: what man Thy praise can state?
Createdst all—Thyself still uncreate!"

Many such gems as this were to be found in the Indian poems. The terrible hierarchy so firmly established on the basis of the laws of Manu, which has crushed all vitality out of the Indian mind, had now received a serious check in the appearance of Buddha, or the wise man. He proclaimed that he had come to redeem the world, declared that all men were equal, that there ought to be no castes, and that the Brahmin was no better than Kshattriya, or Vaisyu, who again was not superior to the Sudra. All men who did good were to enter Nirvana, or paradise. Buddhism required deep study in order to enable us thoroughly to understand it. Properly speaking, the doctrine was nihilism, or quietism, not atheism, for it taught that man's duty in this world was to meditate and prepare himself for his return to the Divinity from which he emanated. Nothing is said, however, as to the nature of the Divinity, nor is man told what the Divinity is; he is merely directed to devote his energies to another world in which he will become happy. This religion had produced the marvellous constructions to which we now turned. The grotesque figures began to vanish, and we met only with colossal representations of Buddha, for the reception of which temples had been hewn into rocks throughout the Indian peninsula. From a general point of view these constructions might be divided into viharas, or monastic caves, chaitya, or caves resembling our Gothic churches, and Brahmanic caves, which were like the Buddhistic viharas. They were hewn into the solid rock, but the forms and patterns used plainly showed that the wood-constructions must have furnished the models. The Brahmanic buildings, which dated from the period when the Buddhists had been expelled from the country, varied in accordance with the Brahmanic faith. Next we had the topes which at first formed a part of the temples, and subsequently were erected as independent constructions. We saw here that men were first compelled to form their architectural products where the material was already provided by nature, and caves had therefore preceded independent huts, which latter had at first been built in the form of caves. The next step led to the erection of buildings where not only the form but also the material had to be found. A place had first to be chosen, and then surrounded in imagination with a certain material. The material had then to be made, and the construction then settled in a geometrically correct form, and thus we obtained by degrees a complete building. The Indians, in constructing, had made the great mistake of working without any regular plans, and, consequently, their works are whimsical, and, though

often stupendous, never really beautiful, regular, or worthy of imitation. The pillars in their temples failed in most instances to express the dynamic force in the building, which properly they ought to do. The cross-beams, which were quite superfluous in a rock-hewn construction, showed us the evil of transferring the treatment of one material to another of a different kind, an offence against the laws of art that was most objectionable. The details of the decorations were very fine, but they were placed at such a height that they could not be seen, and therefore merely represented a useless expenditure of labour and ingenuity. The gopirras were pyramidal erections, imitated from some previous wood constructions, and ornamented from summit to base with reproductions of wood carvings—a great mistake. The amount of labour and trouble expended on all these works must have been incalculable, and we could not but reflect that if this had been applied with a proper understanding of the forms of architecture, grand results might have been attained. When we passed to the consideration of Indian sculpture, we found the same errors repeated. Their sculptural products consisted chiefly of idols, which unfortunately we imitated, large numbers being exported from Birmingham every year. We could certainly descend to their products, but they had been able to equal ours. We should do far better to spend money in improving Indian taste, instead of endeavouring to make a profit out of its mistakes. The Indian mind must be altogether reformed from an artistic point of view, and a wonderful change would be instantly wrought, when once the people learned to appreciate the beauties of classic form, and saw the ugliness of their own grotesque representations. We had unfortunately neglected to spread a knowledge of better works in India, but it was essential that we should do all in our power to repair this error, if we really desired to see an improvement in their art. There was no doubt that the Indians possessed sufficient capacity to carry them to the very summit of artistic development, for the wonderful works they had produced under Mohammedan rule afforded ample proof of this. If so much could be achieved under Mohammedan rule, under English rule and with an English education India ought yet to give birth to her Phidias and her Praxiteles. The Indian mind was exceedingly refined, as we had seen from the passage in the Ramâyâna, but we must teach the people to discard their grotesque forms. We must teach them to respect the idols that we reverenced, Shakspeare, Newton, Bacon, and others; and, at the same time, they would learn to admire the proportioned and symmetrical, as opposed to the wild and unnatural. If once an improvement were produced in art, a corresponding advance in all directions would surely follow, for art was the outgrowth of the civilisation of a nation, and was the last and highest result of the culture of mankind. Whenever art stood high, we might be sure the intellectual power of the nation was great; and when it was low, the degree of culture was small. Ethics, or morals, and æsthetics were only different in form, but in essence they were entirely the same—for ethics was beauty of morals, and æsthetics was morality of form. If a man were æsthetically trained he would be necessarily as moral as one who was ethically trained, for everything ugly would be repugnant to him. It was as necessary to train the mind ethically as æsthetically, and *vice versa.* If we were not trained æsthetically we could not possess good taste, for taste was as little an arbitrary matter as good or evil. In conclusion he (the speaker) must draw attention to the great excellence attained by the Indians in colouring and decorating flat surfaces. Whenever they did not endeavour to represent abstract forms, whenever they discarded their mythology, they were admirable. Nothing could surpass the power they showed in the juxta-position of primary and secondary colours, and in this respect we had much to learn from them. In their poetry there was an abundance of beautiful passages, but we generally found an inclination to bombast, and a sickly sentimentalism, and were struck with the want of power and restraint. This was even more the case in architecture and plastic art; everywhere the sensual and the soft predominated. In architecture the forms were round and swelling, and arbitrarily varied; in plastic art the modelling was imperfect, and the bodies even without sinews and muscles, the forms being stiff and without life and animation. Side by side with these drawbacks, we often found admirable effects produced in architecture by the use of huge masses. We could not but admire their halls and arcades, and the technical skill with which they heaped form upon form in their pagodas and cupolas was surprising. In their sculpture they astonished us with colossal and grotesque forms, and with symbolic representation of supernatural, many-limbed monsters. Their works were, however, too intentional and forced, and never melted into a beautiful harmonious whole. We saw how sensualism and metaphysical loftiness might be united, and found that this union produced nothing but contradictions, which could only be brought into harmony by symmetry and law, aided by a keen sense of beauty. The extreme richness of the Indian imagination had been a great hindrance to their becoming real artists. The spiritual and material—man and nature—were not yet separated. This was the case with them in ethics as well as in æsthetics. Man was only then capable of cultivating his better intellectual nature when he had freed himself from the material nature, and it was only when thus emancipated, that he became able to contemplate nature with advantage, and to progress in art. Everything depended on creating in the Indians a feeling for real beauty. Schools of art should be established, and by degrees, when the people became thoroughly acquainted with the literature and art of other nations, they would in reality be made citizens of a truly civilised state.

DISCUSSION.

Dr. Leitner, while expressing his great admiration for the lecture on the whole, said there were one or two points in which he should be inclined to lean rather more in favour of our Indian fellow-subjects than Dr. Zerffi had done. When he said that we should be more sympathetic, and go there, not only as teachers, but as learners, he fully agreed; and he should go even as far as to say that we had much more to learn than had been

stated. Sculpture, as well as Indian art generally, was mixed up with so many elements, that it was impossible to condemn any portion of it wholesale. For instance, with regard to the knowledge of the human body and its proportions, there eould be no doubt that the Turanian or aboriginal races of India, when they became converted to Buddhism and were brought into eontaet with great sculptors, exeeuted works whieh were eertainly not inferior to any of those whieh had been discovered at Athens. He had seen early specimens of Buddhist sculpture, representing scenes in the life of Buddha, which were cxecuted with the most refined touch it was possible for any artist to possess; in fact, it was only by degrees, when Buddhism relapsed into Brahmaism, that these grotesque outlines were gradually introduced. It was very fortunate that Birmingham did not send Buddhas to India, but only representatives of Vishnu, Shiva, and Brahma, or else perhaps instead of there being only one simple representative of Buddha, there might be as many and as grotesque outlines of the god, as there were of the others. Buddhism was now mueh corrupted, and had not the purity with which it first made itself heard when it spread even into Europe, and was embraced by many of the Greeks, of whom probably Pythagoras was one. In Thibet, where corrupt Buddhism now existed, there were no doubt cxaggerated proportions of the human figure, but Dr. Zerffi did not seem to have paid sufficient tribute of admiration to the colossal character of Mohammedan architecture. Any one who said these men did not understand geometrical proportions should visit some of the splendid buildings he had seen in India—for instance, the celebrated tomb of Achbar tbe Taj Mahal. Nothing in the world could exeeed it; it appeared like the most beautiful lace-work until you came near enough, when you discovered it to be marble; indeed, it fully answered the description of Bishop Heber, as a work carried out by giants, and finished in detail by jewellers. As you approached from a distance it appeared, with its baek ground of dark foliage, to float in the air; it was more like a dream than reality. It appeared like one pure slab of marble rising from the soil, the whole proportions were so beautifully conceived; but on approaching it there appeared a terrace on which rose the main mosque, and it was not until you came almost within arm's-length that you found, instead of being one uniform surface, the walls were inlaid with most precious jewellery in the shape of flowers. Then, again, to say that by introducing our English schools we shall gradually teach them mathematics, it was really absurd, for their mathematical and geometrical abilities surpassed everything which a European eould conceive. He agreed, however, with what had been said as to the pliability of the native character, and that was its great excellence if properly understood. The natives were still very skilful in all kinds of little nick-nacks, though we were not stationary enough in India to allow our houses to be inlaid with jewellery, and thus to give scope to their employment. It might be a mistake perhaps to introduce some of their patterns into this country, but we might study them and adopt anything suitable. But what we should do, going there, was to develope the indigenous civilisation, so as to give a strong, firm, and durable basis to the introduction of our own eivilisation, because, to force a foreign eivilisation upon any country was to ignore the primary laws of human nature, which taught, if you wished to do anybody good, you must first recognise the good tbat is in him, and in the Indians there was an immensity of good, though we had not always developed it as we should have done, and as he believed had been the honest intention of the Government. For instance, at Shahliman, where the work was so beautiful, although so great, that you might fancy it was a toy to put on a mantelpiece, the beautiful assortment of colour had been daubed over by an English assistant commissioner with white-wash to make it look neat. This, he thought, would be a lesson not very advisable to teach. Again, with regard to the art of making encaustic tiles, it was all very well to say that these should not be used to imitate other materials, but many of these things were conventional, and well suited the Indian climate, and scenery, and family life, and might not suit other countries and people; but beeause these tiles did not suit everything it was no reason why that art should entirely die out. Yet at the present moment it was centred in the life of one old man at Lahore, who had no occupation left, and with whom the art would die, because it was not worth while, in this mereantile age, for anybody to learn an art which was no longer wanted. But it was no reason why the art of mixing colour should die out beeause we did not approve of putting tiles on marble. The only way to develope all the virtues of the human mind and intelleet was to develope from within, not only in art. but in science. Many of the inferior men in any of our eolleges in India would easily get a wranglership at Cambridge. He spoke with some experience, having been a professor at King's College, and having had a very varied experience since, but he did not hesitate to say that as far as mere learning went, young Hindoos very far surpassed English lads of the same age, who had all the assoeiations of family life, and the prospect of a good career to push them on; whereas, these young Hindoos had generally to be content with some petty office worth £2 or £3 a month. Again, their literature contained ideas of the greatest purity and devotion; for instance, the Buddhist drama of Nabanundah, where one man sacrificed himself to save the race of his deadliest enemy from perdition. His opinion was that we had much more to learn than to teach, though no doubt they would be all the better for being aequainted with our modern diseoveries in natural science. In other respects, however, they were much deeper scholars, and it very often happened that our missionaries did not know sufficient logic to be able to cope with the pundits. If we wanted to govern and improve them we must give up the idea of their mental or moral inferiority. If we wished to impress the idea of humanity on an Englishman, as derived from the lessons inculcated on the Chinese of obedience to their parents, love for their country, and the respect they ought to pay to their ancestors, that would not be the way to impress an Englishman, but one must appeal to his love of fair play, to the spirit of truthfulness, and the conduct befitting a gentleman. If these feelings were appealed to, no Englishman, however depraved, but was eapable of improvement. In the same way the Hindoo must be approached from the side of his own sentiments, his veneration for the ancient, for authority, for ceremonious behaviour, for everthing that was colossal and massive. It was not by making them familiar with the English language, and talking to them in a sort of how-do-you-do style that we could affect their real feeling. When a native told the government officer that he looked upon him as his father and mother, we thought it was nonsense, and said the man was untruthful, but it was only their method of expressing themselves. He merely meant that he looked upon the Government as the power which was to do him justice with the sternness of a father, tempered with the affection of a mother, just the same as in our way we spoke of mercy being tempered with justice. The English mode of thought was an abstract one, and we must not condemn the grotesque, also, of the Indian style through our love for generalisation. We constantly find in English newspaper articles, abstractions and generalisations which often carry us away, and make us forget the concrete facts on which they were based. If you spoke of civilisation promoting inquiry into antiquity it was often found that tradition was more reliable than documentary evidence; that was one way of expressing a truth, wheroas another way would be to say, when people become rich, they dress well, and begin to inquire what their fathers have been, and they look to reeords; but

who can trust records, because they might be written with the pen of foolhardiness, on the parchment of endurance? But when you read an ancient poem, that shows, truly, the condition of mankind in past ages.

Dr. Dresser expressed the great pleasure he had experienced in hearing Dr. Zerffi, especially as it was the first time he had been privileged to meet him, though he had often wished to do so. He had followed him with the greatest pleasure during the greater portion of his address, because he seemed to have arrived at the same conclusion which he himself had given expression to only two evenings ago in the same room, and these conclusions had been arrived at by Dr. Zerffi, as a scholar and linguist, whereas he could only claim to be a simple ornamentalist, without knowledge of the Oriental languages. He could not, however, agree with the latter part of the lecture, and should much rather side with Dr. Leitner, being strongly of opinion that we had more to learn in the way of art from the Indians than to teach them. There was, however, this difference, the Indian was not a pictorial artist or sculptor, but an ornamentalist, and in this latter department he wonderfully excelled, as was shown in his marvellous rugs and artistic objects of all kinds. Even their architecture appeared to him to possess much more beauty than it seemed to have to Dr. Zerffi. The lecturer seemed to think that pictorial art was far superior to ornament, but in his view the mind of man was capable of taking two directions, and might either tend towards pictorial art, or, on the other hand, develope itself in a totally different direction, beginning with hieroglyphics, and going on in that line the artist would become an ornamentist. He thought both were equal, for the highest flights of genius had been reached in both directions only by those who had devoted their whole lives to the perfecting of one particular idea. He thought there was something poetical in most Eastern arts, though he was more acquainted with Persian, Japanese, Chinese, and Arabian art than Indian. But he was rather disposed to think that a great deal of Indian ornamentation was derived from the Persians. For instance, that form generally known as the Persian pine, which was so common on shawls, was really the representation of the cypress tree which was associated with sacred places of worship, and he believed, in the same way, there was a meaning attached to almost every form if it could be traced. What had been the good of introducing schools of art and English art-training into India? Dr. Forbes Watson had introduced into the prisons in India certain European manufactures of carpet and a piece of Kidderminster—the most abominable pattern of carpet ever made—was actually sent to these educated Indians to imitate, instead of allowing them to continue making those beautiful carpets such as Mr. Edwin Robinson had placed on the walls a few nights ago. He did not believe we were doing anything to elevate India by introducing our schools of art there. A truly great artist could not be procured at a salary such as was paid to the masters, not that he wished to speak in any derogatory manner of them. He had seen a good deal of the work which had come from these schools, and was well acquainted with art manufactures; and he must say he had a most sincere conviction that our artistic instruction was doing a great deal to degrade the Indian and very little to exalt him.

Mr. Andrew Cassels said when Dr. Dresser spoke of an Englishman having more to learn than to teach the Indians, he probably referred to ornamental art, which might be art in one sense, but in another was not art at all. With regard to carpets, curtains, and work-boxes, and the arrangement of colours, and such matters, he might be perfectly right, but what did the natives of India know of real art when they produced those grotesque figures of which we had seen some examples? As regards pictorial art or sculpture, they were simply nowhere; they had everything to learn, they must begin at the beginning and work upwards to the stage at which we had arrived.

Major-General Abbott could not but agree with Dr. Leitner that we had a good deal to learn from India. Anyone who had visited Delhi and seen those magnificent architectural productions, and even the ruins around it, and then contrasted them with the erection at the bottom of Waterloo-place to commemorate the Crimean war must acknowledge that we might take a valuable lesson from India.

Dr. Zerffi, in reply, said he must take exception to some of the remarks which had been made, because he stood there as a kind of authority on artistic matters; and if a gentleman admired a piece of what appeared like beautiful lace-work, which was made in marble, he himself condemned, by that very statement, the thing which he praised, because it was contrary to the laws of art. Marble was not to be treated like lace-work, and had never been so treated by those who were real artists. Those who wished to learn must go to the Greeks and find from them how to use straight lines, and to express, without any secondary aids, the conflict between the static and dynamic forces in architecture, or the beautiful symmetrical proportions of the human body. With regard to ornamentation, he had given the greatest praise to the Indians, and quite agreed that in these matters, and the proper use of colours, we must learn from them; and, as he had already said, we must not attempt to teach the Hindoo before we had thoroughly understood them and learnt what they meant, even by these grotesque figures. When Dr. Leitner said that the English were always apt to generalise, he must beg to differ from him entirely, because our grand mistake was, that we did not grasp generalisation. We had not to consider what was written in newspapers, but whether we had really grasped the idea of what had been going on in India, and what was the real system and mode of thought there. And when he saw what Colebrooke, and Sir William Jones, and Wilson, and many other Englishmen had been doing, it came to this—they had all been gathering stones together, one talking of ornamentation, another of sculpture, and one of pictorial art, but no one had brought the whole together into one general intelligent system. When he turned, however, to German writers, such as Lassen and others, they had put together these stones which Englishmen had gathered together, and built up a beautiful Parthenon, or catacomb, or sarcophagus, and one grand all-embracing system was developed. Englishmen needed to study generalisation and to grasp larger ideas, not to laugh at a man because he worshipped a three-headed divinity. But with regard to the veneration of the Indian for everything old, that was just the very thing they must be taught not to have. So long as these people would venerate that which was old, and which had been yesterday, and will be to-day because it was yesterday, they would never improve, simply because they were foregoing and depressing their own intellectual powers. The English state was based on individual freedom, in which every man should partake, and all must work out their own existence. An Englishman did not go to his Goverment and say, "Good morning, our father, give me sixpence to live to day." That is what the Indian did, and what he had to unlearn. Englishmen had taught all the world to be independent, to venerate that which was honourable, and not to go to the Government and call it the papa or mamma, and ask to be taken care of, and how he was to be washed in the morning. Then reference had been made to the beautiful jewels upon the walls of the temple in the shape of flowers. Now, what was the real criterion of the savage?—that he used flowers and jewels. Amongst the civilised people a man wore one chain or none at all, but in Indian sculpture you saw a figure entirely naked, but with armlets, and necklets, and rings, and chains, and

an immense head-dress, all brilliant with jewels. They called that beautiful, but it simply showed their depraved taste, and when jewellery was either imitated on walls, or stuck on walls, it showed a want of appreciation of beauty in its simplest forms. He must remark again that anyone who wished to make himself useful in teaching ornamentation, should also try to raise the mind of the student by giving him a higher view of his art, not to drag him down if they wanted to aim at something higher. An ornamentist ought to be everything; nothing was excluded from ornament; landscape, flowers, plants, animals, everything might be made use of as an ornament, and by these means the most splendid results might be obtained. If they only used triangular and quadrangular figures and circles they were not artists in the higher sense, but only fit for carpet makers. Even in Paris, at the present day, M. Taine was teaching these higher views of art to carpet manufacturers, and the results would prove very different from those produced when the designs were simply confined to making triangles and squares. The same was done in the German schools, they did not keep down the pupils and say they must not be anything else but ornamentists, but every one was encouraged to occupy himself with art, and to aim at the highest excellence, and then if he only did the lower work he would do that well.

The **Chairman**, in proposing a vote of thanks to Dr. Zerffi for his eloquent address, said he could not help thinking that Indian architecture had been rather hardly treated in the way it was represented on the walls, for every traveller to India was struck with the magnificence of its architecture; and, with all deference to the superiority of the Greeks, each nation had its own individuality and produced a certain class of buildings, and each style had its own beauties. He had been much struck some years ago by seeing the Buddhist Tope at Sanchi, which was supposed to date from the third or fourth century before Christ, and was supposed by Fergusson to be the oldest in India. The sculpture upon that was the best that he knew of. It was rather curious that, although Hindooism existed so many years anterior to Buddhism, the earliest architectural specimen of it was, he believed, at Sanchi, in Central India, of which there was a very fair model in the International Museum. The sculpture seemed to have begun at a later age, and may have been owing to the decay of Buddhism. Hindoo sculpture, however, had received a great check from the Mohammedan conquests of India, because the Moslems discouraged anything like imitation of the human form. As to the native talent of Hindoos, he believed they were clever enough for anything, having seen remarkable instances amongst the most ordinary workmen. He believed a common blacksmith attached to an artillery battery, was capable of doing anything he was told, from founding a cannon to making a beautiful piece of jewellery. In conclusion, he expressed his regret that the recent elections had excluded from Parliament several of the best friends of India, in particular, Professor Fawcett, Sir Charles Wingfield, and Mr. Eastwick, but he hoped before long to see them again coming forward.

The vote of thanks to Dr. Zerffi having been passed, a similar compliment was voted to the Chairman on the motion of **Dr. Leitner**, seconded by **Mr. Cassels.**

TENTH ORDINARY MEETING.

Wednesday, February 11th, 1874; G. C. T. Bartley, Esq., Member of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Abbott, William, 8, Durham-villas, Phillimore-gardens, Kensington, W.
Corbitt, William, Masboro' Works, Rotherham.
Coventry, Joseph, 11, Cecil-street, Strand, W.C.
Dunbar, J. A., M.D., 45, Gloucester-gardens, Hyde-park, W.
Gardiner, Henry John, 6, Orsett-terrace, Hyde-park, W.
Garton, William, Southampton.
Pickford, William, 148½, Fenchurch-street, E.C.
Soper, W. G., B.A., the Priory, Caterham, Surrey.
Thompson, William, the Brewery, Chiswell-street, E.C.
Walker, William, Clifton-grove, York.

The following candidates were ballotted for and duly elected members of the Society:—

Bosanquet, Samuel Courthope, Tanhurst, Dorking.
Brown, Henry, Mayor of Salisbury.
Chown, Thomas Collingwood, 29, Pembroke-gardens, Kensington, W.
Cockburn, George Ferguson, King's Farm-lodge, East Sheen, Mortlake.
Dean, William, Locomotive Department, Engineers' Office, Great Western Railway, Swindon.
Hayward, John Williams, M.D., 117, Grove-street, Liverpool.
Holder, Charles Henry Vane, 37, Grosvenor-place, S.W.
Knowles, John, Westwood, Pendlebury, Manchester.
Rainford, Bentham, 20, Regent-street, S.W.
Stevenson, George Wilson, 19, Great George-street, S.W.
Swanzy, Andrew, 122, Cannon-street, E.C.

The Paper read was:—

ON TYPE-PRINTING MACHINERY AND SUGGESTIONS THEREON.

By the Rev. Arthur Rigg, M.A.

Type-printing machinery has of late years comprehended structures of many different external forms. Within such forms are mechanical arrangements of very various details. These are, however, based upon, or associated with, certain mechanical principles, upon which depend the effective power of the construction. The object of this paper is to remark upon the fundamental principles, and to pass by, or but casually allude to, the accessories—not that these are unworthy of notice, but because there is matter enough in the other to occupy present attention.

The following copy of a table, against the wall, in which P. indicates "Press" and M. indicates "Machine," may be useful for reference:—

Epochs in Type-Printing Machinery.

Names.	Date.
P.—Caxton	1477
P.—Blaew	1601
P.—Roworth	—
M.—Nicholson	1790
P.—Stanhope	1800
P.—Ruthven	1813
M.—Donkin	1813
M.—Kœnig	1814
P.—Clymer	1817
P.—Cope	1817
P.—Hansard	1817
M.—Cowper	1818
M.—Congreve	1820
M.—Applegath	1824
M.—Napier	1830
P.—Kitchen	1833
M.—Hill	1835
M.—Smith	1835
M.—Main	1850

The history of printing from moveable types has been often told, and may, therefore, be assumed as well known. The principle of Caxton's machine of 1477 is at this day the one met with in platen presses. Briefly expressed, this principle is the use of a flat plane of hard material, moved parallel to itself, and so brought to press on a form of type laid upon a hard surface parallel to the moving plane. Simple as this is in expression, it has proved difficult in execution. Two difficulties seem to have arisen—one, the distribution of the pressure from a central suspension; the other, the preservation of the parallelism of the moving plane with the type. The former difficulty has been gradually reduced by improvements in the framing of the platen or moving plane. The latter difficulty has been overcome by the introduction of a guide principle, the framing that supported the type-table being prolonged upwards, and within this prolongation the moveable plane was suspended and guided. Clearly, the larger the area of this plane the greater were these difficulties. Even in presses at use within the present century the platen was so small that large sheets were printed on one side by twice placing them under the platen and twice pulling.

Next in importance to securing parallelism in the immediate contact between the platen and the type were these, viz., rapidity of approach and withdrawal, and a sufficiency of control as to the amount of pressure. From 1477 till 1800 no important change was made, either in the principle or the form of Caxton's press.

Earl Stanhope, in 1800, instead of the straight bar and screw used by Caxton for producing pressure, devised a system of links and levers, the principle of which enters into every platen press adopted by the trade from that day until this. By Earl Stanhope's links and levers the approach and withdrawal of the platen were more rapid, and this rapidity at the right moment was converted into pressure. The pressure was sufficient and with a large margin, it was also under complete control and capable of adjustment. The press was made of iron, and not wood; indeed, great conveniences, as well as mechanical advantages, were, by Earl Stanhope, placed in the pressman's hands. In these days, dependent as we are, year by year, more and more, upon self-acting machinery, we are too apt to neglect a cultivation of skill in the artisan. In hand-platen type presses the skill of the pressmen is as essential to bring out the perfections of the press as is that of the copper-plate printer. Beauty and finish of work depend upon the combination of a perfect press and a skilled operator. Rotating and self-acting machines are extinguishing handicraft skill. Our sewing machines will not improve the domestic capabilities of the wives in the next generation.

Ruthven, at Edinburgh, in 1813, seems to have been the first to recognise the fact that stability was best secured by keeping heavy and moving parts as near the base as possible. He abolished the prolonged framing previously alluded to, with its suspended platen and guides, and incorporated the principles of Caxton and Stanhope in a new form of press. He also provided for a ready and accurate adjustment of the parallelism of the platen with the type, and an equable distribution of the pressure over the surface of the platen. This was accomplished by causing the Stanhope levers to act direct upon the margins of the platen, and not at the centre, as had been the case previous to his day. The press of Ruthven, to which allusion must again be made, does not seem to have won much favour out of Scotland.

The trade in London appear not to have adopted any change in the form in which Caxton and Stanhope had left the press until 1817, when George Clymer, an American, so changed the arrangements that an increased range was given to the operating handle and increased massiveness to the press. This he accomplished by attaching the platen to a massive lever by means of a square bar working in guides, which are now no longer parts of the original framing, but are fixed to it. He recognised the importance of a self-acting recovery of the platen which had been attempted with partial success by Blaew in 1601. This Clymer did by a contrivance which enabled him to place the American eagle in a proud position of supremacy—overlooking the printing-office.

The introduction of this press into the English market, and perhaps the American eagle so triumphantly displayed on its top, seem to have stimulated ingenuity, consequent perhaps upon a pardonable national jealousy. The result of this ingenuity was the introduction of a press known by the name of the Albion, designed by Mr. R. W. Cope. Here, also, the Stanhope lever principle is involved. In the Columbian this principle is carried out by means of links and pin joints—in the Albion it is applied by means of surfaced V-plates of steel. Viewed by the side of the Columbian, it may be said that for all ordinary work the Albion is light, the pull easy, the pieces few, the mechanism simple, the wear not destructively injurious, and the work rapid.

For some years the favours of the working printer were divided between the Columbian and the Albion presses. Such is no longer the case, and estimated by any other standard than that of the value of the old material, the Albion press is superior to the Columbian, and although professedly improved upon, even by its own inventor, yet the original type is still in high repute. The almost national competition between these presses in 1817 and onward, seems to have cast a shade over Ruthven's design. Yet, in a book published by Mr. Savage in 1822, entitled "Practical Hints on Decorative Printing," which, regarded as an example not only of the type-founder's art, but also of the character of the press and the skill of the pressman, is second to none produced in the present day, by what we consider our improved machinery, Mr. Savage writes:—

> "The Ruthven press possesses great power and many valuable properties, of which I can speak with much certainty, as the whole of the decorations in this work were printed with it; and if anything were required in its praise, it would only be necessary to state that the inventors of the two last new presses in use told me separately, that it was superior to every printing press excepting their own inventions."

A few of these presses are employed in Scotland, but not for that high-class work to which Mr. Savage alludes.

Omitting those advantages which may result from changes of form or disposition of parts, it may be broadly stated that since the days of Earl

Stanhope (1800) no new principle has been so introduced into the printing-press as to command a preference in the general market for those various purposes required in some establishments from one and the same machine.

Small and not unimportant contrivances were, doubtless, introduced. These may be passed by, with one exception, viz., that of Hansard, in 1817, who, under very different circumstances, anticipated an important feature in one of the most important machines of the present day. Hansard divided the tympan, and inserted a saw-like knife, which partially cut the paper, "the uncut parts adhering for the pressman to draw it off the tympan."

It must not, however, be assumed that men's minds acquiesced approvingly in the principles on which printing-presses were constructed, namely, a descending platen and Stanhope levers.

To William Nicholson, in 1790, that is, before the introduction of the Stanhope levers, we are indebted for the suggestion and application of original views. He discarded both the platen, the screw, and the bar, or lever by which they were moved, and introduced the principle of rotation, and, in some form or other, that principle has at intervals, since the aforesaid date, exercised the ingenuity of men.

Before entering upon Nicholson's suggestions and the consequences of them, it ought to be stated that a few years prior to his time, namely, between the years 1778 and 1782, James Watt had perfected a contrivance by which the steam-engine should give rotatory motion as well as rectilineal. This probably directed Nicholson's thoughts to schemes which display great originality as well as fertility in mechanical resources, and the fruits of which are still to be gathered in even greater abundance than hitherto.

A brief description of what Nicholson proposed may suffice to connect the present extensive application of this principle with the novel and ingenious suggestions of a man who laid a foundation on which others have so successfully builded.

In 1790, Nicholson gave to his mechanical arrangements for printing the name of "machine," for the contrivance had no similarity to that of "the press." Adopting the same mode of viewing machines as was applied to presses, it may be summarily stated that Nicholson originated a new system and introduced new principles. That these were not in his day carried out as a commercial success does not affect the credit due to him for the suggestions. Nicholson introduced a cylinder; he described taper types for attachment to this cylinder; he proposed that rolls of paper should be used instead of sheets; he planned for sheets round cylinders, and the types flat on a table; he smeared rolls (covered with "felt" or elastic material) with ink; he applied distributing rolls; he suggested and even contrived "grippers" that were self-acting, and took up and laid down the paper. Therefore, rotating cylinders, taper types, continuous rolls of paper, inking distributing rolls, and grippers were principles first introduced into type-printing machinery by William Nicholson, in 1790.

These distributing ink rollers were of the material of which the old inking balls were made, and they would, therefore, be not only offensive in use, but rapid in decay. The present generation of printers know nothing of these pelt inking-balls, and the modes of preserving them soft and elastic, with all the uncleanlinesses attendant upon their use, except from tradition; even the expressive proverb in the trade consequent upon these characteristics is probably forgotten.

In 1813, the same year as that in which Ruthven produced his press in Edinburgh, Bacon and Donkin, in London, seem to have had Nicholson's schemes before them. By a contrivance more ingenious than useful, viz., by approximately square wheels with teeth on the peripheries in gear, they tried to combine the platen of Caxton with the cylinder of Nicholson. One element of this curious machine has survived, and may be said now to be an essential to the trade. They introduced the treacle and glue rollers, which have abolished the pelts, with their attendant offensiveness. The early manufacture of them was entrusted to Mr. Harrild, a name still associated with the supply of elastic inking rolls. These rolls have not only rendered more sweet the atmosphere of the printing-office, but they have given increased facilities for the distribution of ink and application of it to the type. Hence the printer can use thinner ink, and, consequently, he has less personal labour, and increased rapidity in production as well as drying.

No machinery embodying the chief features of Nicholson's plans was made and used until Kœnig spent time and capital between 1810 and 1814 in producing a machine which, although a marvel of ingenious complexity (there were forty wheels in the inking part alone), yet won from the proprietors of the *Times* newspaper on the 29th November, 1814, a eulogium in terms so complimentary as to leave no doubt how welcome to the people generally were any advances towards economy and speed in type-printing arrangements:—"Our journal of this day presents the practical result of the greatest improvement connected with printing since the discovery of the art itself. The reader of this paragraph now holds in his hand one of many thousand impressions of the *Times* newspaper which were taken off last night by a mechanical apparatus. A system of machinery almost organic has been devised and arranged, which, while it relieves the human frame of its most laborious efforts in printing, far exceeds all human powers in rapidity and despatch." The machine to which the foregoing remarks were applied printed about eighteen copies per minute!

The success of Kœnig's multifarious ingenuities was not likely to pass long unnoticed and unimproved. In 1816 Cowper obviated a difficulty which in its early stage Nicholson surmounted by means of taper type; he stereotyped the flat form and then bent the stereotype plate round a cylinder, and so used it for printing purposes. Condensation in narrative is imperative, and therefore Cowper's early efforts, which must be well known, need not be recapitulated, with the exception of stating that to him the trade is indebted for a successful adaptation of the "tapes," to which allusion shall again be made, although modern fashion is giving a preference to "grippers."

In 1818, Mr. Cowper associated himself with Mr. Applegath. The latter had been a calico-printer, at Dartford, in Kent. By their joint efforts

various changes, both in form and construction, took place, and the previous occupation of Mr. Applegath accounts for the introduction into printing machinery of contrivances derived from those other machines with which he was familiar.

The joint labours of these men produced a machine which displaced the Kœnig one that had won such praise. This machine consisted in a simplification of parts, and the introduction of small matters, which in all machinery are as important as the horse-shoe nail in the well-known nursery story.

On the 14th of February, 1828, the *Times* published its highly complimentary valentine to Messrs. Cowper and Applegath, in the following terms:—"The first machine printed but eleven hundred sheets per hour, the reader now holds in his hand an impression which a new machine has yielded at the rate of forty hundred sheets per hour"—*i. e.*, nearly 70 per minute. Mr. Applegath, either jointly with Mr. Cowper, or on his own account, obtained between 1818 and 1851 fifteen patents relating to improvements in printing machinery. Viewed only, as in this paper, in the broad outline of the introduction of novel principles, further remarks on the various and useful contrivances introduced by these men are not needed.

The success of Kœnig, Cowper, and Applegath, building upon the foundation laid by Nicholson, directed the attention of printers to cylinder machines.

In 1835, Sir Rowland Hill revived a proposal of Nicholson's, which probably the fiscal regulations in relation to newspapers had compelled others to set aside; for Mr. Applegath is found suggesting the use of rolls of paper large enough to print 500 or more of the *Times* if only "the Commissioners of Stamps grant a concession as to stamping." Sir Rowland proposed "modes for printing from continuous rolls of paper similar to those practised for printing pieces of calico in cylinder machinery."

He also described a plan for separating the continuous roll into sheets, which, although not adopted by the printer, is utilised by the paper-manufacturer.

From 1828 until the present time the platen press and cylinder machine have been subjected to changes which, if not introducing new principles, were intended rather to quicken the speed of production, and render easier the duties of attendants, than to improve the quality of the work, or develope the skill of the pressman. One or two of these may be named—

Between 1830 and 1837 Mr. Napier endeavoured, amongst other plans, to combine a true platen action with the general outline of the cylinder machine. It should be stated that Mr. Andrew Spottiswoode and Mr. Brown, about 1829, first applied steam power to platen presses, and it may be regarded as an open mechanical question whether the quality of our typography would not now have been of a superior type had ingenuity followed Mr. A. Spottiswoode, rather than Mr. Nicholson, so long as sheets and not rolls of paper were used. Of this early and first attempt to convert the hand press into a power machine, it is reported "that the work done by it was as excellent as by hand—with four times the speed and great uniformity in colour."

In 1833 John Kitchen, of Newcastle-upon-Tyne, so altered the form and arrangements of the platen press that it could not only be worked upon a rotating scheme, but he introduced other features which, within the last few years, have been reintroduced among us as novelties from America. These may be briefly summed up as placing types upon a flat, vertical surface, using means for regulating the temperature of the ink, and employing the "fly" which delays the too rapid striking of a clock to the delaying of the inking rollers as they descended over the vertical face of the type. Thus, in 1833, is presented that form of platen machine which in 1873 is bidding fair to occupy a useful place in the printer's room.

There is now such novel mechanical relationship of parts in these new presses, that whilst to Mr. Kitchen the trade is indebted for the general features and design, it must be admitted that many of the contrivances in his machine have given place to others. To secure parallelism with a vertical type form in the approach and recess of a platen actuated by Stanhope levers, and moving upon a rotating axle—to convert speed into power at the required instant, and to leave it as speed when not so required—to distribute the ink on a table nearly horizontal—to keep it always thin—to transfer it to a vertical face of type, so as to leave not more than about one quarter of a grain in weight of ink on an octavo page—to so balance all the moving parts that the workmen at the rotating handle or traddle shall be unconscious of increased exertion at any phase of the cycle—these are problems for mechanicians yet to solve, and they who succeed should combine in the machine a maximum of strength with a minimum of material.

Traddle worked platen printing machines are well worthy of the attention of the trade. Although they have not hitherto been arranged for large sheets, there does not appear to be any mechanical reason why they should not be. The entrapping air in a platen, and not in a cylinder machine, is not worthy of consideration as a serious obstacle. Doubtless time, ingenuity, and experience will be brought to bear, and we shall yet see in the traddle press strength combined with lightness—speed of production with simplicity of mechanism—webs of paper with platen action, and ease of traddling with a careful balancing of the moving parts.

The repeal of the stamp upon newspapers in October, 1861, and that of the duty upon paper in the same year, liberated both mechanical ingenuity and newspaper, as well as publishing, enterprise, and from this date the allied trades of the paper-manufacturer and the printer entered upon new forms of life.

So far as the machinery for type-printing is concerned, the enterprise of those engaged upon the daily press stimulated both invention and improvement. In 1862 the Hoe and Bullock machines were introduced. By the former, as erected by Sir Joseph Whitworth for the use of the *Times*, sixteen thousand were printed per hour; the maker of the Bullock claimed eighteen thousand. Rapid indeed have been the changes brought into the newspaper printing-room during the past ten years. Foremost in promoting these with deter-

mination and perseverance, regardless alike of cost, of labour, of patience, and of failures, must the proprietors of the *Times* newspaper be ever gratefully remembered by all who acknowledge how large is the debt society owes to the periodical literature of the day. But the Kœnig, the Cowper, the Hoe, and the Bullock have already passed away. The Marinoni, the Walter, and the Ausburg (very like the latter) have succeeded them. To look at these machines of the present day and to trace their descent from the Nicholson one of the last century, would prove an entanglement as complicated as that which they attempt to unravel who labour to trace a human mechanism of a far higher development to a source which has its origin in prehistoric times.

The requirements of the daily newspapers and periodic literature were so fully and urgently present to the minds of mechanicians, that little thought was bestowed upon machines as substitutes for the press in the higher class of bookwork. True, since 1862, many machines have been made for the printing of books, and are now at work. Their very variety and the frequent alterations of portions of them show how first one failing and then another presents itself.

Some of these failings are inherent in the machines; others are unsuccessful efforts on the part of the mechanicians to meet expressed requirements on the part of the printer.

If paper on a cylinder is caused to roll in contact with type on a horizontal travelling-table, the motions of the two for good printing must be strictly accordant. Toothed wheels and racks cannot accomplish this, even though the teeth are of the true involute form which the necessities of the case require for speed. The clearance requisite for the action of the teeth must tell upon the strictly equable motions now under consideration. The attempt at a remedy by double and treble racks, with teeth set in advance one-half or one-third, distributes, but does not destroy, the ill-effects.

So far as relates to the travel of the table, when derived direct from the prime mover and not actuated by the printing cylinder, a double or treble square-threaded screw may meet the requirements of steady and smooth motion in it. If, however, motion is given to the printing cylinder through the agency of one or more racks fixed on the margins of the table, the requisite strictly equable paths are not had. Till toothed gearing is removed from these connections, it may be said that the highest class of type-work cannot be secured by the machine. It may be worth consideration whether motion might not be communicated from a reciprocating table to a reversing cylinder by means of ribbons of steel, the attachment to the table being by adjusting and tightening screws so as to bring the steel ribbons to the required tension.

As a mechanical contrivance for converting the circular motion of a prime mover into the rectilineal motion of the table, a crank is sometimes used. This is fatal to theoretical perfection in typography, whatever may be the connections between the table and the cylinder. The variable rate of travel in guides of any framing, actuated by a link connected to a crank causes the paper and type to be in contact for varying times, and therefore a variation in the quantity of ink deposited on the same sheet must result. Contrivances have been employed to render uniform rectilineal motion resulting from crank action. Even when this uniformity has been secured, during the contact of the paper and type, it has not commended itself for frequent imitation. Main, in 1850, considered that, from the action of a crank, he had obtained equable motion. His contrivance is still in use, but, with all deference to the judgment of others, it will be found to be retained more because of the simple mode of gaining speed than of any equable and uniform motion resulting from crank action.

A type-printing machine, to be perfect, should have in it the means of varying, not only the duration of contact in any part of the travel between the paper and the type, but also that of the pressure in any part of the travel between the cylinder and the form. These should be accomplished without throwing needless strain upon the machinery, or prolonging the contact by retarding speed in consequence of the introduction of a sudden addition of useless resistance.

To link and cam motions and combinations, especially the former, we must look for means to accomplish these aims. A link motion already exists by which the duration of contact between the type and paper may be delayed or accelerated in any part of its travel, or for any, even a brief, period of time. The contrivance, however, will need the exercise of some ingenuity to adapt it to printing machines. It is also quite within the power of the mechanician to arrange for a variable pressure, although, perhaps, some may think that the thickening of the blanket or its equivalent meets all requirements, and is so sufficient and simple, that where a number of impressions have to be taken no better plan need be sought. Hydraulic pressure might be introduced; it is simple in application and easy of regulation. What actual pressure is required on the bearings of printing cylinders has not been determined. That it is great may be inferred from the pressure on the platen, although in the cylinder only a few lines of type are under operation. If this be the case, it will behove both the mechanic and the printer to bear in mind that about one thousand pounds per square inch on the bearings will force out the lubricating material, and, consequently, the journals and brasses will be damaged. The remedy is very simple. Make the journals long and of large diameter.

The flyers or fingers which perform so important a part in newspaper printing machinery have, it is to be feared, shut out an improvement which retailers of newspapers would gladly see adopted. A question will suggest the whole matter. Why cannot the daily newspapers be delivered folded as the weekly ones are? Folding machines are both self-acting and rapid, and might receive the sheets direct from the type; the distributing arrangement, as in the "Marinoni" machine, might, if requisite, be multiplied, and as many folding machines employed as the rate of delivery required. Another question may be the most becoming form in which to offer another suggestion. Why should not the cutting arrangement which causes the peculiar undulation at the bottom of the *Times* be used to perforate, but not separate, the fold at the top of the page, and so render easy the division of the sheet by the reader?

Where reciprocating motion is to be be combined with speed, a mechanical postulate may be laid down thus—let it be granted that reciprocation should be in light machinery. This is clearly ignored in printing machines, where a heavy table, loaded with heavy type, is to be brought to rest and have the direction of travel reversed some hundred, nay, thousands of times per hour. Jar and its attendant—noise—both indicative of a waste of power, and therefore of waste of coals, and therefore of waste of profit, are manifest to all. They further indicate destruction of machinery, and damage to the building in which it is. Until machine printing can be conducted with the same peaceful silence as hand printing, the noise should be regarded as a cry for improvement.

It may be mentioned that these are the elements in type-printing machinery which render the owners of good buildings unwilling to permit cylinder machines to be erected on the floors; these, therefore, are the elements which condemn that numerous class of men who are engaged in printing popular literature to spend much of their time in subterranean, if not unhealthy, cellars in our large towns.

The tendency of cylinder printing (viz., to move the paper and type by jerks) necessarily interferes with the beauty and clearness of the type as produced by the maker, and this the more as the fount of type is small and the speed of printing great. Very high speed is a specialty of the daily press. It is therefore somewhat inexplicable why a large portion of the daily papers is occupied by a type smaller than that used in the weekly or monthly serials. Is it to compensate for the frequent illegibility of this cylinder-printed small type that, in a truly patriotic spirit for the diffusion of knowledge, placards in a type which one illiterate as a child or blind as a man without his spectacles can read, are so freely distributed? The numbers are not few who are contented with these placards, knowing that further details are beyond their easy ken. As one who has thus been at times compelled to "rest and be thankful," let me express gratitude to those who in this way, without fee or reward, give information.

In 1786, a person named Henry made compound stamps. These could be separated, inked in various colours, re-united, and then printed. Clearly one pull of the press could easily take off as many colours as the face of the stamp had parts. This effort of ingenuity lay dormant until 1819, when Sir William Congreve, adopting and materially improving the proposals of Henry, arranged for printing (type-wise) a new description of work which would "throw great difficulty in the way of forgery." The suggesting of but one use of the process seems to have prevented the realising of its value for purely ornamental purposes. There is no reason why the type printer should not, in book-work, introduce what would enable him to print at one motion of the platen or cylinder on the same side of the sheet at the same time in two, three, or even more colours, a page which, for beauty of ornamentation, might not only vie with, but surpass, much now considered as specimens of superior artistic work, and which have been more than once passed through the machine.

Mr. Deacon, on behalf of Messrs. Whiting, has (I understand) improved upon Sir William Congreve's process which, in 1819, is described as "a hard metal pierced in fillagree, softer metal poured in. When separated, after a joint engraving upon the two, each may be inked, and then united so as to print different colours."

This operation of duplex, or even of triple, colouring and one printing, may be carried on at the same time by one machine. Ornamental coloured margins, rubrical letters, pages with compound coloured type, are all within the compass of it, and the difficulty of register on a page to be printed with ornamental border lines is obviated. Sir William's plan was at one time in use at Somerset House for coloured stamps on country bank notes; it was also employed in the stamp, as many will remember, when duty was levied upon paper.

The abolition of the duty on paper not only led to the introduction of new materials, but also to great variety in texture. Cowper and Applegath dealt with paper in their machines as Izaak Walton advises fishermen to deal with worms when placing them on hooks. "Handle them," he says, "as if you loved them." Their tapes carried the paper without much strain from tension. The improvement, or rather re-introduction, of grippers by Smith, in 1835, treated paper very roughly. It was dragged and pulled, instead of being gently handled.

It must be borne in mind that paper is a felted material, not only of naturally short fibre, but of fibre rendered even more short by the manufacturer's process of "pulping." This clearly damages and partially destroys the *cohesion* of many of the molecules of the fibres. Again, although "felting" shows that the *adhesion* of the separate fibres is sometimes very great, yet they are not, as in a thread, united by twisting to resist tension. Further, the printer damps his paper, and thereby relaxes the adhesion of the fibres. Thus the manufacturer and the printer destroy the cohesive and adhesive forces, and then, either by the suspension of weights or by the tension of pulls, they exhibit the qualities that have survived their injurious treatment as evidence of the strength and goodness of the paper. They try to neutralise, and that which they fail to destroy is triumphantly appealed to as a proof of success.

Surely physicists and chemists might be pressed into the service of paper manufacturers and printers. If the introduction of glycerine into the pulp of printing paper cannot enable the latter to dispense with damping, other suggestions may be more successful.

Consider the usual practice. Paper is laid in damp bundles, grippers seize a sheet by the edge and drag it along, however much it may cling, owing to the damping, to the lower sheet, even though attempted to be relieved by a lifting bar, as the Japanese do, under somewhat similar circumstances, with a bamboo cane.

When paper in rolls is used the effect of this dragging action is not only injurious but prohibitory of a high class of work. In the Walter machine, the damping takes place after the heaviest part of the dragging is over. If machines are to produce first class book work, with rolls of paper three or four miles in length, they must be dealt with more gently, and fed to the machine, and carried through it, without tension. In cotton machinery

a similar difficulty presented itself, and the injurious effect of tension on the thread, in all stages of its manufacture, is obviated. It may be well to state that in Houldsworth's bobbin motion the printer has a complete and perfect apparatus, which can feed paper off rolls uniformly, even though these rolls are of very rapidly decreasing diameters. Therefore in the introduction of paper to the printing machine there need not be any tension. It is clear that under such circumstances as are now described, viz., tension on a damped felted material, a high class of book work cannot be produced; indeed the register cannot be preserved.

For that class of bookwork which may bear creditable comparison with some of the best work of the platen-press in former years, and on a high quality of paper, it is clear that small cylinders must be dispensed with. Bending, damping, coiling, dragging necessarily damage not only the texture but the surface of high-class paper, and thus, if in no other way, take from the finish of the work.

The failure of schemes to fix moveable type on a cylinder has prevented continuous and compelled the introduction of reciprocating motion. Now that web paper is being more introduced, it is to be hoped that failures may cease. It is to be further hoped that paper manufacturers may not needlessly destroy the amount of cohesion in the raw material, but that, taking hints from Japan, paper may in England subserve those purposes to which in that country it is applied; as, for example, the making of pocket-handkerchiefs, umbrellas, underclothing, and waterproof-coats. May not this hope, too, be entertained, that by some contrivance reciprocating motions may be discarded from printing machines, damping dispensed with, and paper of a superior quality and finish not injured by the printer?

DISCUSSION.

Mr. Ellis Davidson would like to ask whether the Society could not add to the many benefits which it had already conferred upon the public and the working classes in general, by getting together something like a collection of the works turned out by each of the presses which had been described. There had probably been certain special features in each class of printing done at different periods, and he had no doubt that specimens of the work done by each machine could be found somewhere, so that by having these specimens the difference of each kind of work produced by the different machines could be seen, and also the particulars in which they had failed or succeeded. There was also a Patent Museum, though it was not so useful as it ought to be, where no doubt would be found either models or actual machines, and thus men would be able to build up in their minds a series of presses from the machines they saw there; and, secondly, from the work produced by each, see what its excellencies and defects were. He thought such a paper as they had had that night would bring about a practical result. A great many inventions had been produced by men who not only saw what ought to be done, but who every day of their lives suffered from obstacles in their machines which up to the present had not been overcome, and these would be the best persons to suggest the remedies required. When the technical education of the working men was improved they would not only be able to understand what they wanted, but to give some suggestions to the scientific engineer how the improvements should be carried out. To show the interest taken by the working printers of London in this subject, he might mention that when Dr. Rigg gave two lectures a year ago at the Stationers'-hall, the working men came by thousands to obtain information.

Mr. H. T. Wood asked if it was quite correct to say that in presses used during the present century the sheets were laid on twice and twice pulled? Was it not rather that the sheet was once placed, though it received two separate impressions? He also thought it might be questioned whether the excellence of the work did not depend as much on the skill of the workman now as in the days of the old hand-press; that skill being displayed, not so much in the mere pulling of the press, as in the preparing, or "making ready" of the type which had to be very carefully attended to, even in the best machines. As allusion had been made to printing machinery in the Patent Museum, he might mention that he had found, in going through the catalogue, that there was not a single printing machine of any kind in that museum, or, so far as a cursory inspection could be trusted, a single instance of any invention connected with the art of printing.

Mr. Conisbee had listened with great attention to the lecture; but with regard to the names of inventors, mentioned by the lecturer in the early part of the paper, he should like to ask how many of them were known to the trade? Reference had been made to the platen printing press and double impression, and he knew that the old Stanhope press did require a double impression on one side only, and he also knew what modern machines meant, and was prepared to maintain that they now produced impressions quicker, and even better than were formerly produced from the old Stanhope press. With reference to cylinder machines, the lecturer had said that such good impressions could not be produced as from a platen press, but he maintained that they could; and he thought they were all indebted to the rotary printing machines, especially for penny and halfpenny papers. He had been a partner with the late Mr. Main, and knew what that gentleman had done towards improving machines. Applegath produced the vertical cylinders; then came Bullock, and Nicholson (an American), who taught the *Times* how to produce the Walter press. He ventured to say that not only plain but coloured printing, on a continuous roll of paper, could be produced with the wheel and pinion on a cylinder machine, although it had been stated otherwise. He had produced and patented a machine which would accomplish this, and, in fact, he believed that more could be produced from the cylinder and table than had ever been done by the hand-press.

Mr. Judd begged to endorse to a great extent the remarks of the preceding speaker, but he wished to add an expression of thanks to Mr. Rigg for his interesting paper. Practical men owed a great deal to scientific gentlemen who studied these matters quietly and theoretically, and then gave the result of their investigations to the world, but it did not appear to him that sufficient credit had been given to the rapid strides which had recently been made in those points to which special reference had been made, viz., the beauty of cylinder-machine work as compared with platen. The fact was that of late the "Wharfdale" and other machines familiar to practical men had been introduced, in which many, if not all the difficulties referred to as incidental to cylinder machines had been overcome, and not only colour-printing, but perfect register and beauty of finish in every way had been attained fully equal to anything turned out by a platen press. And if so much had been done during the last ten years, what might not be expected in another period of equal length? If so much had been already attained, he saw no reason to despair of those who were even now going down the hill of life

seeing very much that was still desired before they reached the bottom. Like all who were connected with printing, he had felt the inconveniences to which allusion had been made—the noise, the wear and tear, and so on—but even these had been largely overcome, and no doubt would be so to a still greater extent. Of course, no one could complain that the paper had not dealt with matters which did not come within the scope of the writer. but, still, he felt that there were many other improvements to which allusion might have been made. In fact, the number of machines now in use was almost bewildering, and he thought practical men would be much indebted to scientific gentlemen like Mr. Rigg if he would point out the mistakes which had been made by recent inventors and where they had attempted impossibilities, so that attempts which were really useless might be eliminated. He spoke feelingly, because of the varied experience which he and many others had had in attempting to introduce machinery, which the inventors always guaranteed would do everything that was required, but which did not always turn out successful in practice.

Mr. T. Wright, while he agreed with Mr. Judd, that practical men would be greatly benefitted by the suggestions of scientific mechanicians, thought it of great importance, in the first place, that the latter should know to what particular points it was necessary to direct their attention. He had been practically acquainted with printing all his life, but it was quite new to him to learn that "a type printing machine, to be perfect, should have in it the means of varying, not only the duration of contact in any part of the travel between the paper and the type, but also that of the pressure in any part of the travel between the cylinder and the form." He believed there were many other matters, to say the least, of much greater importance, and that practical printers would be quite content if they could secure a perfectly even pressure and regular motion.

Mr. Dipnall said, the reader of the paper had made some very just observations regarding the defects which existed in the daily papers, owing to the extreme rapidity with which they were turned off. The *Times* turned itself off on a very beautiful material, but he found it very incovenient to read in the evening, in consequence of the blurring appearance it had, sometimes more so than the penny papers. It was suggested that newspapers should be perforated, so as to be cut easily, and he should also like to have his *Times* folded and pressed, so that the paper would have a smooth face, like that used for books, but probably it was impossible, at the railway speed with which papers were printed, to turn them off with a perfectly agreeable and uniform surface.

The Rev. A. Rigg, in reply, said the point of view from which the paper was written, was that of perfection of typography. He admitted the marvellous perfection which had been attained with respect to the rapidity of newspaper printing, but the like perfection had not yet been attained with regard to book printing. He understood that the very best printing was done in France by cylinder machines, whereas in England it was done by the platen. He spoke, of course, under correction, but he believed that no English type founder who wished to get up a book of specimens illustrating the beauty of his type, would think of having it printed by a cylinder machine, but he would have recourse to a platen. He had purposely omitted bringing forward any names likely to affect the present generation, or any remarks which might appear to recommend one modern machine as better than another. With regard to the statement that the sheets were printed twice on the Stanhope press, he could only say that he had made it on very good authority, as would be acknowledged if he were at liberty to mention the name.

Mr. Conisbee said the statement was quite correct.

The Rev. A. Rigg said it was, no doubt, the fact that beauty of the work depended on both the workman and the press. A good pressman could not produce good work with a bad press, nor could a bad workman produce good work with the very best press. Cylinder machines, hitherto, had been regarded in England more with a view to rapidity than to finish, and this latter point, he thought, required more attention. There could be no doubt that some of the best printing ever produced had been done on the old Stanhope presses. One gentleman had suggested to him about as thankless an office as could be conceived, that of informing inventors that their productions were not mechanically correct, or likely to be commercially successful; he was quite sure that any one who tried that once would never do so a second time. With regard to variation of pressure and speed in passing the form under the cylinder, he had been informed by a practical printer that this was a want which he should be glad to have supplied; for he explained that there were certain portions upon which it was very desirable that there should be increased pressure; also that there were certain parts, such as wood-cuts, which required a larger amount of ink. He had looked at the subject from a scientific point of view, and science seldom considered the question of commercial profit. Commercial people must adopt scientific suggestions, and obtain a profit from them. Scientific men were not those generally who engaged in commercial enterprises. It was a very remarkable fact that in France the best book-work was done on cylinder machines, whereas, in England, it was only entrusted to platen presses.

The Chairman thought they were all indebted to men like Mr. Rigg for bringing forward such an interesting subject. People in general bought their penny newspapers and read them without thinking how the work was done, and forgot the enormous amount of mental labour and research which hundreds and thousands of persons had gone through to produce the requisite machines. To have the history of such an invention as printing brought forward would, he thought, be of great benefit to all. Mr. Davidson's suggestion that the Society should collect specimens of the styles of printing was a very good one, and though it was rather a large undertaking, if the Society were supplied with the necessary funds they would be happy to do it. Mr. Davidson had said they had a Patent Museum, but he denied that altogether. He knew there was an old lumber room at South Kensington where might be found some very interesting machines. If they had them in America palaces would be built to exhibit them in, but England was content to leave them in a room which was a disgrace to the country, and he hoped everyone would bring their influence to bear in removing such a national scandal. The collection which Mr. Davidson wanted formed would be a most valuable one, and well worth a large expenditure. In conclusion, he proposed a hearty vote of thanks to Dr. Rigg for his valuable paper, which was carried unanimously.

CANTOR LECTURES.

The third lecture of the second course of Cantor Lectures for the session, "On the Chemistry of Brewing," by Dr. Charles Graham (University College, London), was delivered on Monday evening, February 2nd, 1873, as follows:—

Lecture III.—Mashing.

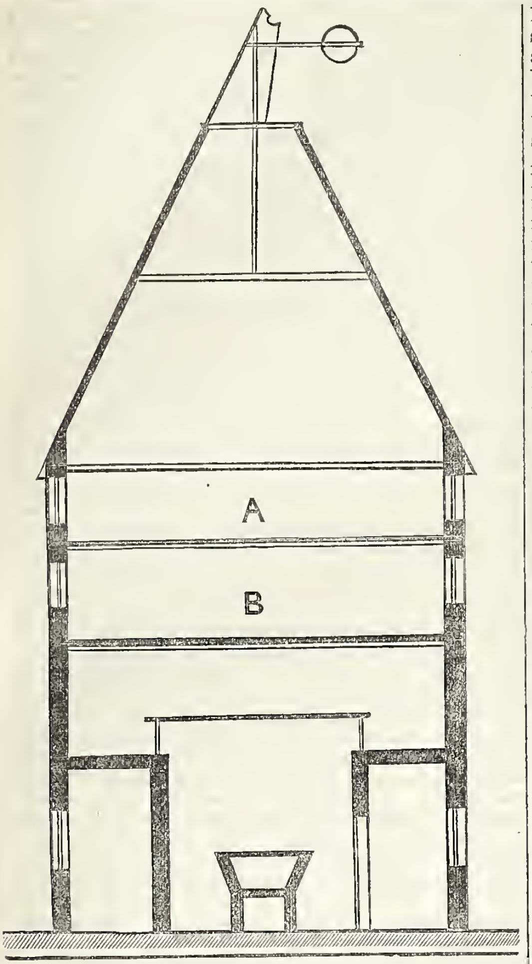
Those of you who did me the honour to attend our last meeting, when the subject of our study was malting, will perhaps remember that I laid especial stress upon

the breaking down, as it were, of the albuminous bodies in malt; and I pointed out to you that while albuminous matter was itself breaking down, it in some way or other caused the breaking down of the molecular structure of the starch of the grain, and in that process changes were preduced. The insoluble starch was converted into soluble dextrine, and into sugar; there was in addition carbonic acid and heat produced in the germinating process. I then pointed out to you that this aetion went on still more vigorously at higher temperatures, and suggested that the English proeess of drying malt, while it was still saturated with moisture, for so long a period as from two to three, four, or even in some cases five days at a temperature higher than 100° Fahr., was certainly a source of great injury. In reference to this point, it occurs to me that I did not explain one of the points which I drew your attention to, viz., the use of two kiln-floors. First of all with reference to these drawings, which Mr. Scamell was so kind as to prepare for our use, you see the nature of the foreign system of malting on the extreme left, where the drawing represents two kiln floors, marked upper and lower. I believe this is a drawing of an actual malt-house, erected by Mr. Scamell in France, but here are some other drawings which are taken from the very valuable and useful book on brewing, Heiss' "Bierbraurei." You will see the two floors that I was speaking of more plainly, and the point I particularly wish to call your attention to is this. A very able brewer who was present on a previous occasion misunderstood my remark as to the use of these two kiln-floors, and thought that the steam arising from the malt on the lower floor went up through the interstices and came in contact with the malt lying on the upper floor. But such is not the case. The Germans take especial precautions that the steam arising from the still moist malt lying on the lower kiln-floor shall not come in contact with that on the upper; and that is done, not by allowing the products of the combustion of the coal or coke to come in contact with the malt, but by making these products heat air, and by a current of air supplying the heat necessary for the drying of the malt on two floors. In this drawing there is a representation of this method of drying malt; the red lines indicating the channels by which the products of combustion pass off, and the others those through which the air itself is warmed. That warm air comes in contact with the malt; the products of combustion do not; and the air, after it has dried the malt on the lower floor, passes out through the main flues and does not come in contact with the malt on the upper floor. I pointed out that the malt is first of all placed on the upper kiln-floor, where the temperature is lower, and then, after being dried to a certain extent, it is allowed to pass down on to the lower floor where the temperature is about 165° to 170° Fah. We learnt, putting aside the very important uses of the empyreumatic substances produced in the kiln-drying process, that the main object of malting was the production of the peculiar albuminous bodies which have been grouped together under the term diastase. I pointed out to you that while this may be a convenient term, still there is no such peculiar property due to the albuminous matter of the malt, but it exists in other animal and vegetable products.

Such I told you was the main object of malting; now the subject before us this evening, viz., the subject of mashing, depends on the action of these soluble albuminous matters produced in the germinating process; and this leads me, before I go any further, to remark upon one very important difference that exists between what is called wine must and beer wort. The wine must or juice of the grape is left, as you know, to ferment spontaneously; it is not boiled, cooked, or treated with anything, but is left entirely to itself, and so the wine is produced. Beer wort, on the other hand, differs from the expressed juice of the grape, inasmuch as it has a gummy or tenacious substance in it; further than that, it contains albuminous matter in a tolerably large quantity. Therefore the liquids which are produced, viz., wine and beer, differ to this extent. Of course they are both alcoholic, both are produced from sugar, and to a certain extent they both contain acids, including carbonic acid (of course I am including at present the effervescing wines), but still there is this marked difference in wine, that there is no gum or dextrine, and the whole of the albuminous matter, or nearly the whole of it, is got rid of during the process of fermentation. This most important process of mashing which is carried on by the brewers, depends upon the property which the soluble albuminous matter called diastase has under the influence of moisture and heat upon starch. Roughly speaking, this diastase has the power of converting about 2,000 times its own weight. Of course that very much depends upon its own activity, and upon the temperature. The theories which have been broached from time to time as to the action of diastase upon starch have been very various. First of all, taking the opinion of Mülder, to whom we are greatly indebted for researches carried on some years ago with reference to the chemistry of brewing—he supposed that the action of this soluble albuminous matter was to convert the starch into dextrine in the first place, and then afterwards to convert some of that dextrine already formed into sugar. Of late years, Schwarzer, the German chemist, has also, at any rate to a great extent, made the same assertion—viz., that dextrine is first of all formed, and then afterwards converted into sugar; and I ought to say that he states that at temperatures above 65° to 70° Cent. the ratio of glucose to dextrine is as one to three; whereas below 60 Cent., that is below 140° Fah., the ratio is about equal—viz., one glucose to one dextrine. Muschylus, on the other hand, in writing upon this subject has concluded from his researches that three parts of starch, when thoroughly acted upon by diastase, produced two of dextrine and one of sugar, or to put it into more chemical language, from three molecules of starch one obtains two of dextrine and one of sugar. Within the last year or so, though I am sorry to say I have only heard of it within a very short period, Mr. Sullivan, the very able scientific adviser of Messrs. Bass and Co., has from his own point of view studied this subject, and he asserts that there is no dextrine formed at all, and that there is no glucose formed at all; in other words, that the assertion of the other chemists that there was so much glucose and dextrine in this or that ratio is not really the truth. I shall have occasion this evening to see how far the experiments I have been carrying on during the last two or three months support his view, or how far they may support the view of Schwarzer or Musculus. This soluble albuminous matter, which is an active agent in all these cases, is by long digestion dissolved out in greater quantity from the malt at low temperatures than at high temperatures, and the temperatures at which one may say practically the solution is most complete is between 100° Fah. and 140° Fah., whereas the temperature at which it is most active in converting the soluble matter formed—no matter what you call it—into a more sugary or saccharine liquid is higher, as we shall see.

We shall have to notice that at low temperatures the dextrine is decidedly produced along with the sugar, and then, as the temperature gradually rises, we obtain more and more of the sugar, and we shall finally arrive at a point at which this action upon dextrine can go no further—at least not in these experiments. Before, however, taking up these theoretical points, I will first briefly describe the methods which have been adopted by practical men, not only in our own country, but also abroad, in this process.

First of all, as to the English, which is a process of infusion; while the Continental methods are in the main—or at any rate the Bavarian—methods of decoction, or cooking, or boiling; and we shall see in what they differ. First, then, as to the English. This is of course preceded by a process by which the malt is cracked, although I

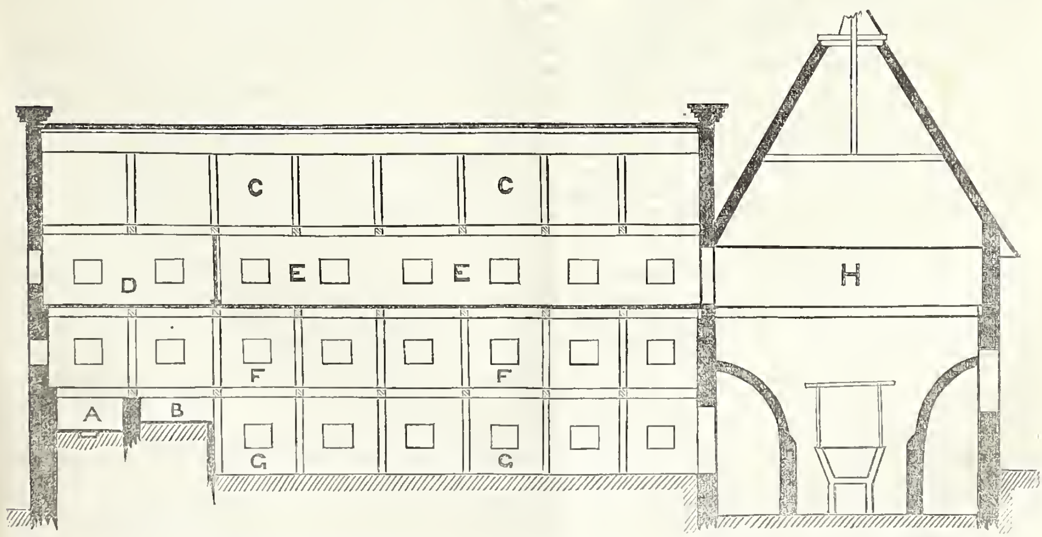


A, Upper drying-floor. B, Lower drying-floor.

FRENCH KILN.

have had occasion myself to notice that the malt comes sometimes from the roller not perfectly crushed; and now and then one comes across a grain which has not been so broken, and I prefer, therefore, with the Germans, and with some in our own country, to have the malt somewhat more ground—not necessarily fine, but still so much so as to ensure the perfect solution of the contents. After this has been done it passes down through a hopper into the mash-tun. The old process was, that it fell down into the water that had been originally placed in the mash-tun; but the more recent method is that the malt comes in contact with hot water at a temperature consonant with the brewer's notion of what is right, and afterwards falls, along with the water, into the mash-tun. There are many forms of these mashing machines. They are small Archimedean arrangements, of which Steel's and others may be taken as examples, and they certainly are most valuable in their action. One attains a thorough mixture of the malt with the hot liquor, and then it lies in the mash-tun at a temperature consonant with the brewer's particular views about mashing. The temperature of the liquor which is mixed with the malt varies between 160° and 175° Fahr., in some cases even more. The variation of temperature, however, depends upon several conditions. First, as to the amount of radiation that may take place from the mash-tun itself; secondly, as to the specific heat of the malt used, because this varies in different malts; and, thirdly, as to the particular class of ale which is to be brewed. If it be a strong ale, less hot water will be used than if it be a weak one. Lastly, we shall have to notice whether a thick mash is better for the extraction process than a thin one; so that temperature depends upon these different points.

The English process, as I have said, depends mainly upon using water at a tolerably high temperature. It is characteristic of the English method of infusion that there is a high initial temperature; and I have here a table showing the action, after three hours, of water used at a temperature so high that at the moment of the mash falling into the mash-tun it was 150°. 160°, 170°, and 175° Fah. When the temperature of the water was such that in the mash-tun the malt combined with the water would, after the one had given out the heat to the other, be 150°, we find, after carefully examining the result, that the weight of extract obtained from 100 parts by weight of malt was 69·5, and the draff, or insoluble matter, 23·16—the draff was dried at the temperature



A, Cistern. B, Couch. C, Barley store. D, Screens. E, Malt store. F and G, Working floors. H, Kiln.

ENGLISH MALT HOUSE.

of 130° Cent.—the grape sugar or glucose was 30·5, and the dextrine or gum 34·1 When the water was used at such a temperature that the initial mashing heat was as high as 160° we find that the glucose or sugar has been reduced to 29·4, and the dextrine has been slightly increased. In the determination of the dextrine, however, there is a small quantity of soluble starch—it is not all dextrine. Then, still further exaggerating the case—because, in order to see the true bearing of any determination, one must always carry the experiment to an extreme point—in exaggerating the temperature and bringing it up to 170° in the mash-tun, one finds the sugar is reduced to 20·79, whilst the dextrine and soluble starch together becomes 41·13. Still further exaggerating the process—because I do not mean to say that anybody in England uses such a temperature—the sugar is 15½.

English Infusion Process of High Initial Temperature.

	140° Fah.	150° Fah.	160° Fah.	170° Fah.	175° Fah.
Wt. of Ext. per cent.	70·00	69·75	69·00	67·25	—
Draff ,, ..	22·28	23·65	23·96	24·39	—
Glucose ,, ..	33·35	30·50	29·41	20·79	15·62
Dextrine ,, ..	32·50	34.11	34·33	—	—
Soluble Starch ,, ..	none.	trace.	small quantity.	41.13	—

Therefore, we see that the higher we go the less sugar is there in the extract, and there is still more unconverted starch. After this infusion has gone on for two and a-half or three hours, as the case may be, the thin extract is run off, and if the temperature originally had not been too high, that extract may be tolerably clear. This particular temperature, in brewer's language, is called the tap heat; and brewers speak of their tap heats, and all attach very great importance to them. But it is not long since I was speaking to a very able brewer, who said to me, "You may have your theory of this way and the other; all I can say is this, that unless you have your tap heat at 150° or 151½°, you cannot possibly have good beer." No doubt he was perfectly correct, so far as his own experience went; but that experience was entirely based on the particular qualities of the malt he used, and also in the nature of his brewery and of his mash-tun. Therefore, such an empirical rule can have very little value indeed to brewers at large. A tap heat of 150° to 150½° may be good in one particular mash-tun, and may be bad in another.

After it is run off, the proces of sparging commences—the process of extracting the remaining wort which adheres to the insoluble draff or grains. Now this sparging or washing, as we would call it, is carried on by means of hot water; and the question is, to what extent may one heat the water of a sparge. If you have run off your wort at a temperature between 145° and 155°, you must not use your sparging liquid higher than about 170°. You may say, Why not? I do not know exactly why. I was inclined to think a little while back that it was partly due to the action of the high temperature on the cellulose itself, but I am not quite sure of that. It may be due to the action of the high temperature of the water upon some still remaining insoluble starch which was not extracted in the previous digestion process. If you make use of the solution of iodine in water or in alcohol you will find very often indeed—not with all samples of malt, but still very often—that after you have run off your first extract, and after you have found by the use of the iodine solution that there is not the slightest trace of soluble starch present, yet if you run on your sparge at a temperature of 176° or 180° you will find in your first sparge a slight blue reaction, indicating starch. However, it may indicate disintegrated cellulose. I showed you at our first meeting that cellulose or woody fibre under certain conditions, excessively finely disintegrated, gave the same reaction with iodine which soluble and insoluble starch did, namely, a slight blue colour. But if you take care not to have your sparge liquor too hot—not above 170°—you do not run the risk of disintegrating cellulose, if this be the true theory, or the extraction of starch that may have escaped the action of the diastase. This process of sparging or washing goes on in different breweries to different extents. Sometimes it is carried to such an extent that the wort obtained is excessively weak, containing only some 4, 5, or 6 lbs. per barrel. This is not used at once for the production of beer; as a rule it is not mixed with the previous wort, but is pumped up into the copper, and there used for a subsequent wort. Now this "return wort," as it is called, is excessively liable to undergo a decomposition, by which acidity—mainly lactic acid, but probably others as well—is produced. In order to prevent the return wort becoming acid in that way, it is found convenient to keep it at a temperature of at least 190° Fahr., and from time to time, if you have any reason to be afraid of it, to add a little bi-sulphite of lime. Throughout the whole of the period, whether during the night or during the day, until the next time you use it, it must be kept at least as high as 190°, for if you allow it to go down to 150°, you are very liable indeed to have acidification set in. The wort obtained contains not only sugar and dextrine, but also an amount of albuminous matter, and this amount depends upon two or three conditions. In the first place, it depends very much upon the nature of the barley which was originally employed for the purpose of making the malt. For instance, if the barley came from the North of England or Scotland, or if it had been growing on heavy land, it would contain much more albuminous matter than barley grown on a light warm soil. And brewers occasionally make an error in judging of the goodness or strength of the wort by merely depending on the use of the saccharometer, because, of course, the soluble albuminous matter keeps up the floating instrument quite as well as sugar and dextrine. The amount of albuminous matter in the wort also depends on the previous history of the malting process; lastly, it depends on the nature of the water employed.

Before going on to discuss the German method of mashing, it may be well if we devote a few minutes to the consideration of the water or liquor made use of. A very convenient and a very practical division of the various kinds of matter that we find dissolved in natural water is the following:—In the first place, if you take a bottle of water and boil it for some considerable time, and if while it is boiling you add distilled water, so as to keep the volume very much the same as it was at starting, that water will give a deposit of chalk, and sometimes of ferric oxide, providing that it contained that chalk, dissolved in carbonic acid. Many waters, if not all, deposit carbonate of lime or chalk upon boiling, even although there is no great reduction of volume in boiling. Then if we take a sample of water, and boil it in that way, taking care to add distilled water, so as to keep up the volume to its original extent, and if you filter that off, and weigh the amount of precipitate, that will give you the total quantity per quart or per gallon, of the chalk dissolved in the water. Now, if you take the filtrate which has been in this way separated, and evaporate it down to dryness and then digest with alcohol, the alcohol will dissolve up a number of very soluble salts and leave some insoluble salts. The salts which did not dissolve in the alcohol are these: calcic sulphate—or gypsum—which is the most important; and silica, or silicic acid. So that if you filter again you will obtain the weight of your sulphate of lime and of silica. Lastly, there are the soluble salts which the alcohol dissolved up. If you evaporate off that alcohol and heat in a platinum vessel to about 110° or 120° Cent., that would give you the total soluble salts. The soluble salts are in the main these: first of all, chlorides—chloride of sodium, of potassium, of magnesium, and of calcium. We have also in addition to those, sulphates

of the same—soda, potash, and magnesia. In addition to these, one occasionally finds, sometimes to a considerable extent, nitrates, especially if the water has come from some doubtful source, as if it has derived its source from chalky districts. In addition to these nitrates, one finds, as a rule, a slight quantity of ammoniacal salts; in some cases, also, albuminoid organic matter. That is the thing I attach special importance to. The mere fact of a little nitric acid being present is of no great injury to the brewing and fermenting operations; but the presence of the albuminoid organic matter, putrescent organic matter perhaps, is one of much more serious influence to the future processes. A rough and ready but sufficiently useful mode of detecting when the water contains any organic impurity of this kind is to employ some of what is called Condy's Fluid, the permanganate of potash. If this be thrown into impure water, the beautiful chameleon colour will be destroyed, as you see in this glass of water which I have here, and which has been purposely rendered impure. You cannot see at this distance the production of the brown oxide of manganese; but you can see the rapid disappearance of the beautiful colour of the permanganate of potash. The solution to be used for this purpose—and you will not find it at all troublesome to use—should be of this strength: in every litre of water should be dissolved ·3955 gramme of potassic permanganate. The process which then goes on is a process of burning the organic matter. The matter in the water is being burnt up by the oxygen separated from the permanganate. It will occasionally happen, partly by leakage from some drain, or from some other causes, that water in a well may receive some impurity, and it may also happen that the brewer is not able to stop his brewing operations there and then, but must continue. The question is, what must he do as a temporary expedient to get rid of the danger due to the putrescent organic matter; for it is astonishing how minute a quantity will do injury in the after processes. He may get rid of the difficulty by doing what I have done here—by making use of a very much cheaper source of oxygen than this permanganate, that is, by employing chloride of lime. If he takes some few grains of chloride of lime, say 10 grains per barrel, and boil these together, the oxygen of the chloride of lime will do what I have been doing here, the same reaction would take place, and the oxygen will burn the organic matter. You may say that there may be a little chloride of lime left, that possibly six or seven grains might have been all that was required to destroy the organic matter in the barrel, and that three or four grains might be left which would be dangerous. Well, it is very easy to meet this difficulty. After you have been boiling for half an hour, all you have to do is to throw in as much bi-sulphite of lime as you originally threw in of chloride, and the bi-sulphite will be oxydised if there be any remaining chlorine, and converted into sulphate of lime. In that way you obtain chloride of calcium and gypsum, two very useful and valuable constituents in water. I only point this out as a temporary expedient, because as soon as you can you should search the well, trace the condition of the ground around, and get rid of the organic impurity.

There is a remarkable discrepancy of opinion with reference to the influence of these chlorides of calcium, potassium, magnesium, lime, and so on, and these sulphates amongst the brewers of Europe. If you ask any able brewer in Germany, he will tell you that he looks on these mineral salts as being bad; but if you ask a Burton brewer, or many English brewers, they will tell you that they look upon them as being almost the sheet-anchor of their pale ale system. What, then, is the right action of these mineral salts in the mashing process? Some years ago Mülder put this in a very neat way. He showed that the action of these salts in producing hard water in the mashing process is very much the same as that which occurs when one boils peas or beans, or other vegetables in hard water, as compared with the result when one boils them in soft water. Of course no cook who wants to serve up any delicate, tender peas, would select hard water to boil them in if she could get soft, because the hard water produces a leathery insoluble toughness in the skin, and prevents its bursting, whereas the soft water allows the contents to come out more easily. The German brewer then says, "I object to keeping the albuminous matter insoluble; I want to get all that is possible out of the malt." The English brewer, on the other hand, working on a different system, is afraid, and very justly, of having very much albuminous matter in solution. I am speaking of those whose ale is drunk some months afterwards, not those whose ales may be used in a week or ten days. He is justly afraid of too large a quantity of albuminous matter, because we have already seen that albuminous bodies are powerful agents of change. Hence, therefore, the Burton brewer, as regards his own particular production, is perfectly correct, when he prefers water which contains these mineral salts to perfectly soft water.

The next question is this: Is it the sulphate of lime, which is found so largely in the Burton water, which is so important and valuable an ingredient? I think the sulphate of lime has very much to do with the properties of the Burton water, but if you examine the water of Burton, you will find it contains chlorides as well—chlorides of sodium, magnesium, calcium, and what not. And many of you who are practical brewers will know that in certain cases where the water contains a large quantity of chlorides, the ale produced is as well known for its long-keeping qualities as that made with water containing sulphate of lime. Some few months ago, when I was speaking to a very able English brewer, Mr. Black, of Edinburgh, he said, "I entirely agree with the Bavarian theory, and I do not hold to the Burton theory. I do not think it necessary to have sulphate of lime present." And certainly, judging by the success of his productions, he being the director of Messrs. Younger's brewery, he had a right to speak confidently on that point; however, he forgot that the water he employs contains chlorides, and I have no doubt that the chlorides have the same preserving action as the sulphate of lime. In this way those who have soft waters may readily, by means of chloride of sodium, or common salt and gypsum, imitate to some extent the Burton water, because if you dissolve common salt and gypsum in water, you will have, not two salts but four, you will have chloride of sodium, chloride of calcium, sulphate of sodium, and sulphate of calcium. And so in that way, when it is necessary, you may produce water somewhat resembling that of Burton. On the Continent they employ both methods, both the infusion and decoction methods. First of all, as to their method of infusion. In some parts of Germany and Belgium they adopt the English system in using a high initial temperature, the temperature of the original mashing heat varying from 150° to 160°. Their infusion method, however, is generally modified, because it is performed by a brewer who is in the habit of using the decoction process, or else because around him there are brewers who use that process. Therefore the plans adopted abroad are generally somewhat modified. It is mashed, first of all, at a temperature of about 100° to 129°, but occasionally as high as 140° Fah. After standing a little time, hot water is added to bring up the temperature to about 150° or 160°, and then, after a sufficiency of digestion or infusion, the wort is run off. In some cases the temperature is carried even higher. After a digestion at that temperature, more hot liquor is added, in fact even boiling liquor, in order to raise it to 170° F., and then it is left to digest until iodine water or an alcoholic solution gives no blue reaction. Therefore tho general infusion process as practised abroad is not exactly like ours. They start with a low temperature, and by successive additions of hot waters they get it up to 160° or 170°.

Now, as regards the far more important and more

widely-spread process, that of decoction, it is remarkably interesting, and I will describe it before going back again to take up in more detail the nature of our English method. The Bavarian, or old Bavarian, method of decoction consists in boiling the worts along with the grains, and is carried on in this way:—The malt, after it is properly ground, is thrown into cold water, and it is allowed, after being mashed, to remain in cold water for a time, varying from one hour to three. After this process has gone on as long as the brewer may think necessary, hot water is added, in order to raise the temperature of the mash in the tun to about 95° to 100° F. Thus the infusion process is set up, and, so far, it agrees with the English method. After standing a short time, the tap is opened, and grains, meal, water, and everything is run off, and that is pumped up into a boiler. You will bear in mind that we have wort and grains together in a thick mass, and the Germans call this *dickmaisch*. This thick mass is then boiled vigorously for half-an-hour. After it has been boiled it is run back again into the mash-tun, in order to raise the temperature to about 122° or 125°. Of course that varies a little. Then the infusion process goes on again. After that a second thick mash is again pumped up into the boiler, and again boiled briskly for half-an-hour, and it is then again run into the mash-tun, and the temperature in this way is raised to 145° Fah. It is then allowed to stand quietly after a little mashing. I ought to mention that before the thick mash is run from the copper, the mash apparatus is set to work for about ten minutes previously. It is thus infused, and after that, in the old Bavarian method, the third mash, or *lautermaisch*, is run off, that is to say, a tolerably clear one not mixed with grains. That is pumped into the copper, and is boiled. After it has boiled about half an hour, it is run into the mash-tun, and they then raise the temperature in that way to 165° or 170° Fah. So that you see, we have first of all cold water, then in the second stage it is raised up to about 100° and in the third stage to about 140°, then in the fourth stage to 165° to 167°, and lastly, the process is allowed to go on for a period of one hour. They then tap. and in the old Bavarian method they sparge with cold water. Of late years they have had occasion to alter that pernicious system, and have commenced to sparge with hot water, in that particular imitating the Scotch or English method. That is what is called the old Bavarian method of cooking the malt, as I may call it. But in addition to that there are modifications. For instance, sometimes instead of running off in the third stage the *lautermaisch*, they run off a third *dickmaisch*, and use no *lautermaisch* at all. In other cases, instead of two thick mashes, they only use one, and have two thin mashes and so on. In Belgium, where they use malt and raw wheat together, the process is first of all the English infusion process, and then after that they pump up a portion of the thick mash, that is to say, grains and wort together, and boil it. In other cases, instead of doing that, they pump up a portion of the clear wort, and boil that and pass it back into the mash-tun, and in that way raise the temperature. Now the points which are gained by this method of boiling the thick mash are the following. Of course it must have occurred to those of you who have not heard of this method before, that it is a very odd method indeed to take the grains and the wort and boil it all up, and so destroy the activity of the diastase. This is perfectly true, the diastase is destroyed so far as its converting energy is concerned. But you must bear in mind there is still some left in the tun. Now I told you that diastase is able to convert about 2,000 times its own weight, and the Bavarian brewer maintains that he leaves a sufficiency of diastase in his tun to carry on the process which he has in view. This boiling process, while it destroys the diastase, which may be looked upon as a disadvantage, has, at any rate, this advantage, that it thoroughly breaks up the integuments of the malt, and in that way the starch is converted into a sort of starch-paste. Now when it is run back again into the mash-tun, it there meets with the diastase that has not been destroyed, and the starch-paste is then very rapidly converted into dextrine and sugar. In addition to that, it is generally maintained by Bavarian brewers, although denied by Mülder—but still I believe the brewers are right and the chemist wrong—that in this way there is a large amount of albuminous matter brought into their worts—not insoluble, but soluble albuminous matter—and that this soluble matter has undergone in that way a process of cooking, and therefore their worts and beer are rounder. It is an undoubted fact, whether that be really the case or not, but while they are killing so much of their diastase, they naturally have a greater ratio of dextrine to the sugar, so that their worts are rich in dextrine and poor in sugar. Now when you ferment such worts you naturally have less alcohol, so that, finally, one may sum up the difference in this way, that the beer made from the worts mashed in this process are less alcoholic or stimulating, because they had originally less sugar but that they are rounder or fuller in the mouth; and in addition to that it is supposed, on account of the long cooking the albuminous matter has undergone, that it tends to preserve the beer better. Of course a Bavarian or German would naturally prize these forms of mashing far beyond our very best system, but that is a question of individual taste.

So much for the Continental methods of mashing. Of course, I could have gone on and described in more detail many of the variations that have occurred in Belgium, France, and Germany, but this course of lectures is but a mere beginning and can only be suggestive. I can merely point out here some of the main points of difference amongst practical men. I have made it my duty to go about to discuss these matters, and to see the various brewing operations carried on, not only in my own country but abroad. It is impossible for me in so short a course to go in detail into all these distinct points; therefore, after this short description of the Continental methods—especially of the very important one, the *dickmaisch* method—I will now go on to a consideration of the chemical reaction that takes place. We have seen that the German, by his method, obtains a larger quantity of dextrine in his wort, and that the English method of infusion gives a less amount of dextrine. Therefore, I think the very natural problem presents itself to us—In what way can the practical man alter the ratio of dextrine to glucose? Can he alter it to any extent, or is there a limit to his power over the action of the diastase upon the starch?

I have made a series of experiments upon this question, and I have purposely taken one—malt. I need hardly point out that malts differ from each other; sometimes you may have one that mashes readily, and undergoes the saccharification process readily, whereas another one does not do so; but, still, in taking a fair sample of malt, I was better able to eliminate those discrepancies than if I had varied the samples used.

ANALYSIS OF MALT.

(*Christopher*).

Water	7·51
Glucose	5·48
Dextrine	8·82
Starch	48·77
Albuminous bodies (soluble)	1·48
Ditto (insoluble)	10·71
Ash	2·50
Woody fibre, empyreumatic products, &c.	14·37
	100·00

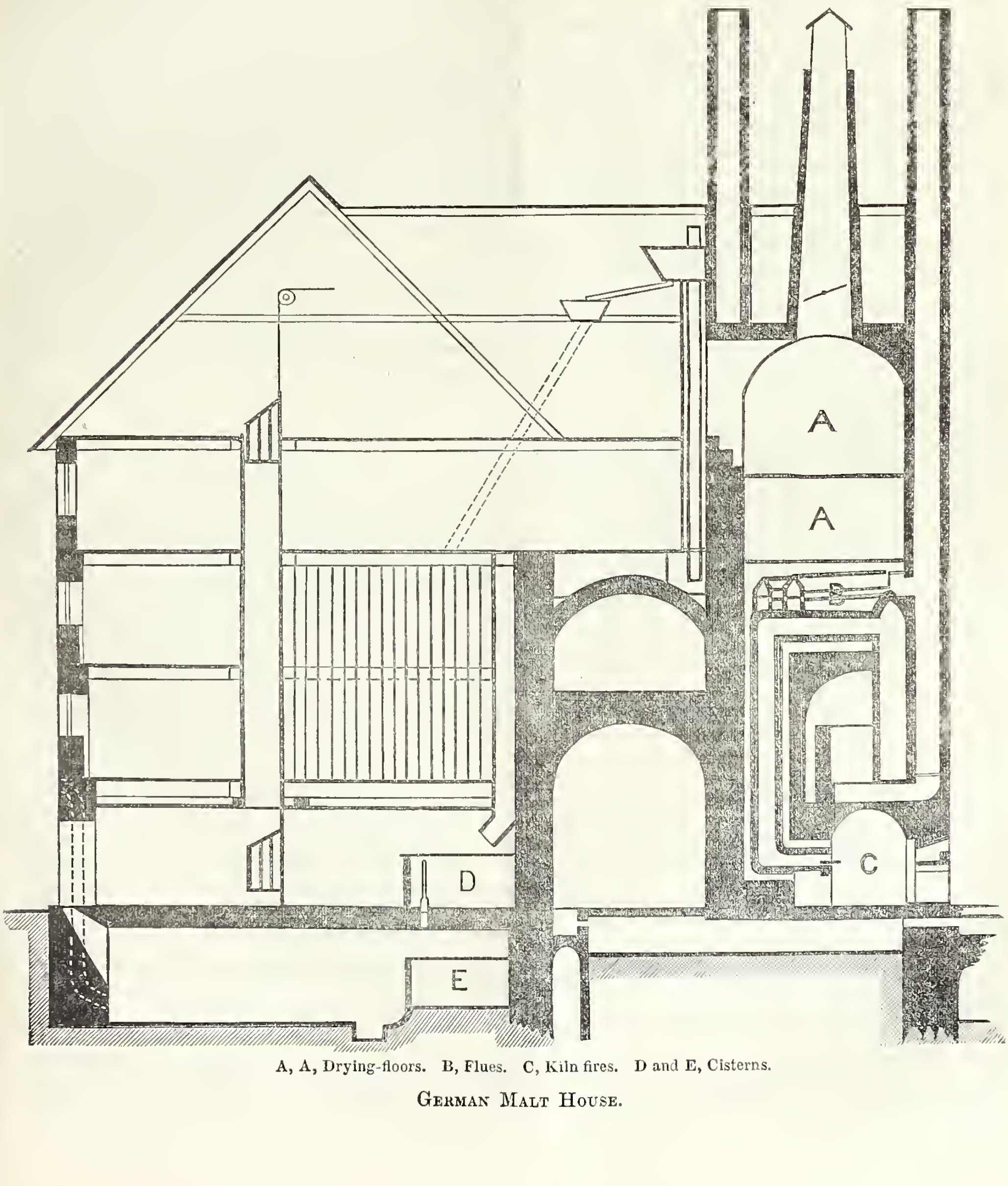
Cold Aqueous Extract.

	15 minutes.	30 minutes.
Glucose	5·48	7·14
Dextrine	8·82	9·65

Alcoholic Extract.

	80 per cent.	50 per cent.
Glucose	1·00	5·68

In this particular sample, for the analysis of which I am indebted to the very able and careful work of Mr. Christopher, we find that there was about $7\frac{1}{2}$ per cent. of water, 5·48 of glucose, 8·82 of dextrine, and 48·77 of starch; altogether about $12\frac{1}{2}$ per cent. of albuminous matter, of which in this particular sample, 1·8 was dissolved in the mashing, and 10·7 did not so dissolve. There was in addition to that $2\frac{1}{2}$ per cent. of ash, and 9 or 10 of woody fibre, the rest being empyreumatic products. With reference to the statement of the amount of sugar, chemists somewhat differ about it. Does malt really contain that amount of sugar already formed? At our last meeting I had some analyses by Oudimens, which, if I remember correctly, only showed about one-half per cent. of sugar. How comes it here, then, that we have so large an amount? Now it is exceedingly difficult to determine the right way to treat malt, in order to ascertain the amount of sugar existing at the moment when it is in the dry condition. If one makes use of water, it will entirely depend on the length of time during which it is digested as to whether we get one number or another, because, as I pointed out to you, the action of the albuminous matter is always going on, breaking down the complexity of the starch. If, on the other hand, one takes absolute alcohol, we shall not dissolve any of the sugar, and that is probably what Oudimens did. He took concentrated alcohol, and got out, therefore, the small quantity of $\frac{1}{2}$ per cent. But he was not aware of the action of alcohol, and hence he got nothing practically dissolved. In making the experiments from that point of view, I found also that if I used absolute alcohol, even after 24 hours' digestion, there was, practically, no sugar dissolved. If I used 80 per cent. alcohol, I got about $\frac{1}{2}$ to 1 per cent.; but if I used, as I did finally, 50 per cent. of concentrated alcohol, I find 5.48 was dissolved. Now, in treating it



A, A, Drying-floors. B, Flues. C, Kiln fires. D and E, Cisterns.

German Malt House.

with cold water, after a period of 15 minutes, and then afterwards comparing that with the extract for thirty minutes, I find in the one case I had 5·48 sugar and 8.82 dextrine; whereas, in the other case, after an additional 15 minutes, it had increased to 7·14 sugar and 9·65 dextrine. Now that solution is almost identical with the one obtained by the 50 per cent. alcohol, so that I have come to the conclusion that there was in that particular sample of malt an amount of sugar already formed equal to about 5½ per cent. And I tested the truth of that statement in another way. I asked two or three gentlemen to kindly allow me to experiment upon them. I took some crushed malt and placed it on the back of the tongue, and, with a stop-watch, I learned that they all found a distinct sweet taste in ten seconds. Had it only contained ½ per cent. of sugar, I am perfectly certain there would have been no distinct sweet flavour in so short a time. So that I have adopted this number as representing the amount of sugar present, though you can readily understand the impossibility of determining it accurately.

The next point I was anxious to take up was to see the amount of action that took place at different temperatures in a given time, and I started a series of experiments, of which I have the results in the following tables. Firstly, I took cold water at 60° to 70° Fah., and raised it up to the temperatures indicated, and kept them at those respective temperatures for two hours. At the end of that time I digested the first at 100°, and we had 24 per cent. converted into sugar; when it was raised to 110°, 30 per cent.; at 120°, 32 per cent.; at 130°, 35 per cent.; at 140°, 37½ per cent.; and the dextrine also increased.

	100°F.	110°F.	120°F.	130°F.	140°F.
Glucose, per cent...	24·19	30·00	32·17	35·71	37·50
Dextrine and starch	34·00	29·25	27·33	24·11	26·70

We see from this that we have had a gradual increment of sugar formed. The total amount of extract, if you were to add these together, gradually increased, but when you come to 140°, instead of being a gradual process, there is a sudden leap, and at that temperature we have a much greater amount of extract.

The next point that occurred to me was to test the truth of the German brewers' theory about the range of temperature of 165° to 167°, being the most favourable for the convertion of starch and dextrine into sugar. The mashing heat was started on the principle of a low initial temperature raised up in the first hour to 100° Fah. It was then kept for two hours at a temperature of 140° to 145°, and finally was heated up to 165° to 167°. In these tables, the first column shows where the temperature was raised to 167° and kept up for two hours, whereas, in the second, it was kept for no less than six hours at that temperature.

	2 hrs. at 165-167° F.		6 hrs. at 165-167° F.	
Wt. of Extract per cent.	70 25	....	70·55	
Draff............... ,,	21·58	....	20·71	
Glucose .... ,,	39 06	=Starch 62·52	41·67	=Starch 62·51
Dextrine .... ,,	27·36	....	25 00	

We find here a very large extract; there is a considerable amount,—very much higher than any of the series you have seen with the cold water—very much higher even than any in the English infusion process. We have no less than 39 of sugar and 27 of dextrine. In the second, when it was carried on for six hours at this range of temperature, the ratio of sugar and dextrine increases, that is to say, the dextrine diminishes and the sugar increases, but by adding these two together you will find they are practically identical. If you take one-tenth from the whole of the numbers on these diagrams representing the glucose, you will have the amount of starch that it originally came from; ten parts of sugar represent nine parts of starch, or nine of dextrine, so that if you make these deductions here, you will find that these two numbers indicate 62·5 and 62·51, in other words they are identical. But there is a different ratio between the sugar and the dextrine. You see therefore that by prolonging the temperature at this higher stage, the German brewer is correct in his idea of getting more sugar, because 2·36 of dextrine have been converted into 2·61 of sugar. Having thus proved the correctness of his idea, I proceeded next to test what would be the result if I were to take the extreme case, which, of course no practical brewer ever uses, a temperature of 175°. I took that as a crucial test. I took a sample of malt and heated it gradually during 60 minutes from the cold up to 175°. It was then kept at that excessively high temperature for a period of two hours, when the amount of sugar formed was 32 and the dextrine 30.

		(1.)	(2.)
Wt. of Extract, per cent.	....	69·70	69·10
Draff ,,	....	23·51	23·35
Glucose ,,	....	32·10	32·05
Dextrine ,,	....	30·29	30·60

Therefore, practically, the two results were identical. If you compare this with the others, it is not so very bad, considering that in so short a period we have obtained this excessively high temperature of 175°. In other words, in that short time we have obtained a ratio quite as high as one finds in the English infusion method. Thus, these two points being settled, viz. the advantage of a low initial temperature and the advantage of a high final temperature, I proceeded then to discover, if I could, what would be the best way to arrange the mashing temperature. First of all, I heated malt from the cold up to 85° for one hour; I then carried it on from 85° to 140° for one hour, and then for three hours it was kept at 140° and then boiled. In the second series it was raised during the first hour from the cold up to 140°, it was then allowed to remain for two hours at that temperature, and then it was raised very rapidly to 175°, when it was boiled. In the third experiment it was raised in the first hour up to 140°, it remained during the second hour at that temperature, and then in the third hour it was raised to 175°.

	(1.)		(2.)		(3.)	
Wt. of Ex. per ct.	71·50	...	71·06	...	69·00	
Draff ,,	21·70	...	22·35	...	22·61	
Glucose ,,	41·66		40·07		35·72	
		=starch	62·59	=starch	62·51	=starch 60·76
Dextrine ,,	25·09		36·45		28·65	

We find in the first two, practically, the same results. You will find, if you make the same deduction I spoke of before, by taking one-tenth from the determination of glucose, which will give us the starch from which it is derived, those numbers added together are 62·59 and 62·51, showing practically the same amount of extract, whereas in the other case we have only 60·76, if you make the same deduction from the glucose. So that there has been in the rapid increase of temperature a very great falling off in the production of extract, and there has also been a great falling off in the ratio of the sugar to the dextrine. I think with these few experiments we must, on thinking them over carefully, and comparing the numbers together, see that the more gradually we raise the temperature, the more perfect will be the extract, and the higher will be the sugar-forming ratio. At our next meeting I shall go on to show you there is a point beyond which we cannot go on increasing the ratio of the sugar to the dextrine, and I shall point out to you why we cannot get beyond that; secondly, how you may readily enough in other ways increase the amount of sugar, and then, in addition, other methods by which you may increase the dextrine. I shall also have occasion to call your attention to an exceedingly interesting malt which I have here made from maize, and will point out various methods by which we may vary the ratios of sugar and dextrine at will.

N.B.—Dr. Brewer would be glad if the specimens of yeast, asked for by him for next Monday's lecture, could be forwarded to him at University College.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

The third meeting of the Ethnological and Geographical Committee was held at the Royal Albert-hall, on Friday, the 6th inst., Colonel Lane Fox in the chair. There were also present Major Donnelly, R.E., Dr. Leitner, and Mr. G. Saunders, Secretary.

The Committee for Ancient Bookbinding held its first meeting on February 6th. The following gentlemen were present:—The Right Hon. Sir David Dundas, Mr. R. S. Turner, Mr. Henry Vaughan, and Mr. F. W. Moody. Lieut. H. H. Cole, R.E., also attended the meeting. The Committee recommended that the arrangements should be in chronological order and according to countries. The names of some known collectors of old specimens of bookbinding were mentioned, and applications recommended to be made to them.

The Committee for Painting held its first meeting on February 9th, at the Royal Albert-hall. The following were present:—Lord Ronald Leveson-Gower, M.P., Mr. R. Redgrave, R.A., Mr. Henry O'Neil, A.R.A., and Mr. A. Clint. Lieut. H. H. Cole, R.E., attended the meeting. The Committee recommended that paintings in water colours and oils should be received up to March 10th, in order to pass before the Committee of Selection, which will sit on Wednesday, the 11th March.

The fifth meeting of the Sub-Committee for Sanitary Apparatus was held on Tuesday, the 10th inst., Mr. W. Clode in the chair. There were also present Mr. C. Gatliff, Mr. George Godwin, F.R.S., and Dr. Hardwick. Captain Clayton, R.E., attended the Committee. The method of supplying sewage to the various companies who are desirous of showing their processes was further considered.

The Committee for Wine held its seventh meeting on February 11th, at the Royal Albert-hall. The following gentlemen were present:—Sir Daniel Cooper, Bart., Col. Charles Barnie, Mr. F. W. Cozens, Mr. E. Apps Smith, Mr. C. Lombard de Luc, Mr. John Corlett, Mr. H. Matthiessen, Mr. Robert Gray, Mr. H. G. Smith, Mr. C. H. Kayser, Mr. Joseph Prestwick, F.R.S., F.S.A., and Mr. Morgan Yeatman. Lieut. H. H. Cole, R.E., also attended the meeting. The allotment of space to intending exhibitors was approved. The committee adjourned to the 16th March at 3 p.m.

The Board of Management have it in contemplation, for various reasons, to change the method of supply of refreshments to visitors at the Exhibition. They propose to permit light and moderate refreshments to be obtained and consumed in certain prescribed parts of the buildings, but not to continue the supply of luncheons and dinners.

In the French Annexe and Royal Albert Hall Tea Rooms, will be sold ices, pastry, sandwiches, patties, fruits, tea, coffee, etc., lemonade, and seltzer water.

In the Queensland Annexe, Colonial Annexe, Royal Albert Hall Gallery, East and West Arcades, South Galleries, and Swedish House, in addition to the above articles, will be sold bread, butter, and cheese.

Wines, spirits, and beer may be obtained at all the places specified.

No refreshments are to be taken out of the areas.

Her Majesty's Commissioners have presented a medal to exhibitors and others, and issued it with the following notice:—"Following the practice of ancient and mediæval times, the medal has been made of a compound metal and has been gilt. It is 2⅝ inches in diameter. On the obverse is a head with inscription, 'Albert Edward, Prince of Wales, President,' which has been designed by Mr. F. Miller, teacher of modelling in the Art Training School. The reverse represents the buildings of the Exhibition, the Royal Albert-hall, the Albert Memorial in Hyde-park, and the Arcades of the Horticultural-gardens. It was designed by Mr. J. Gamble, one of the decorative artists of the South Kensington Museum."

It is the subject of criticism. It is objected that the medal is made of mixed metal. The Greeks and Romans made their medals of mixed metals; sometimes of rings of copper and mixed metal. It is objected that it is large. Nicolo Pisano, and the mediæval medallists have left medals much larger, impressed in lead and sometimes gilt. If the novelty issued by the Commissioners leads to a discussion about medals, a reform in the art may follow, and the public may learn to recognise that it is the art, and not the material, which gives value to a work.

NOTTINGHAM LACE.

At the last meeting of the Nottingham Chamber of Commerce, the following communication was read:—

"Upper Kensington Gore, London, S. W.,
"7th January, 1874.

"Sir,—I am directed to inform you that a certain portion of the machinery galleries in the Exhibition Buildings has been reserved for the exhibition of lace machinery this year, and that her Majesty's Commissioners desire to ensure an adequate representation of the most interesting and important processes in operation, used in the manufacture of the article in question. No processes, perhaps, show so clearly the immense results obtained by machinery than that employed in the making of lace, and probably no machinery surpasses lace machinery in rivalling the work of the hand. Her Majesty's Commissioners, therefore, direct me to express their hope that your Chamber will, in the interest of the lace manufacturers of Nottingham and for the instruction of the public, further the object which they have in view, by taking the necessary measures to induce the Nottingham lace manufacturers and machine makers to show in this year's exhibition some of the most interesting processes in actual operation. Her Majesty's Commissioners have hitherto been so fortunate as to secure an exhibition of machinery in all the industries which have been represented in previous exhibitions, and they are unwilling to believe that the exhibition of this year will prove an exception in this respect. I am, therefore, again to express their hope that your Chamber will take such steps as may be necessary to ensure as good a representation as possible in this year's exhibition of the process of manufacturing lace.—I have the honour to be, Sir, your obedient servant,

"HENRY Y. D. SCOTT, Major-General,
"Secretary."

"The Secretary to the Nottingham Chamber of Commerce, Nottingham."

Mr. Carver thought it was quite open to manufacturers to send machines. He thought there seemed to be an impression that they would not send any.

Mr. Donald thought Lieut. Cole went away with the impression that they were not willing to send any machinery. He did not think they had anything to lose by exhibiting machines there, and he might observe that the mere fact of Messrs. Howard exhibiting their implements in various places had created a new business and made Bedford what it was. He suggested that it was the makers of machines who might send to the exhibition.

The Chairman said the great value of lace machinery made its conveyance to such an exhibition a difficult

matter. He believed the Chamber was asked to take general action in the matter, and that funds might be raised for the purpose.

Mr. Carver thought the machine makers ought to be appealed to, and if it were to be made known that this Chamber would raise a guarantee fund to meet the expenses, he thought they would find makers to find machines which would do justice to Nottingham.

Mr. John Bradley did not think it was contemplated at the council meeting that the expense of sending machinery should be met by a guarantee fund. They did not consider that the Chamber would undertake to send any machinery at all. It was thought to be impracticable as a whole to have machinery taken there. There was also the question as to whether they should send machinery properly clothed and at work. Lace-makers might not think it worth while to take a machine there with lace produce on it. There was, further, the objection to the machines being at work there, for they were obliged to be more jealous in the lace trade than in any other trades. He believed Mr. Cole was given to understand that the objections were great, and that no one would be at the expense of sending machines there. He was surprised, if the commissioners were so anxious about the matter, that they had not made an offer to bear the expenses, which under the circumstances were exceptional.

Mr. Marx understood that the committee was appointed to consider what would be the most practicable course to take under the circumstances, and with regard to the expense to decide whether they should raise a guarantee fund. The question was put whether the commissioners would meet the Chamber in the matter of expense. He thought they ought to hear something of what the committee had done.

The **Chairman** said the committee were to make an exhibition of lace alone, and as to sending machinery at their own expense that would be a difficult thing to do. They would require various classes of machines, plain net, cotton net, warp, and other machines.

Mr. Barwick moved that the matter be referred to the committee already appointed. There seemed to be a great difficulty in sending up machinery, and he thought the matter should be left to the committee to consider.

Mr. Ward thought that they ought not to take the position of refusing to exhibit machinery on behalf of the town. He could not agree with the previous speakers that machine builders alone should exhibit machinery, because they were not in the habit of getting them to work or getting the patterns put on them. Bnt although there were difficulties existing, he thought it quite possible they might be got over. They must look at this matter in a broader way than merely individual interests. He was quite certain the interest of the public was excited more by an exhibition of machinery in motion, than by anything else in connection with machinery, and so long as the interest was kept up in that department, so long would the exhibitions be crowded by thousands who would not go elsewhere. He thought it was the interest of Nottingham and other parts of the country to keep up these exhibitions, and they should not allow any selfish considerations to interfere in the matter. He for one should be willing to bear his share of the expense, and he suggested that the regular way of dealing with the question was that the secretary should be requested to send a circular to the machine-makers, &c., asking them if they would lend machines for exhibition, provided the expenses could be defrayed without putting a burden on them. If her Majesty's Commissioners were as anxious to have these machines exhibited as they appeared to be, and the difficulties being greater and expense more than any other machinery, he thought it would not be unfair to ask them to bear a part of the expense. He would move that the circular be issued as he had suggested, and also that the delegates from the Chamber, who were about to see Mr. Cole on the question, should ask whether, if the machines were forthcoming, the commissioners would join in bearing the expense.

Mr. Carver seconded the motion, which was carried unanimously.—*Warehouseman.*

PUBLIC MUSEUMS AND LIBRARIES.

The following returns of the numbers of visitors for January last have been made up to the present date:—

	Number of Visitors.
British Museum	(no return)
National Gallery (Trafalgar-square)	71,331
Kew Gardens and Museum	6,507
South Kensington Museum	
Bethnal-green Museum	
Geological Museum, Jermyn-street	3,938
Patent-office Museum	19,406
Edinburgh National Gallery	24,633
Edinburgh Museum of Antiquities	22,449
Edinburgh Museum of Science and Art	46,113
Royal Dublin Society:—	
Natural History Museum	6,685
Botanic Gardens, Glasnevin	2,867
Dublin National Gallery	
Zoological Society, Dublin	3,632
Museum of Irish Society, Dublin	
Tower of London	9,208*
Royal Naval College, including Greenwich Painted Hall	19,138

CORRESPONDENCE.

DR. DRESSER'S PAPER.

Sir,—May I ask space for one or two remarks on Dr. Dresser's very masterly paper of the other night. To commence with the union of art and utility. Though his principle of determining, from the centre of gravity, the position of a handle on a jug or other vessel for holding liquids is certainly correct, we must not forget that this centre of gravity varies constantly with the amount of water in the jug, and the small handle he showed makes no allowance for this; whereas, if the handle be long, I find, from constant use of one of this shape, that the hand naturally accommodates itself to the shifting centre of gravity by grasping the handle in different parts.

With reference to the scuttle he drew for our edification, though the shape is undoubtedly economical in manufacture, when the coals are nearly exhausted and lie at the bottom angle, they slip out of the scoop as fast as you can persuade them to go in. The utility, to be combined with the art, must be genuine and proved. The cost of a scuttle of this kind in oak is about £3—the painted iron one, ridiculed in the paper, is about £1. I entirely endorse Dr. Dresser's sweeping assertion that engineers are utterly devoid of art, though I do not clearly see how we are to learn to make artistic bridges from Eastern examples. I remember, as a pupil, venturing to introduce ornament in some work I was then drawing; I was told we were engineers, not artists, and had to rub it all out. On my asking why the two could not be combined, one of our cleverest engineers said, "Absurd nonsense!" I never could see why all our engineering works and machinery should invariably be made as ugly as the wit of man can possibly devise. Dr. Dresser asks why we cannot compete with the barbarian (so-called) in, for instance, Japanese goods. I submit

* Total number for 1873, 140,125; being an increase over 1872 of 13,345, and over 1863 of 79,916, the increase being progressive.

that we are a commercial people, and that unless we can combine commerce with art, we let art alone. Painting is recognised because it pays—because we can trade with pictures—the sister art of music, which surely, as an art, ranks higher, since the composer creates while the painter but copies, is yet in a struggling state of transition. Our musical caterers confine themselves to threadbare operas, worn-out oratorios, trashy ballads, &c., simply because anything higher and better will not pay—they are, if artists, still commercial and not philanthropic ones. We can purchase a Japanese tray—a work of art in itself—for less money, after paying three or four profits, than an inferior Birmingham one. We can never, I think, hope to infuse into a rough English workman the delicate Japanese feeling in art, till whole generations have been turned out of the South Kensington mill, though it is not always the art or power of production that is wanting, but rather a road to commercial success.

Dr. Dresser remarks that the non-manufacture of such things here tends to send money abroad; but what, I would ask, is the difference between sending sixpence to Japan for a tray, or the same sum to America for corn to support a Birmingham workman while he is making a tray? Let us have art in everything, let us combine utility and art in the closest possible bond of union, but let us have common sense to help us. An Englishman will buy his works of art in the cheapest market, and if the English workman, from strikes, high wages, and stupidity, cannot compete with the foreigner, why, we must go to the foreigner or attempt the almost hopeless task of reforming our workmen. I have not yet read Dr. Dresser's valuable paper, so I must apologise for any inaccuracies due to the defects of my memory in this somewhat hurried note.—I am, &c.,

W. F. C.

21, Wellington-street, February, 1874.

Sir,—It will perhaps interest members to learn that the paper which I read to the Society on Wednesday the 4th inst., is being translated into Japanese, with the view of its publication in Japan.—I am, &c.,

C. W. Dresser.

Tower Cressy, Notting-hill, London, W.

THE UNWHOLESOMENESS OF CAST-IRON STOVES.

Sir,—In last week's *Journal* you quoted from the *Practical Magazine* a paragraph under this heading, giving the results of an inquiry into the subject by a commission appointed by the French Academy.

An important conclusion arrived at by that inquiry is "that all stoves should be lined with fire-brick, or other substance, so as to prevent them from attaining a red heat," and "no more prominent cause of disease in families (this refers especially to America) exists than such devices for burning anthracite coal in cast-iron stoves not provided with good fire-brick linings." This evil would result as well from burning an ordinary, so called, bituminous coal, as from anthracite, and every maker of stoves provides for and guards against it, if not in France, certainly in this country and in America.

Lest a wrong impression should prevail, even to a limited extent, I can assure members and the readers of the *Journal*, that castings of fire-clay form a part of all "Anglo-American" stoves, and other precautions too are taken in their construction, to obviate any approach to the evil suggested as a probability by the learned French Commission.—I am, &c.,

W. B. Murdoch.

115, Cannon-street, E.C., 11th Feb., 1874.

INDIAN TEAS.

Sir,—Mr. S. Ward speaks truly as to the number of chests in some of the "lots" of Darjeeling tea, but there are numerous other companies whose teas come in much smaller "lots," as everyone connected with the trade is aware.

With regard to adulteration, we have regretted to find many samples of Indian green tea coloured artificially (we do not say from Darjeeling), and we trust the Indian tea companies will resolutely set their faces against any sophistication of an article at present bearing a very high character and value.—We are, &c.,

Phillips and Co.

8, King William-street, City, Feb. 10th.

GENERAL NOTES.

Stuttgart Museum.—The director writes, "The Industrial Museum, which was erected in this town, Stuttgart, in the year 1849, owes its principal stock to the International Exhibition of 1851; and it, though having much smaller means at its disposal, has taken the Kensington Museum as its model for imitation—the director, L. von Steinbein, having had recourse to it at regular intervals, and ever since fed upon the treasures of that institution."

British Museum.—The following from the *Athenæum*, is in correction of a paragraph copied into last week's *Journal*:—"In our last week's number we said that the Trustees of the British Museum have resigned their patronage into the hands of the Government. This statement, we have been informed, is incorrect. However, the Trustees will, we believe, in all probability, take the step before long, and, indeed, would have done so by this time, but for the dissolution of Parliament."

Technical Education.—At a meeting of the Master, Wardens, and Court of the Painter-stainers' Company, held at their Guild, on Wednesday, the 4th of February, with a view to promote the important subject of Technical Education, they have determined to invite competition, and offer prizes for the year 1874, in the following subjects:—decorative painting in ornament, in oil or tempera, first prize, £5; second prize, £3. Painting from natural foliage or flowers, first prize, £5; second prize, £3. Freehand drawing and design, first prize, £3; second prize, £2; in pencil, chalk, or shaded in water colours. It has been the object of this Guild, from their first effort in the year 1852, to promote to the utmost extent in their power, technical education, and they hope by thus giving an early intimation of rewards to induce competition amongt the operative and industrious classes in the above branches—open to young men under thirty years of age. Specimens in competition to be sent in by the middle of May.

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

The Church Builder for 1873. Presented by Messrs. Rivington, the publishers.

The Royal Horticultural Society, as it is and as it might be. In some letters by G. F. M. Wilson, F.R.S.

Linear Drawing, by G. Christian Mast. Presented by the Author.

How to Preserve Health on the Gold Coast, by Henry MacCormac, M.D. Presented by the Author.

Questions and Answers on Company Drill, by J. W. Towse. Presented by the Author.

Gemeinnützige Wochenschrift, for 1873.

Two Years in Peru, with Explorations of its Antiquities, two vols, by Thomas J. Hutchinson, F.R.G.S. Presented by the Author.

The following have been presented by the Regents of the University, on behalf of the State of New York:—

The 84th and 85th Reports of the Regents of the State of New York.

Catalogue of the New York State Library, 1872. Subject Index of the General Library.

The 54th and 55th Reports of the Trustees of the New York State Library.

Results of a Series of Meteorological Observations, made under instructions from the Regents of the University, at sundry points in the State of New York. Prepared by Franklin B. Hough.

The following has been purchased for the Library:—

The Colonial Office List for 1874.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

The following arrangements for Wednesday evenings up to Easter have been made:—

February 18.—"On Thrift as the Outdoor Relief Test." By G. C. T. Bartley, Esq. On this evening the Right Hon. the Earl of Derby will preside.

February 25.—"On a New System of Cultivating the Potato, with a view to Augment Productiveness and Prevent Disease." By Shirley Hibberd, Esq.

March 4.—"On Bells, and Modern Improvements for Chiming and Carillons." By George Lund, Esq.

March 11.—"On the Manufacture of Cocoa." By John Holm, Esq.

March 18.—"On the Channel Tunnel." By William Hawes, Esq., F.G.S.

March 25.—"On the London International Exhibition of 1874." By Henry Hardy Cole, Esq., Lieut. R.E.

Indian Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

March 13.—Dr. Leitner, Principal of the Government College of Lahore, will give an account of the Races of Dardistan (north-west of Cashmere), discovered by him.

African Section.

These meetings are arranged for Tuesday evenings, at 8 o'clock, and the following arrangements for papers have been made:—

February 17.—"On the Present Aspects of Africa, with Reference to the Development of Civilised Trade with the Interior." By Trelawny Saunders, Esq.

March 3.—"On the General Features of West African Trade from Senegal to St. Paul de Loanda." By Consul Thomas J. Hutchinson, F.R.G.S.

March 17.—"Remarks on the Geographical and Physical Character of the Diamond Fields of South Africa." By the Honourable Theophilus Shepston, Secretary for Native Affairs in Natal. Communicated and explained by Dr. Mann.

Chemical Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

March 6.—"On the Paraffin Industry." By Frederick Field, Esq., F.R.S.

March 20.—"On Anthracene and Alizarine." By Dr. Versmann.

April 10.—"On some Recent Processes for the Manufacture of Soda." By C. W. Vincent, Esq., F.C.S.

April 24.—"On Pyrites, as a source of Sulphur, Copper, and Iron." By Dr. C. R. A. Wright, F.C.S.

May 8.—"On Sugar Refining, with special reference to Finzel's Sugar Crystals." By Dr. Griffin.

May 22.—"On the Manufacture of Chlorine." By W. Weldon, Esq., F.C.S.

CANTOR LECTURES.

The second course is on the "Chemistry of Brewing," by Dr. Charles Graham (University College, London), and consists of seven Lectures, the remaining three of which will be given as follows:—

Lecture V.—February 16th, 1874.

On Fermentation. (Primary.)

Lecture VI.—February 23rd, 1874.

On Fermentation. (Secondary.)

Lecture VII.—March 2nd, 1874.

The Beer of the Future.

A third course "On Carbon and Certain Compounds of Carbon treated in reference to Heating and Illuminating Purposes," will also be given during the Session, by Professor Barff, M.A. Further particulars will be given in the *Journal.*

All the above Meetings and Lectures are open to Members, each of whom has the privilege of introducing two friends.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS, 8.** Cantor Lecture. Dr. Graham, "On the Chemistry of Brewing." (Lecture V.)
Medical, 8.
Asiatic, 3.
Victoria Institute, 8. Mr. N. Whitley, "The Brixham Cavern, and its Testimony to the Antiquity of Man examined."
London Institution, 4.
Institute of Surveyors, 8. Mr. Ralph William Clutton, "The Self-sown Oak Woods of Sussex."
Royal United Service Institute, 8. Surgeon-General W. C. Maclean, "Sanitary Precautions to be Observed in the Moving and Camping of Troops in Tropical Regions."

Tues. ...**SOCIETY OF ARTS, 8.** African Section. Mr. Trelawny Saunders, "On the Present Aspects of Africa, with Reference to the Development of Civilised Trade with the Interior."
Civil Engineers, 8. Discussion on Mr. B. B. Stoney's Paper, "On the Construction of Harbour and Marine Works with Artificial Blocks of Concrete of large size."
Statistical, 7¾. Mr. F. H. Janson, "Some Statistics of Courts of Justice and Legal Procedure in England."
Royal Institution, 3. Professor Tyndall, "On the Physical Properties of Liquids and Gases."
Pathological, 8.
Zoological, 8½.
Anthropological, 8.

Wed. ...**SOCIETY OF ARTS, 8.** Mr. G. C. T. Bartley, "On Thrift, as the Out-door Relief Test."
Meteorological, 7.
Royal Horticultural, 1.
London Institution, 7.

Thur. ...Royal, 8½.
Antiquaries, 8½.
Linnæan, 8.
Chemical, 8. Mr. J. Bell, "Lecture on the Detection and Estimation of Adulteration in Food and Drinks."
Royal Institution, 3. Professor Duncan, "On Palæontology, with Reference to Extinct Animals and the Physical Geography of their Time."
Numismatic, 7.
Royal Society Club, 6.

Fri ......Geological, 1. Annual Meeting.
Philological, 8.
Royal Institution, 8. Weekly Evening Meeting. 9. Mr. Vernon Heath, "The Autotype, and other Photographic Processes and Discoveries."

Sat......Royal Institution, 3. Mr. R. Bosworth Smith, "On Mohammed and Mohammedanism."

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,109. Vol. XXII.

FRIDAY, FEBRUARY 20, 1874.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

INTERNATIONAL EXHIBITION OF 1874.

The Council have resolved to offer the Society's Gold and Silver Medals in connection with the International Exhibition of 1874.

A gold and a silver medal is offered in each class, and these medals will be given for any object exhibited which, in the opinion of the Council, shows paramount or very great excellence, whether in respect of the final result, the machinery, method of production, or novelty.

TECHNOLOGICAL EXAMINATIONS.

The Programme for the Examinations in the Manufacture of Cloth is now ready, and can be had upon application to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C.

The following donation has been received since the last announcement:—

Bath Gaslight and Coke Company...... £2 2 0

INSTITUTIONS.

The following Institution has been received into Union since the last announcement:—

Sheffield Young Men's Christian Association.

PROCEEDINGS OF THE SOCIETY.

AFRICAN SECTION.

A Meeting of this Section was held on Tuesday evening last, Vice-Admiral Erasmus Ommanney, C.B., F.R.S., in the chair, when a paper was read—

ON THE PRESENT ASPECTS OF AFRICA, WITH REFERENCE TO THE DEVELOPMENT OF CIVILISED TRADE WITH THE INTERIOR.

By Trelawny Saunders.

The African Continent is once more remarkably exciting public attention, and the circumstances appear to point in a special manner to the necessity for some great effort to carry legitimate commerce, and the influence of European civilisation, into the interior. This, of course, is a subject that first of all appeals to the consideration of African merchants; but it may also be found necessary to call for the co-operation and support of the public at large. For the extension of legitimate enterprise into the central regions of Africa seems almost to lie beyond the reach of European trade, as at present organised, at least, in regard to the direct operations of Europeans themselves. Whether the resources and aims of private firms be too limited to advance beyond the coast or the boundaries of European administration, and whether the extension of European trade into the heart of Africa be at this moment an object that it is politic or profitable to pursue, are, no doubt, subjects on which different opinions may be formed. Still, there can be no question about the utility of discussing such subjects at the present moment; and it is for the purpose of promoting such discussions, and of inviting information and encouraging measures that may tend to the opening up and advancement of legitimate commerce in the interior of Africa, that the Society for the Encouragement of Arts, Manufactures, and Commerce has constituted a special African Committee.

Concerning the spirit in which the committee have entered upon their task, it seems unnecessary to say more than to refer to the introductory words of Admiral Ommanney, the Chairman of the committee, at the first meeting, and to the inaugural address delivered by the Right Honourable Sir Bartle Frere on that occasion, and published, as all future proceedings of the committee will be, in the *Journal* of this Society.

It is not for any individual to dogmatise on questions of such magnitude as the extension of trade into the interior of a barbaric though productive continent, till lately all but totally unknown, and still containing vast regions on which the feet of civilised men have never yet trodden. This is particularly the case, when such questions touch on the interests of an important and prosperous class like the African merchants. As a class, these enterprising men deserve ample consideration, for they are, and have been, most persevering pioneers in the great work of opening Africa. They are the pioneers in the pursuit of commerce, just as geographers and explorers are its scouts and reconnoiterers. Now that our scouts—our Livingstone and Baker, our Burton and Speke, our Denham and Clapperton, our Mungo Park and Lander, *cum multis aliis*, have made known so much of the length and breadth of Africa, the question is whether the time has not come to advance into the midst of this rich and virgin continent, with the full force of the commercial resources and capital of the country at large, since by such vigorous measures alone can an adequate result be attained.

Many who would take no part in solving this question on a purely commercial basis, are nevertheless deeply concerned on behalf of the dissemination of philanthropy and religion. Great national sacrifices have been made to abolish African slavery in the West; and under her Majesty's Government the Right Hon. Sir Bartle Frere has recently inaugurated measures for

abolishing the African slave trade which rages in the East. It is in support of this great, benevolent, and politic object, that the opening up of direct European intercourse with all the chief seats of population in the interior of Africa is now urged. The establishment of this intercourse is no less demanded on behalf of the dense manufacturing populations of the civilised world, who are yearning for more abundant products and new markets for their prolific industry. Africa can supply raw products to an incalculable extent. Its fertility is unquestionable, and it has literally millions of industrious inhabitants who have yet to be brought under the protection of legitimate intercourse with more enlightened nations.

Africa has still other claims upon philanthropy and religion to a greater extent than any other part of the world. Besides the terrible evils of slavery, and the want of that encouragemement which is so much needed to elicit natural wealth and industry, the African Negro suffers indescribable horrors from diabolical customs, and the most cruel and wanton superstitions and misgovernment. In exchange for these he is also now fast becoming the prey of a very active and fanatical Mohammedanism, the very instrument which was the sole means of European exclusion from Africa up to the establishment of the Western slave trade, and which is now, at the present moment, the great supporter of the Eastern slave trade. Can Christian men stand coldly on one side, with folded hands, while Mohammedanism is riding rampant over millions of our Negro fellow-creatures? Can Christian men any longer suffer this poor Negro, whose claims upon civilisation are many and indisputable, to go on a pitiable victim of intellectual darkness and foreign avarice? No! It is Christians only who can rescue the African negro, and legitimate commerce seems to offer the most practicable, if not the only adequate, path to the performance of that great duty.

The question must be repeated—How is commerce with inner Africa to be brought about? The answer requires an examination of the present aspects of Africa, and to understand these aspects it is necessary to recur to the records of the past, a brief review of which may, therefore, be permitted.

The time was when Africa in the north was the seat of governments that held the first rank among the nations of antiquity, and contended for the supreme mastery of the civilised world. The grandeur of Egypt, Carthage, and Greek Cyrenaica, although eclipsed by the successful rivalry of Rome, was far from being destroyed by the Roman conquest. It is even probable that the irruption of the Vandals into Northern Africa left abundant remains of classic civilisation, in the conditions that made Northern Africa the cornfield of Southern Europe, endowed it with handsome cities, kept it open to European intercourse, and, doubtless, extended that intercourse, in a remote way, as far as the Soudan and its southern highlands. Indeed, further to the east, it probably reached the equator, where the great Nile leads up to the lake regions, which have at length been revisited in these days by Consul Burton, Captains Speke and Grant, Sir Samuel and Lady Baker, and Dr. Livingstone.

No; it was neither the Roman nor the Vandal that blotted out the very traces of ancient European intercourse with Africa. It was, first, the Persian Khosru-Perwiz of the Sassanian dynasty, who in the seventh century utterly destroyed the beautiful cities of Cyrenaica, and paved the way for that complete obliteration of the past which marked the invasion of the Arabs, and the establishment of Islam in the same century. From that date the blight of Mohammedanism overwhelmed the land, swept away the civilised inhabitants, gave the country to lawless nomads, and the sea to reckless pirates, and, finally, put an entire stop to European intercourse for more than a thousand years.

Thus, shut out from the old ways and routes of commerce—not only with Africa but also with the Orient—by a fierce and relentless foe, too strong to be put down, European enterprise began to search into the mysterious unknown, for new tracks and openings for trade. It was at the beginning of the fifteenth century that Prince Henry, of Portugal (a grandson of our own John of Gaunt, and nephew of Henry IV.), began to promote the exploration of the West Coast of Africa, which was only known as far as Cape Nun. That cape was doubled in 1415, Cape Bojador in 1432, Cape Blanco in 1443, and Cape Verde in 1446. The Rio Grande, the Azores, and the Cape Verde Islands, were all discovered before Prince Henry died in 1463. He had reached the age of 67, and had devoted himself with admirable foresight to the cause of African discovery for 46 years of his life. He began his career in the teeth of public opinion, but when he died the whole Portuguese people had become the ardent promoters of African discovery. Within ten years of his death, the Guinea Coast had been traced, and navigators crossed the line. Diego Cam reached 22° south in 1484, and Bartholomew Diaz doubled the Cape of Good Hope in 1487. Ten years after, in 1497, Vasco de Gama explored the East Coast of Africa, finding Arabs in possession then as now, thence he pursued his voyage to India. Thus, in spite of Mohammedans, Africa and Asia were once more laid open to European intercourse. Four years earlier, in 1493, the unheard of Continent of America had been discovered by Columbus, in an attempt to reach Asia by a westerly track across the Atlantic.

This simultaneous discovery of America imposed a sad fate upon the natives of Africa, for it was soon found that the American aborigines were unequal to the heavy labour required from them by their European conquerers, and that an African labourer was much more serviceable. Hence the African slave trade with America sprang into existence as early as 1503. This abominable traffic speedily supplanted all legitimate enterprise; and although suppressed to a very great extent since 1808, it is still in some parts a serious obstacle to lawful trade, and it has everywhere left the marks of its deadly influence. The slave trade goes far to account for the remarkable limitation of European establishments in Africa to the ports on the coast, although four centuries have elapsed since those ports began to be founded. Indeed, the year 1788, which is memorable for the introduction of the anti-slavery movement into Parliament by Mr. Wilberforce, is equally notable for

the establishment of the African Association, which signalised the rise of the tide against slavery by encouraging the exploration of the interior of Africa. From that time European exploration has never ceased; and now, although the geography of many parts is but imperfectly known, still absolute ignorance is confined to a few tracts. These are the Libyan Desert, which Gerard Rohlf, a distinguished German explorer of Africa, is attempting to penetrate; the Kong Mountains, including the space between the Guinea Coast and the Niger; the Western equatorial countries; and the Galla Mountains, between the snowy Mountain Kilimanjaro and Abyssinia. That the time has come for a substantial and perserving effort to establish European intercourse with the interior, on a sound commercial basis, is indicated by this meeting now assembling—not to listen, as our fathers did nearly 100 years ago, to proposals for the geographical exploration of an unknown continent, but to discuss, under the auspices of the Society for the Encouragement of Arts, Manufactures, and Commerce, the ways and means of acting upon the knowledge which a century of geographical research has, through much noble, self-sacrificing devotion, and many disappointments, at length brought to light.

Let us pause a moment to pay a tribute to the heroic men who have mainly contributed to throw the first rays of light upon inner Africa—to Mungo Park, Brown, Hornemann, Bruce, and Lacerda, at the end of the last century; to Denham and Clapperton, Lander and Caillié, in the first part of the present century; to Livingstone, Burton, Speke, and Baker, our contemporaries. Many others have toiled and suffered in pursuance of the same end, and the records of African discovery will do justice to their respective merits. The time has arrived to utilise their successful work, by drawing forth the natural wealth of Africa for the benefit of her own sons and mankind at large, and by implanting there the blessings of civilisation, and the desire and the skill to replenish the earth and utilise its fruits.

Besides the slave trade, there are other causes which contribute to prevent the extension of European establishments into the heart of Africa. The chief among them are the intolerable exactions which commerce suffers from every potentate, and every petty chief and individual, who has local influence enough for the purpose. The organisation best adapted to suppress these robberies is the great question which it is now desired to urge upon the consideration of all who are concerned in the welfare of Africa. It is of paramount importance. It concerns the missionary and philanthropist as much as the merchant. Its ultimate solution must depend on Parliament and her Majesty's Government, and it will probably require the same strong and unmistakeable expression of public opinion as that which supported the Anti-Slavery Society. Until measures are taken to open up, perhaps, by degrees, and in the course of time, the highways to all the great seats of population in the interior of Africa, rendering it safe to form permanent mercantile posts, with suitable communication between them and the coast, it will be a deception to suppose that any sound commencement has been made. Without such an established policy, to be persevered in through evil report and good report till the end is gained, it is useless to think of propagating religion, uprooting slavery, rescuing the poor people from their cruel sufferings, or encouraging the cultivation of the soil, the collection of natural products, or the trade springing therefrom. That there will be difficulties to overcome in pursuing such an aim no one can doubt, but surely the qualities which enabled British merchants to maintain their interests against the armies of the Mogul, and to acquire the most magnificent foreign possessions in the world for the State, are qualities not lost or deteriorated, and not inadequate to extend and maintain legal trade, and to secure good government, either through native or British administration in Africa.

The importance of opening the roads and preserving the freedom of traffic on them has been fully recognised by her Majesty's Government. It is sanctioned in the simple treaty made with Ashanti in 1831. It has been quite recently enforced in this hall, at the instigation of the Royal Colonial Institute, by an experienced African governor, Sir Richard Graves Macdonnell, whose words well deserve to be reiterated. He says:—

"That clause is in force still, but certainly it has practically dropped into abeyance, with the consent both of Liberal and Conservative Governments. It provides that the paths shall be perfectly open and free to all persons engaged in lawful traffic, and that parties molesting them in any way whatsoever, or forcing them to purchase at any particular market, or influencing them by any unfair means whatever, shall be guilty of infringing the treaty, and liable to the severest punishment."

Sir Richard goes on to say—

"All we have to do is to constitute ourselves henceforward the sole tribunal of reference on those points, and assume all authority necessary for such a purpose, without regard to questions of jurisdiction or fruitful quibbles. We must assert," he says, "and take with a high hand, what jurisdiction we require for the general benefit; and we must, if necessary, hang any native chiefs who may persist in attacking traders or stopping roads. Our commission there is to see that commerce be safe and wholly unfettered, and that it be so, not merely in the words of a treaty lying in some musty pigeon-hole, but palpably so, on and over the face of the country and along the coast. If we can do this," (says Sir Richard Graves Macdonnell, with his experience of government in Africa). "If we can do this, let us stay there; but if our rule is to be a sham again, let us abandon the coast, before a fresh war overtake us. I venture to say (he continues), that in ten years, under an impartial and clearly defined policy such as that, the whole social life and appearance of the country would be so altered for the better as to be scarcely recognisable. I also assert," he says, "that this could be done without risk of expense or war; nay more, I believe that although in regard to many articles of export, our settlements on the Gold Coast are not so favourably placed as in other districts, our legitimate commerce there, instead of being represented, as now, by less than half a million—less in fact than its amount thirty years ago—might be quadrupled ere ten years of secure and free trade had elapsed."

Enough has been quoted from this excellent authority to prove his opinion of the importance, practicability, and profit attending the protection of trade routes in Africa. Now, permit me to make another quotation, not from a British governor, but from a work by an educated and experienced negro gentleman, Mr. Benjamin Anderson, formerly secretary of the Monrovian Treasury, under President Warner, of the Negro republic of Liberia. This native official took a journey from the cost to Musardu, 30 days distant in the interior, and in the very interesting and

well-written narrative of his journey and observations, he says :—

"To carry on trade safely, free from risks and interruptions incident to a country peopled by barbarians and semi-barians, and divided into so many jarring interests, it would be necessary to establish forts. . . . The natives declare that they would be glad to have such establishments among them. These forts would also second and strengthen any missionary effort that might be made out there. . . . The support, protection, and moral and material influence which would be exerted, would ensure permanence and success."

This combination of high official British and native testimony places the argument which it supports beyond cavil or doubt. It remains only to be so impressed on the understandings of those who desire to promote commerce in Africa, as to secure a system of administration qualified to give it lasting effect.

It is obvious, however, that no progress can be made in this direction on the West Coast of Africa, if a majority in Parliament entertain the idea of abandoning the British establishments there. It may be, and it is believed it will be found to be wise to reorganise them, and to make them sufficiently free to contend with the exigencies pertaining to the progressive advance of mercantile posts and free roads towards the interior. But to abandon the establishments altogether is simply impossible. Let a few questions be put. Would the abandonment of the Government establishments involve the withdrawal of the British merchants? Certainly not. Could this important interest be left to its fate in any case? Would this abandonment be consistent with the national resolution to put down and keep down African slavery? And would not the spirit of the nation be aroused by any neglect of that imperative duty? After the experience of nearly 100 years, or three generations, it may be considered undeniable that the nation will not rest while a vestige of African slavery can be exposed. What, then, is the case at present? Restrained on the West Coast, it finds outlets on the East, where numerous ports, shallow waters, islands and reefs, narrow seas, and irrepressible fleets of Arab dhows and other Eastern craft afford extraordinary facilities, unexampled in the Western slave trade. There is too much cause to complain also of a tacit, but potential concurrence with slavery on the part of the Turkish Government, in covering piratical slavers by the Turkish flag, and encouraging, or at least permitting, that brutal trade in its ports and markets. The Turkish Government may forget what it owes to the British bondholder, but it must not be supposed that the credit of any State can be maintained in the long run on the basis of slavery or concurrently with it.

To contend, then, with Eastern African slavery, it must be tracked to its source among the threatened populations of Africa itself. It must be hunted out as an abomination, exposed, followed up, attacked, and effectually stamped out, after the brilliant example of Sir Samuel Baker. The people and governments that support it must be made sensible, by every available means, that modern civilization cannot and will not endure the unholy stigma, and will, sooner or later, treat those who do as enemies to humanity. The great continent that suffers chiefly from it must be thrown open to legitimate commerce; lawful trade must penetrate to the remotest regions inhabited by settled populations, who must be encouraged in the pursuit of agriculture and other profitable occupations that may contribute to bring them into the fold of civilisation.

Nothing less will satisfy the expectations of the nation which has sacrificed ten millions sterling to the abolition of African slavery among its own people; and the support, countenance, and aid of other nations, who have joined in the work already done, may be fairly deemed to be assured. Besides, there are the teeming millions of civilisation in the densly peopled hives of labour, who are also certain to promote the solution of this African question, for they are ceaselessly craving for more raw material and cheaper food. In Africa there is the fertile soil, the climate, and the ample population of cultivators, ready to raise the cheapest produce in the world, if you will only secure their lives and property from destruction and injury; give them liberty to work, free roads, and open markets.

It is commonly asserted that the African is indolent. Some, no doubt are, but that great numbers are quite the reverse is proved by the testimony of Sir Richard Graves Macdonnell, in speaking of the natives of Western Soudan, one of the regions at present beyond the limits of European intercourse. Sir Richard says of them :—

"I may here fitly explain that the prevalent idea of the native African's want of industry is a great delusion. I have seen many hundreds of natives along the Gambia who had made journeys of months to reach the banks of that river—journeys attended with great risk and severe toil—and the object of which was to hire a plot of land in a convenient locality for raising ground nuts, used in manufacture of oil, to barter for guns, Manchester goods, or other articles, laden with which these hard-working men would return to their own distant homes, true missionaries of industry. One such man could perhaps raise in a favourable season, by his labour, about 300 bushels of ground nuts, worth perhaps 2s. each, making a total on the venture of £30, payable in goods whose price rose according to the distance from the coast. The chief whose land he tilled had, of course, to be paid an equivalent for rent; others had to be reimbursed for board and lodging, however rough and scanty, during the raising of the crop. Scarcely a nominal moiety, as well as I was able to ascertain (says Sir Richard), would generally remain to the labourer in a good year. Nevertheless, I have seen them by hundreds trudging off to the distant regions of Bambarra, Bambook, and countries near the sources of the Niger, laden with their hard-won and scanty earnings, quite content if they could get even a portion of that remnant safely back."

A small portion indeed, it may be truly said, owing to the successive exactions already referred to, the extent of which appears to be regulated only by arrangements between the plunderers, that each may get a share, and still leave some little inducement to the poor wayfarer. Who can doubt, if such a system can be maintained in all parts of Negroland—as it unquestionably is—that an ample and rich profit awaits good administration in return for any just and equitable system for the repression of such robbery, the security of life and property, and freedom of trade and industry. It will not be expected that such a work will be speedily accomplished. Let it only be speedily commenced, and let it be well understood that on such a policy the nation is firmly and fully resolved. Events now travel with unprecedented rapidity, and no one can foresee how soon we may be permitted to succeed in planting trade and good government in Negroland.

There is another condition which it may now be well to mention, that is also said to interfere with African prosperity. It is the brief tenure of authority in the British establishments there. To resolve on permanent employment as the rule of the service, whether under a mercantile system or otherwise, should be no more onerous there than in India, or, at least, not more than comparatively. The necessity for acclimatisation points to this principle. Its adoption would also probably involve a consideration and selection of the most favourable sites for the principal ports and inland posts, with a view to the healthiness as well as the accommodation of the residents and shipping. The proximity of sanitary resorts may perhaps be the only solution attainable on the coast, coupled with a strict attention to sanitary matters in general. The qualities of the *Eucalyptus globulus*, or blue gum tree of Hobart-town, seems to point to it as the tree for the healing of fever-stricken localities, while chinchona and ipecacuanha plantations also afford other remedies for tropical diseases that no European settlement in the tropics should neglect. Permanent employment also involves the selection of the best men who can be got for the work, and the adoption of a scale of remuneration which would encourage them to remain when their services were in request. These suggestions are believed to be not only reasonable, but also supported to some extent by the successful experience of our countrymen in another tropical region, namely, India. Another word on this topic may be added. Permanent employment also permits of enlarged responsibility, and in the future management of African affairs, especially in opening up the interior, it would be most necessary. Finally, permanent employment, by drawing out men like Governor Maclean, would, doubtless, prevent such complications and costly wars as that now waging against Ashanti, the character of which has been so clearly explained by Sir Richard Graves Macdonnell in the lecture already quoted.

These are some of the questions that serve to draw attention to Africa at the present moment, and that demand a speedy and decisive solution. How the past has led up to them has been briefly told. To consider them more in detail, and with reference to the actual conditions of the continent, requires a discussion of its natural or physical, its political, and its commercial aspects, which, to describe within the narrow limits remaining on this occasion, must needs be very concise.

The African Continent and Islands embrace an area estimated at 11,556,300 square statute miles, being three times larger than Europe. The distances between its extreme points, taken east and west, and north and south, are 5,000 miles in each direction. It must not, however, be supposed from those figures that any point in Africa is 2,500 miles from the sea—for Africa is not square, but may rather be compared to a crescent, the convex side of which partly fits into a circular or corresponding recess formed by Europe and Asia, and is partly thrust from thence, forward to the west and south, into the broad ocean.

The parallelism of outline thus displayed between Africa and the sister continents of Europe and Asia is also maintained on the concave side of the African crescent; which, although divided from South America by a vast expanse of water, finds in the opposite coast of that portion of the western hemisphere, an equally well-fitting counterpart.

Speculation on these features is not requisite for the present purpose, further than to notice that the proximity of the parallelisms on the one side afforded the only access to the continent in ancient times, and until fanaticism drove Europeans to explore the Atlantic.

Although the outline of Africa presents the great length of 5,000 miles between its extreme points, still its peculiar form reduces the distance of any place in the interior from the sea-coast to a maximum of 1,200 miles. This distance, again, undergoes a great reduction, with reference to the most populous parts of the interior that are nearer the coast, such as the Soudan and the equatorial regions, which also have the advantage of access by means of great rivers—the Nile, the Niger, the Benuwe, and other inland waters.

The natural divisions of a continent are generally deduced from the configuration of its surface into mountains, plateaus, and low plains, and also river-basins. These features are not wanting in Africa, for a great range of mountains characterises the whole of the eastern side of the continent, from the Isthmus of Suez to the Cape Colony, and rises above the snow-line in the peaks of Kenea and Kilimanjaro, near the equator. From this range, which rises more or less abruptly within a short distance of the Eastern Ocean, a mountainous plateau proceeds, crossing the Nile at Gondokoro, and extending westwards and southwards to the opposite coast. Its general level is probably between 2,000 and 3,000 feet above the sea, but in some parts it appears to rise to 10,000 feet, and perhaps greater altitudes may be discovered. In this description is included the southern and equatorial regions, as far north as Gondokoro and those ranges which extend from thence westward to the Niger, throwing off their waters to the Bahr el Ghazelle, Lake Chad, and the Lower Niger. The rest of Africa, between the Gulf of Guinea, the Atlantic, and the Mediterranean, is also elevated; having on the west the Kong mountains and plateaus, between the Gulf of Guinea and the Niger; with the rocky defiles, the sandy wastes, and fertile oases of the Sahara, stretching from the Niger to the Atlas Mountains, which skirt the Mediterranean from the Atlantic to the Little Syrtis, or Gulf of Cabes. On the east is the plateau of Fezzan, the highlands of the Tibboos, and the Libyan Desert, extending to the Nile, and almost unknown.

These orographic features are, however, far less distinctive of Africa than its climate. Africa is more especially tropical than any other part of the earth's surface. It is the only continent intersected by the equator and both tropics, the tropic of Cancer crossing the widest part of Africa, and the tropic of Capricorn the narrowest. In the remarks that follow on African climate it will, it is hoped, be interesting to bear in mind the course of the equator and tropics around the world, because those remarks will have an equal application to the rest of the tropical belt, as well as to Africa. The equator, which bisects Africa midway between its northern and southern extremities, leaves Asia untouched, traverses the Asiatic archipelago, and crossing the Pacific, passes over the State of Equador, and the Valley of the Amazons in South

America, returning to Africa over the Atlantic. The tropic of Cancer proceeds from the widest part of Africa, over the three promontories which form the southern shores of Asia, viz., Arabia, India—touching Cutch and Calcutta, and South-eastern Asia—crossing Burmah and the frontier of China at Canton; thence it proceeds over the Pacific Ocean, and crosses the narrow isthmus of Central America at Mexico, and returns by the Gulf of Mexico and the Atlantic to Africa. The tropic of Capricorn proceeds from the narrowing southern part of Africa to the end of Madagascar, crosses the Indian Ocean to intersect Australia, and thence passes over the Pacific, and the narrowing portion of South America in the latitude of Rio Janeiro, and thence returns by the Atlantic to Africa.

Recurring now to the climate of Africa, it should be remembered that Africa ranges through 75 degrees of latitude, divided almost equally by the equator; and that it has 47 degrees, or nearly two-thirds of its extent, subjected twice a year to the vertical action of the sun. The sun's action is, however, far from being uniform throughout this wide belt, as it is commonly supposed. Neither is the greatest heat to be found at the equator, as meteorologists have taught. The greatest solar heat on the earth's surface is confined to the northern and southern extremes of the wide tropical zone, and occurs at each of them alternately, once every year during the summer solstice, which lasts for two months. These extremes are also alternately belts of lowest temperature within the tropics, once every year at the winter solstice. In the extreme northern belt is the Sahara and Libyan deserts, and part of the valley of the Nile, which is saved from desertion by the bounteous waters conveyed to it from afar by the great river.

The equatorial belt is not subject to these excesses, but is remarkable for uniformity of temperature with scarcely any variation. Thus at Singapore the temperature never varies beyond ten degrees of Fahrenheit's thermometer from one end of the year to the other. This belt is also usually subject to much rain, which, with a warm and invariable temperature, is productive of excessive vegetation. Such is the state of the valley of the Amazons, the Asiatic Archipelago, and generally of equatorial Africa. The variations of climate arising from aspect, altitude above the sea, distance from the sea, winds, and other causes, are all subjects for which equatorial Africa offers a most interesting, wide, and prolific field. The equatorial belt has the dominions of Zanzibar on the East Coast; the French settlements on the Gaboon on the West Coast; the region of the great lakes in the eastern part of the interior; while the western part remains still unexplored.

In the southern extreme belt is the Kalihari Desert, dividing the breadth of the continent with the Republic of the South African Dutch Boers, the latter deriving its habitable state from elevation above the sea, and the deposit of rain-bearing clouds attracted to it from the ocean.

Unlike the invariable climate of the equatorial belt, these extreme desert belts have a diurnal variation exceeding 50 degrees of Fahrenheit. The most striking record of the intense solar heat in these extreme belts is Captain Sturt's, from obsertions made in the Australian desert, and equally applicable to the African deserts. He says:—

"On the 21st of January, at a quarter past three p.m., the thermometer has risen to 131° in the shade and to 154° in the sun. The mean of the thermometer for the months of December, January, and February had been 101°, 104°, and 101° respectively in the shade. Under its effects every screw in our boxes had been drawn, and the horn handles of our instruments, as well as our combs, were split into fine laminæ. The lead dropped out of our pencils, our signal rockets were entirely spoiled; our hair, as well as the wool on the sheep, ceased to grow, and our nails became as brittle as glass. The flour lost more than eight per cent. of its original weight, and the other provisions in a still greater proportion. The bran in which our bacon had been packed was perfectly saturated, and weighed almost as heavy as the meat; we were obliged to bury our wax candles; a bottle of citric acid in Mr. Browne's box became fluid, and, escaping, burnt a quantity of his linen; and we found it difficult to write or draw, so rapidly did the fluid dry in our pens and brushes."

Dr. Livingstone gives a very different picture of the Kalahari Desert on the African part of the same zone; but his description applies to the opposite season of the year, when, freed from solstitial heat, the surface of the ground is clothed with abundant grass and the foliage of plants, whose roots are adapted to resist the burning heat which bakes up the soil in the summer. So also in the oases, where natural springs supply bounteous irrigation, which, with the labour of man, enlivens umbrageous trees, that serve to defend animal and vegetable life by the shade and moist exudation of their foliage. Here, in these deserts, is the last resort of nomadic life, the pasturage ground of wandering herdsmen and shepherds, who, in the freedom of their habits, change of scene, and the productiveness of their flocks and herds, find a charm that withstands the allurements of cultivated fields and populous cities. The wild animals also roam over these regions, at the proper season, in wonderful abundance, offering an equal attraction to sport and industry.

Between the central equatorial belt, with its invariable temperature, and the extreme tropical belts, with their excessive heat and lowest degree of cold within the tropics alternately prevailing, there are two intermediate belts, one on each side of the equatorial belt, which enjoy the advantage of temperature free from the extremes that distinguish the other three belts. These two are the belts most favourable to man, except where the equatorial belt enjoys similar modifications through elevation above the sea. Thus, in the northern belt is the populous Soudan and Abyssinia, with an aggregate population of eighty millions. In the southern of these belts are the Portuguese settlements of Benguela on the West Coast, and Mozambique on the East Coast, with the populous kingdoms of the Cazembe and Muatahianvo in the interior.

The story of African climate would not be complete, even under the limited aspect selected for this discourse, if the regions beyond the tropics were unnoticed. These lie between the solstitial deserts and the sea. They enjoy the variable climate of the temperate zone in its warmer conditions. The summers are hot, but not with the intensity of the deserts; and winter restores vigour without severity. While moisture is not wanting, the dryness in the air of these regions is remarkable, and of curative benefit to weak respiration. Here are situated Morocco, Algiers, Tunis, Tripoli, and Egypt, on the North, the puny successors of

the great powers of antiquity. In the South are the prosperous British colonies of the Cape of Good Hope and Natal, together with the territories of the Republican Boers. The Hooper Company's submarine cable along the Eastern Coast of Africa may soon be expected to exercise a potent influence on the advancement of these invaluable portions of the British Empire.

In concluding this branch of the subject, it may be useful to explain the way in which solar heat produces these varieties of climate. The sun, in pursuing his apparent course from one tropic to the other, through 47 degrees of latitude, or 23½ degrees on each side of the equator, passes vertically over 40 degrees, from 20 degrees north, to 20 degrees south, at a nearly equal rate of about 10 degrees a month, or 20 miles a day. But in his passage from 20 degrees to 23½ degrees, the sun also occupies a month, or the same time as in going over 10 degrees in the rest of his course. Then, after reaching the tropic in 23½ degrees, he takes another month to return over the same ground to 20 degrees. Thus, the sun is vertical for two months continuously in these 3½ degrees of latitude, at the tropics of Cancer and Capricorn, once a year alternately; whereas, elsewhere, he passes over the same extent in ten or eleven days. There is thus a sixfold increment of solar heat at each tropic during the solstice, or when the sun is prolonging his stay there. On the other hand, when the sun retires from the tropic, he does not return to the same one again for ten months, and this absence is, of course, productive of the restorative change in vegetation and temperature before mentioned. Now, with regard to the equatorial belt, the sun passes over it at his normal rate of ten degrees a month, and he is only absent from the equator for six months at a time, hence there is no intensity of solar heat, and but little change, owing to the brief period of recurrence. As to the intermediate belts, however, they have the advantage of the sun's passage at his normal rate, coupled with the absence of his vertical action for a longer period than at the equator, though not so long as at the extreme tropics; hence they enjoy advantages corresponding to those of the temperate zone in freedom from extremes, with considerable variation. From this brief exposition, may it not be inferred that the climate of Africa is a subject well deserving of study on its own account, and very necessary to be understood in attempting to carry European trade and civilisation into the interior?

The population of Africa is another important branch of this great subject. The inhabitants of the continent and islands are reckoned at 192 millions, exceeding by twice and a-half the population of North and South America combined. The ratio of population to area (about 16 to the square mile) is three times greater than in the Western hemisphere. This ratio is, however, low in comparison with Europe, which, thanks to civilisation, has the highest in the world, or 76 persons to the square mile, being nearly five times more than Africa, and exceeding 14 times more than the Western hemisphere. It should, however, be observed that this ratio of population to area for the whole continent altogether fails to convey a just idea of its really populous character in the interior. If population is very sparse in the desert regions, it is very abundant in other regions. According to Dr. Behm, the Negro countries, to which it is so much desired to draw public attention, are by far the most populous parts of the continent. Thus in the Soudan, which our travellers have repeatedly visited, but where our merchants have not yet formed any posts or establishments, the population is estimated at nearly 80,000,000, or 54 to the square mile. According to Captain East, the town of Bida, on the Niger, has a population of 80,000. East Africa is said to have a population of nearly 30,000,000. Equatorial Africa is estimated to contain 43,000,000. When the numbers in these Negro countries are compared with those of the European settlements and the Mohammedan territories in the basin of the Mediterranean, the preponderance of the Negro population is very remarkable, and must afford a great attraction to commercial enterprise. It cannot be doubted that, rescued from slavery and deadly customs by the influence of European civilisation, the growth of population in Africa would be exceedingly rapid and great. The details of African population are contained in the following tabulated statement:—

AREA AND POPULATION OF AFRICA.

	Area in square miles.	Population.	Popula. to square mile.
Morocco	259,593	2,750,000	11
Tunis	45,710	2,000,000	44
Algeria	258,317	2,921,246	11½
Tripoli, with Barca and Fezzan	344,423	750,000	2
Egyptian Possessions	659,081	8,000,000	12
Sahara	2,436,473	4,000,000	1¾
Mohammedan Kingdoms in Middle Soudan	631,017	38,000,000	61
Western Soudan, from Senegal to the Lower Niger, with Upper Guinea	818,536	38,500,000	47
French Senegambia	96,523	201,012	2
Liberia	9,567	718,000	75
Dahomey	3,997	180,000	45
British Possessions	140,968	200,091	14
Portuguese Possessions	35,867	8,500	¼
Dutch Possessions	10,630	12,000	11
Eastern Africa	1,594,550	29,700,000	18½
Abyssinia	158,392	3,000,000	19
Southern Africa	1,965,974	16,009,000	8
Portuguese Possessions on East Coast	382,692	300,000	1
Portuguese Possessions on West Coast	312,532	9,000,000	29
Cape Colony	192,834	496,381	2½
British Caffraria	3,402	81,353	24
Natal	19,347	193,103	10
Basuto Land	7,654	60,000	8
Caffraria	14,257	100,000	7
Orange River Free State	48,049	37,000	¾
Transvaal Republic	76,964	120,000	1½
Equatorial Africa	1,352,179	43,000,000	32
Islands in Atlantic Ocean, including Cape Verd Islands, Prince's and St. Thomas Islands, Fernando Po and Annabon, Ascension, St. Helena and Tristan d'Acunha	2,721	99,145	36
Islands in the Indian Ocean, including Socotra, Abd el Kuri, Zanzibar, Madagascar, Arco, &c., Nossi be, St. Mary, Comoro Islands, Bourbon, and Mauritius	237,992	6,000,000	25
Total	11,556,662	192,520,391	17

It would no doubt be interesting and useful to take up the ethnology of Africa, but the present occasion is inadequate. Suffice it to say that

Negroland does not extend further north than the Soudan. The Mediterranean countries and the northern deserts are not Negro, but are inhabited by Moors, Berbers, Arabs, Turks, Copts, Tuaricks, Tibboos, and mixed races, professing Mohammedanism. That faith is also established among the Negroes of the Soudan, and is now being actively propagated along the river Niger by the conquering nation of Fullas, who have become its converts. It is also spreading southward beyond the Bennwe, and Sir Samuel Baker reported that the Arabs from Zanzibar have introduced it recently in the Lake regions of the Nile.

The Copts of Egypt retain an ancient but debased Christianity; so also do the Abyssinians, who, far from being Negroes, are described as "in general well made, sometimes handsome, with features completely Roman." The pastoral Gallas to the South of Abyssinia, and reaching as far south as Kilimanjaro, are not Negro. They are described by Mr. New, who visited their country, as "tall, stalwart, and well proportioned, with features of a superior order," and instead of the Negro Africans' woolly hair, theirs is wavy and silken. The Galla women are also remarkably handsome, and are much sought after by slavers. The Kafirs, so-called as unbelievers by the Mohammedans, are also a noble pastoral race, quite distinct from the agricultural Negro. This distinction between agricultural and pastoral people is one that should be treated as of great importance in promoting the civilisation of Africans. Their tastes and habits admit of no compromise, and the development of commerce and steady industry among them must be promoted with a due regard to their very different pursuits. It is a pleasure to notice that a large migration of agricultural Negroes is proceeding from the northward into the Colony of Natal, where abundant cultivation awaits them.

At this hour the concluding topic, relating to the political divisions and trade of Africa, must be very briefly noticed. There are some present who can throw ample light upon it, and who will have an opportunity of doing so in the discussion that is to follow.

The Mediterranean countries first claim attention. There is the Mohammedan empire or sultanate of Morocco, with an area of about 2,000 square miles, and a population of 2,750,000, with exports to Great Britain that have risen from £329,290, in 1868, to £685,940 in 1872. The imports of British home produce for the same years were £195,748 in 1868, and £255,386 in 1872. The exports are chiefly beans, maize, and wool. The imports are cotton goods. This state competes with the other Mediterranean territories in the trade with Soudan.

Algeria comes next. It is a costly possession of the French, and is said to have absorbed, since its conquest in 1830, an expenditure of £120,000,000 sterling. Its population consists of 2,500,000 of nomadic Arabs, and about 500,000 settlers, of whom 122,000 are French. Its commerce is chiefly with France. The imports average about £7,000,000, and the exports have risen from £3,709,316 in 1866, to £4,978,250 in 1870. British exports from Algeria have risen in five years from £37,076, in 1868, to £358,618 in 1872. The most important article in this account is "esparto," for paper-making. The export of corn is also rising in value. The British imports are chiefly cotton goods and coal. The influence of this French possession on the trade of the Soudan is well deserving of attention.

Tunis, still an appanage of Turkey, was designated in the ancient times of Roman occupation, "the Emporium," on account of its productiveness, and the extraordinary quantities of grain which it supplied. Its capacity remains, but the miserable government under which it has suffered during the centuries of Mohammedan occupation, have destroyed and kept in abeyance every vestige of its wealth and productiveness. With an area of 45,000 square miles, it has a population of about 2,000,000; but although of some commercial importance, there appear to be no recent reports on the subject.

Tripoli, with Barca (the ancient Cyrenaica), and Fezzan, which stretches into the Sahara, half-way to Lake Chad and the Soudan, is estimated to have an area of 344,000 square miles, and a population of only 750,000, or about two to the square mile. It is at present the chief avenue of British commerce with the Soudan and its population of 80,000,000. In 1872 it suffered great distress from want of rain, causing failure of food crops. The chief exports were then ostrich feathers, ivory, salt, and esparto, or *halfa*, for paper-making. The total exports amounted to £165,000. The imports amounted to £457,800. They were mainly wheat and barley, which covered half of the total amount; British cloth also was valued at £35,000. The only comparison at hand is with the trade of 1827, when the imports amounted to £112,440, and the exports to £90,412. Although it is through Tripoli that many of the British expeditions to the Soudan were made, yet no one would commend this locality as the proper outport of that region, especially since the Turkish Government resumed the full exercise of its authority in 1835.

Egypt.—With regard to the interior of Africa, Egypt possesses an avenue of great importance in the River Nile, which, besides forming the eastern extremity of the Soudan, penetrates to the equatorial belt in the region of the great lakes. But the only dependence to be placed on Egypt as a promoter of lawful trade and the welfare of the Negro, rests entirely on the continuation by that government of the employment of able Englishmen as the chief instruments of its authority in Negroland. It is impossible to view without anxiety the present operations of the slave trade by way of the Nile, Red Sea, and Gulf of Aden; while at the same time Egypt is seen, with the concurrence of Turkey, to be sparing no means of forcing her authority in those directions. It is necessary to include Abyssinia in this consideration. The Christianity planted there by the Emperor Constantine still survives to a wonderful degree, though much debased, through its isolation, mainly due to surrounding Mohammedanism, and partly at least to the absence of much sympathy on the part of other Christian nations. The Abyssinians once carried their arms into Arabia, and built Christian churches in the country of Mohammed. Now, indeed, it is to be feared that under the eye of the great powers that now represent Christendom, Abyssinia will find the grasp of Mohammedans tightening upon her as it never succeeded in

doing hitherto. One by one her ports on the Red Sea and the Gulf of Aden are being occupied by Egyptians and Turks. Is such an occupation likely to aid in putting down slavery and carrying European civilisation into the heart of Africa? Will it be for the benefit of the Abyssinian? Nothing can be more unlikely. It is impossible to consider the position of Abyssinia, at the junction of the Red Sea with the Gulf of Aden, overlooking the eastern gate of the Soudan and the passage of the Nile, where it enters the highlands of the great African lakes, without recognising its political and commercial advantages to any civilised power concerned in Africa and the East. Standing high above the sea, its climate renders it a paradise for Europeans. As a sanitary resort it is invaluable to any European power that may develope a trade with the interior. I say nothing of its interesting nature as an ancient seat of Christianity in Africa, which once gave Christian teachers to Europe. In the present age, when enthusiasm only excites ridicule, no appeal can well be made on a purely fanciful and religious ground. But political and commercial foresight ought at least to form a basis for reflection and action, and on that ground the future of Abyssinia ought not to be any longer neglected. At least let not the ports of Abyssinia on the Red Sea and the Gulf of Aden be absorbed by her Mohammedan enemies, as if civilisation and commerce were alike indifferent about them.

It is now time to bring this discourse to a somewhat abrupt conclusion. The subject requires for its due completion an outline of the state of the Soudan, of Senegal and Gambia, of the rest of the West Coast and the regions behind, from Sierra Leone to the Cameroons, and from the Cameroons to the Congo. Of the Portuguese settlements and the British Colonies in South Africa, Sir Bartle Frere's correspondence in a recent blue book amply tells; and it is an especial object of this paper to aid him in the noble work which, under her Majesty's Government, he has so ably and successfully inaugurated.

DISCUSSION.

Colonel Gawler, having had several years' experience in the management of the Kaffir tribes in South Africa, gave it as his opinion that the most fertile source of irritation amongst the natives was the constant change of policy, which was naturally in favour generally of the stronger party. Probably the present war in Ashanti was due to the same cause. But even supposing that civilised nations should ever adopt the happy policy of swearing to their neighbour and disappointing him not, even though it be to their own injury, it was very improbable that the less enlightened neighbour would be equally observant of his obligation, unless the stronger party showed its strength. Moreover, civilisation, whilst it carried with it certain views, also imposed additional restraints, which the less enlightened races were very loth to observe. The native chiefs also became jealous at seeing their people attracted by the superior qualities of white men, which tended to diminish their own authority. Some risk, therefore, was unavoidable to those who came in contact with uncivilised races. To those who were interested in such questions, he would recommend the perusal of two letters of Earl Grey, in the *Times*, and the recent lecture by Sir Richard Macdonnell. The basis of all our dealings should be good faith, and where any change was necessary it should rather be to our disadvantage. With regard to the future of South Africa, he thought that unless some suitable position were established on the Zambesi or on the seaboard, there would be a serious danger of the wealth of that country passing out of our hands by some foreign intervention. It might be new to some to learn that our right to the diamond fields was not altogether unquestionable, but this was the history. The Cape came to England from the Dutch many years ago, by conquest, but about 240 years ago a body of Dutch farmers, dissatisfied with the English policy towards the Kaffirs, crossed the Orange River and called themselves independent. They made their way to Natal and thought they had a seaport, but they were driven back from there and obliged to return to their inland territory. In 1840 Sir Harry Smith called upon them to acknowledge the English crown, saying very justly that their crossing the river did not alter their allegiance as British subjects; they refused, and a battle followed, in which the ringleader was taken, tried by court martial, and afterwards shot. The country was then annexed, and called the Orange River Sovereignty. Some seven years later three commissioners came out from England, after the Kaffir war, and, in accordance with the policy of the time, it was said that England had too much territory, and this was given back to the Dutch, an indemnity being paid to the British subjects who had invested in land there. The Dutch then set up their own government and called it a free state under a president and parliament. About four years ago diamonds were discovered in the northern part of this Free State, when England claimed the land as having formerly belonged to a Kaffir chief; in fact, most of the land in that neighbourhood had belonged to Kaffir chiefs at some time or other. The Dutch remonstrated and proposed arbitration, but England shelved the proposal and took possession of the diamond fields, though she had to march across the Free State to do so. The Transvaal Republic was an offshoot from the Free State, formed by a number of the poorer colonists who crossed the Vaal; it extended from the Vaal to Lepopo, bordering on the Zulu land, and near the northern boundary of this territory the recent gold discoveries had taken place. Ledenberg was about equidistant from Natal and the mouths of the Zambesi, and he believed the gold now discovered there was but the southern limit of a vast gold-field extending to the Zambesi and beyond it. He was led to this belief by the accounts recently published by the Geographical Society of Portuguese Travellers. Some time ago, he had also met with the account of a Portuguese abbé, who visited the country in 1553; he ascended the Zambesi, and established a trading station or fort at Zetti, and at two other places, and he said that at one of these localities the natives brought in gold in such quantities, that he thought he must have discovered the ancient Ophir. That point was rather less than half way from the Zambesi to Ledenberg, and he believed the accidental mention of the word Ophir by this abbé had led to the tradition which he had heard repeatedly, that the ruins of Ophir existed in that locality. Where gold was discovered a crowd of Europeans would be sure to follow, there being nothing to prevent the rush but the ill-armed savage tribes. He thought, therefore, it would be very politic to regulate this emigration by some hand capable of maintaining order, and of turning to good account the vast mineral and agricultural products of the country. He considered the Kaffirs to be Arabs grafted on a Negro stock, for he had found several Arabic words in use amongst them, and the highest families were really very handsome, and appeared of a very restless temperament. As you went farther north, they partook more of the character of the Negro, and were more addicted to agriculture.

Mr. Consul Petherick said he believed he was the first Englishman who introduced European trade into Central Africa, for, previously to his time and up to 1848, Mo-

hammed Ali Pacha kept a monopoly of it. In that year Sir Charles Murray (the Consul-General) obtained from the old Viceroy the abolition of that monopoly, and on his inducement, he (Mr. Petherick) first entered Central Africa as a trader, beginning with the gum arabic trade. Subsequently he ventured up the White Nile. It had always been his earnest endeavour to introduce British manufactures as much as possible, especially calicoes and other kinds of clothing, which he took with him, not only for the purpose of making presents, but also with the view of introducing it as a sort of medinm of exchange, as it was used in the Soudan and other parts. He found, however, that though they were all very glad to accept bright calicoes as presents, he could not introduce them as an article of barter. The only things he could get rid of in this way were lances, spears, hoes, and similar implements of warfare or agriculture. The natives possessed these things, made from a very good native iron, but in small numbers, and he therefore introduced some of Birmingham manufacture, made after native patterns, which were much sought after; his agent's name, Thomas Short, being soon recognised as a badge of good quality. He had always found an honest policy, but a firm one, the best, but no man who could not protect himself, and who was relying simply on philanthropy, had any business in such a country as Central Africa.

Mr. Edgar said there were several serious obstacles to the development of commerce with Africa. In the first place there was the climate, which necessitated the constant replacing of European agents; whereas, the welfare of Africa would be much more rapidly promoted if it were possible for Englishmen to settle down there and devote their whole life to the development of trade with the interior. Unfortunately, they could not do this; and very frequently plans which they had long been maturing were quite put on one side by their successors. He was rather hopeful of better things, for the introduction of the *Eucalyptus* he trusted would be found to give greater security to European life, and enable energetic men to await the completion of schemes which they had commenced. Another great difficulty was the want of roads, and the great number of independent and often hostile tribes, in consequence of which those natives who attempted to engage in commerce ran the risk of losing their goods, and being themselves carried into slavery. He was exceeding sorry therefore, to see it suggested that the English Government should withdraw its protection from traders and natives in those districts. Some years ago, there was a Consul at Lacojeh, during whose occupation the natives around felt a greater sense of security; but he had been removed, the Niger expedition had been abandoned, and the trade was left to take care of itself; the consequence was it was dwindling away. The great thing needful to encourage the trade of those districts was the establishment of some superior power, which should be a kind of paramount authority over all the petty tribes; and he was quite sure that if something could be done to make traffic secure between the coast and the interior, commerce would increase tenfold. At the mouth of the Niger there were a great number of hostile tribes, and as the river was too low during a great part of the year to admit of traffic upon it, those who had property in the interior were at great risk. Even if it were possible to ascend the river in the dry season there would be great danger, because there was no doubt that many of these savages were in the habit of killing and eating all who fell into their hands. It seemed desirable, therefore, that the English Government should do all it could, by the presence of consuls and men-of-war, to exert a moral influence, at any rate until a more settled state of things was established. He thought it would be well if a gunboat were sent up and down the river in the rainy season, just to let the people know that if they molested the traders, a heavy but just retribution would follow. He was sorry to say that the trade with the interior was also much interfered with by the merchants themselves, and by a number of middle-men, who all made a profit out of the goods passing through their territory. If it were possible to induce educated Negroes or white men to colonise some of the districts in the interior, and make it their home, he was sure it would tend very greatly to the civilisation of Africa, and the rapid extension of its trade. At one time the African trade was very profitable, but he could not say the same now, for though the trade had increased, the number of competitors had increased in a still greater ratio, and profits were very much reduced. If merchants would combine together, perhaps something might be done, but not otherwise, for the natives could not understand lowering prices after they had once been raised, though they appreciated the lower value of English goods. He hoped the Government would not abandon the policy followed some years ago, but that England would still think its mission one of humanity, and do what she could to promote the welfare, not only of people abroad, but of those at home also. Unfortunately the tendency seemed to be the other way, and merchants who had been induced by the Government to invest their capital in the interior, and to carry on a trade at great risk, were now left to fight their own battles as best they could.

Mr. Consul Hutchinson, who said he knew every inch of the Niger for 735 miles from its mouth, did not think the Government could fairly be charged with inducing persons to go up there and then neglecting their interests. The British colonies did not extend to the river Niger, and if a man-of-war or a gunboat were required to go up and settle every difference between a trader and a petty chief, no less than ten or twelve would be required for that one river, which was rather more than the Admiralty would be likely to allow. He believed that civilisation in Africa, as everywhere else, must begin at the beginning; on the coast the natives must be taught the advantages of commerce, and then they would work out their own civilisation and acquire a spirit of self-reliance. Many persons fell into the mistake of supposing that because the slave trade was checked on the West Coast, it had gone to the East, but in truth there was no communication whatever between the tribes of the West and East Coast, and never had been. He was glad to say that for many years there had not been a single cargo of slaves exported from the whole of the West Coast, and many of those who were formerly engaged in the trade, had now become owners of canoes and stores of goods. Even ethnologically there was a great difference between the East and the West Coast; the population of the former being, to a great extent, Arabs, Turks, and Egyptians, while the latter were pure Negroes. The conditions of Africa were quite different to those of India; within a distance of forty miles you might find almost as many tribes, all speaking different languages, with different superstitions, and with animosities which kept them in a constant state of warfare. It was quite impossible, therefore, to establish on the West the kind of government which Sir Samuel Baker had established in the Valley of the Nile; the only plan was to establish consuls where necessary, with men-of-war cruising about to lend a little moral force to their position. He concluded by moving a vote of thanks to Mr. Saunders for his very valuable paper.

The Chairman, in seconding the motion, expressed his disapprobation of the idea that England should give up the position she held in Africa, especially when, by treaty with the Dutch, she had acquired exclusive rights over a coast of 250 miles. In his opinion, we should rather strengthen our position there, and see what could be done to encourage and develope trade.

The motion having been carried,

Mr. Saunders acknowledged it, and replied to the

observations which had been made. He said it was impossible that British policy could be otherwise than changeable, because there was no distinct object kept in view. If a body of merchants united for the purpose of carrying commerce into the centre of Africa, they would so organise themselves that their policy would be continuous, and descend from one generation to another; but this could not be expected from Governments in to-day and out to-morrow, and leaving scarcely a trace of their intentions behind. It could only be done on some such basis as that by which a mercantile company succeeded in planting themselves in India. He did not see that the Ashanti war was due to any change of policy, for the treaty of 1831 was still in existence, but it was forgotten that it involved the maintenance of peace along the road connecting Ashanti with the coast. This was too much trouble, and therefore it was abandoned; the natives took advantage of the neglect to establish their exactions, and the Ashantis found themselves practically excluded from the coast. With regard to the Zambesi, he did not think it at all desirable that we should interfere with the pretensions or rights of any other European powers, and the rights of the Portuguese to the Zambesi were as unquestionable as ours to the Cape. There was plenty of room for us without going there, unless, indeed, as a consequence of the rush which would doubtless take place if gold were found in any quantity, Portugal desired to get rid of it. He saw no reason to fear the inability of Englishmen to stand the climate, for Governor Maclean lived on the Gold Coast 17 years, and he did not doubt there were plenty of young men able and willing, if they saw their way to making a moderate fortune, to brave the African climate for some years, and to take advantage of the great resources which, under proper management, that great continent would yield. With regard to the *Eucalyptus globulus*, the French government were so convinced of its value that they were forming large plantations of it in Algeria, and it was also receiving the attention of the British Government in India. There was no doubt that Sir R. Macdonnell hit the nail on the head in saying that the great obstacle to progress in Africa was the maintenance of these petty exactions which were met with in every direction, and these could only be put down by force, and by a force capable of moving about from place to place as required. If a body of merchants existed in London authorised by the legislature to take the steps necessary to protect their own interests in Africa, they would soon find the way of doing so, and he believed the difficulties would be much less formidable than even in India.

ELEVENTH ORDINARY MEETING.

Wednesday, February 18th, 1874; the Most Reverend Archbishop Manning in the chair.

The following candidates were proposed for election as members of the Society:—

Addis, William, Leicester-street, Leicester-square, W.C.
Allott, Alfred, Young Men's Christian Association, Sheffield.
Bowring, John, 4, Unity-place, Woolwich, S.E.
Hickson, John Godfrey, Education Department, Whitehall, S.W.
Judd, James, Phœnix Printing Works, St. Andrew's-hill, Doctors'-commons, E.C.
Prim, J., 7, Bedford-street, Bedford-square, W.C.
Waring, William, 39, Princes-gardens, S.W.
Warren, Captain Charles, R.E., Shoeburyness.
Williams, Richard Harris, C.E., Cuddra-house, St. Austell, Cornwall.
Wood, C. Malcolm, F.R.G.S., 14, Waterloo-place, S.W.
Woodall, Corbett, Engineer's-office, Phœnix Gas Light Company, Bankside, S.E.
Youle, Frederick, 4, Montague-street, Russell-square, W.C.

The following candidates were balloted for and duly elected members of the Society:—

Bigwood, James, M.A., 115, City-road, E.C.
Cooper, John Bucknall, Belle Vue-house, Shrewsbury.
Darby, Charles E., Brymbo Iron Works, near Wrexham.
Eyre, G. L. P., 1, John-street, Bedford-row, W.C.
Hadwick, Joseph Epton, Forest-gate School, West Ham, E.
Harman, Henry W., Messrs. Fairbairn and Co., Manchester.
Hutchinson, Edward, Church Missionary Society, 15, Salisbury-square, E.C.
Jefferys, John Compton, 2, Grove-terrace, Chesnut-grove, Balham, Surrey.
Jones, Edwin, J.P., Mayor of Southampton, Woodlands, Bassett, Southampton.
Lee, Sir Edward, Exhibition-palace, Dublin.
Lyttle, William Alexander, B.A., Woodstock lodge, the Grove, Hammersmith, W.
Price, James, F.R.G.S., 35, Chepstow-place, Bayswater, W.
Pritchard, Edward, Borough Engineer, Warwick.

The Chairman said it was with great regret he had learned that Lord Derby was hindered, by an occasion of great moment, from being present and taking the chair. He knew of no one who had more entirely made all social subjects his own than Earl Derby. As a statesman, he had clearly seen that what was needed was not change in the constructive lines of the Commonwealth, but a minute knowledge, an elaborate care, and a progressive development of all those social questions upon which the well-being of the mass of the people depended. He therefore regretted exceedingly Lord Derby's absence, and also that it had fallen upon him to take his place; but, being there, he must express his great and earnest sympathy with the Provident Knowledge Society, at the initiation of which he had had the happiness of being present.

The Secretary read the following letter from Lord Derby:—

"23, St. James's square, Feb. 17, 1874.

"Sir,—I greatly regret to find that it will not be in my power to take the chair, as I had intended, at the Society of Arts to-morrow. I have written to inform Mr. Bartley, who is to read the paper. I can only beg you and the meeting to believe that I would not have failed them had it been in my power to keep my engagement.—I remain, &c., Derby.

"Secretary to the Society of Arts."

The Paper read was:—

THRIFT AS THE OUT-DOOR RELIEF TEST.

By George C. T. Bartley.

It is just two years ago, almost to a day, since I last had the honour of reading a paper before this Society on the subject of "Individual Providence for Old Age as a National Question." On that occasion the Society, and myself in particular, were to be congratulated on having the meeting presided over by Lord Derby; and I cannot but feel that his lordship so kindly consenting to preside to night, though unforeseen circumstances have prevented his coming at the last moment, is a further unmistakable proof, if indeed proof were needed, of the great interest his lordship takes in all matters relating to the social improvement of the community.

The present paper must be considered as grow-

ing out of the former one, and I will therefore, in very few words, remind you of the points raised before, and of the circumstances which have happened since it was read, and which have led me to make the suggestions and proposals which I shall presently elucidate.

The aim of my former paper was, first, to show what provisions existed in the country for enabling persons, particularly those receiving weekly wages, to provide for their old age; secondly, to show that these, as a rule, were not taken advantage of in a national sense; and, thirdly, to suggest certain ways likely to promote a habit of systematic thrift.

The meeting in February, 1872, led, through the interest taken in the subject by Lord Derby and others, to the formation of the Provident Knowledge Society. The object of this society, I may mention, is to extend facilities for regular and systematic saving, by making known the advantage of the Post-office schemes for saving, for life insurance and for pensions, by encouraging the formation of penny banks under the Post-office in villages, in manufactories, and in schools; by suggesting and urging on the Post-office reforms and improvements in their schemes wherever needed; and in fact by endeavouring, in every possible way, to induce persons to provide for themselves, instead of depending, when in trouble or old age, on charitable or legal relief.

It can easily be imagined that such being the objects of the Provident Knowledge Society, the Poor-law and its workings are constantly coming up and presenting themselves in some way or other to our notice, for it must be clear that that powerful influence which is in operation in all parts, even to the most remote country village, must either help forward or retard our operations in the most marked and obvious manner.

That this would invariably be the case was at once foreseen by Lord Derby, for in his concluding remarks at the reading of my former paper he stated:—

"The question of individual prudence and provision for old age opens the infinitely wider question of the operation of the Poor-law, and of all laws in the nature of poor-laws, as they affected the formation of individual character, and as to them, I should say there is no subject upon which we require more to be taught to reason calmly and justly, because, as far as I have observed, it is a question upon which we are perpetually tending to fall into one of two extremes. Sometimes we take a compassionate fit, and many are apt to talk what in effect is the very wildest socialism. At another time we take an economic fit, and use language which, if human nature allowed it to be acted upon—and for the most part it would not—would be enough to bring about a revolution in a very short time."

The Poor-law system really lies at the bottom of our social edifice, and in considering any scheme for the improved welfare of the community, it is impossible to disregard this great and universal influence. If this is true as regards any social problem, it is doubly so as regards the natural habits of thrift, and as our chairman foretold in the passage referred to, we have already come upon the difficulty.

In my duties as Honorary Secretary of the Provident Knowledge Society, the special bearings of the Poor-law and its effects on thrift have come forcibly before me, and though it must be understood that my remarks are simply my own, and that I do not in any way speak on the authority of that society, I must frankly say that the conclusions I have come to have been brought about to no small extent by the experience which the work of that society has given me.*

It is almost superfluous to state that Poor-law relief is divided into two main branches; namely, in-door and out-door relief. I do not propose to do more than touch on the former, for so long as we are socially constituted as we are, so long, I feel convinced, must the present system, or one more or less allied to it, continue. It is, however, comparatively the unimportant branch of the subject. Few persons enter a union-house willingly, and only about one-sixth of the paupers in the country are in receipt of in-door relief, and the pauperising influence of the union-house on adults is as nothing compared to that of the out-door relief. My remarks will therefore be directed almost entirely to the out-door system, and I shall refer to the in-door only so far as it bears relation to the other, and furnishes an argument in support of the views I wish to submit to the consideration of the meeting.

The existing poor law is based upon the theory that before relief can be obtained the applicant must be absolutely destitute; in other words, the qualification for relief is a condition of absolute poverty, and until this condition is reached the qualification for aid is not attained. This general idea in practice varies with out-door relief and in-door relief. Destitution is theoretically a supposed condition in both cases, but in-door relief is the stern aspect of the law, while out-door relief is the gentler feature, and is more laxly administered. Out-door relief is granted either because it is thought to be hard to send a family to the work-house, or because it appears cheaper to give a few shillings a-week out-door relief than to have the whole cost of the family thrown on the parish, as might be the case if an order for in-door relief were given. Probably the latter reason is commonly the more powerful one, if the truth could be known. As a matter of practice, the house exists for able-bodied persons who can't or won't work; for old persons who can get no assistance from alms or from their friends to supplement the out-door relief; for persons who are ill or afflicted; or for children. The out-door relief, on the other hand, exists for the old who can get other help as well as the parish money; and for the sick and their families who have made no provision, but who can either manage to earn something or get something given to them to supplement the parish dole. This is the coveted prize, to obtain as much of which as possible, in its various forms, without going too far and running the risk of an order for the house, is the aim of a million—or rather, of fully two millions—of our population.

The parish, in the shape of out-door relief, includes the following items:—

1st. In large familes usually, when there are more than four children, it supplies a doctor and a nurse at the time of a birth.

2nd. During childhood, under certain circumstances, it pays for schooling.

3rd. In adult life, provided no attempt at any

* "The Poor-Law, in its effects on Thrift." 2nd Edition. Bell and Sons, York-street, Covent-garden. Price 1s.

independent provision be made, it gives medical attendance and so much a-week, varying with the number of the family, whenever the breadwinner is laid aside by sickness.

4th. It provides medical attendance to the family, if it be a large one.

5th. It gives a pittance in old age, but one on which it is impossible to exist.

6th. It buries at death if the family of the deceased will permit it to do so.

Now the point I wish most strongly to bring forward, to throw the whole ray of intense light upon, is the condition on which all this parish out-door relief is granted. This, to my mind, is the key-note of the whole of our poor-law troubles—the hinge on which they all turn. The condition, then, of receiving all this relief, of sharing in all these benefits, which might read like so many advantages of belonging to a provident club, is—Destitution. Those who wish to get these good things must, at each stage when they apply for them, be prepared to show that they are destitute, or assert themselves to be so, so cleverly that the relieving-officer cannot ascertain, or prove, that their statement is incorrect.

It will be said, and said with truth, that logically and theoretically this is quite sound, for it is clear that no one should wish to receive aid from others unless he himself has nothing of his own. As a matter of practice, however, and taking human nature as it is and not as it should be, or as we would desire to see it, how does this work? It must be remembered that the gulf which separates the weekly-waged man from the pauper is but too often a very narrow one. A single step, and that of very short span, usually bridges the chasm; and it but too frequently happens that, the interval being so narrow, no small effort is required to prevent a man on the independent side, when sickness or other troubles come upon him, from slipping over the boundary. Under these circumstances, the tendency of a system which debars the thrifty man who has saved a little from all aid, and requires a man to show himself to be destitute before he can obtain aid in distress, must surely be to discourage him from being thrifty, and to induce him to keep himself in such a state as to be always eligible for relief whenever he wants it, or as often as he can get it. At any rate, it cannot in any way directly encourage him to make an unusual effort to place himself in a better position, for by so doing it naturally seems to him he is going against his own interest, for he is practically cutting himself off from readily claiming aid, should he ever require it.

If it gets noised abroad in the neighbourhood where a man lives that he is a careful man, and is saving a little money—though in reality it be but a pound or two—that very rumour will probably cause the relieving officer to be more than usually hard upon him if ever he is in trouble and applies to the parish, or when he is old and infirm. Nay, further, when he has spent all his savings, and has to go to the parish at last, the officer will probably think he is an impostor, and that he is concealing some private store. It may even be that he will be ordered into the House in consequence, and his former good habits may be his ruin, by causing him to be refused out-door relief altogether.

Take the example of two men in the same trade, living next door to one another, and earning similar wages, and with a like number of children. The one, let us suppose, is thrifty and careful, his rooms are clean and tidy. By dint of pinching and management he has got together some decent furniture; he is a member of a club, and his home, though humble, is respectable.

The other is a careless drunken spendthrift; his wife, perhaps, not much better; everything goes to the publican. His children lie about in rags, and his furniture is represented by a few broken-down chairs, a miserable bed, and a rickety table. Sickness or old age, with inability to work, comes on them both. What happens? The relieving officer is applied to. The one is relieved at once. It is well-known to all that he is badly off. Look at his miserable room! Probably charity, or rather blind almsgiving, comes to his assistance also, and the man's vices, so to speak, are his fortune. But what about his neighbour?

"What you, Jones! I always thought you well-to-do. Why your furniture must be worth a five-pound note, at least. You are a member of a club. You have been well-to-do all your life. You can't really want help!" These remarks are the bitterest gall to him. His club-money is but 2s. a-week, and he can't live on that, now that his little savings are at an end. The very qualities which render him deserving of some extra consideration cause him to be looked upon with suspicion, when, with the utmost reluctance, he is compelled to ask for relief. He may, indeed, struggle on, pawn or sell his furniture, make his home a hovel, and thus in time no doubt become "eligible" for assistance.

However theoretically perfect this system may be, the effect then is to discourage a struggling man who might otherwise be careful from desiring to be thrifty or fairly well-to-do; and what is more, it makes him object to ever being supposed to be in such a condition. In fact the great idea throughout the country is that saving must never be acknowledged, in however small a degree it may be practised, and that everyone must be ready to declare and prove his own complete destitution whenever any unforeseen trouble occurs. The more closely we look into the matter, the more certainly must we arrive at the conclusion that such must be the inevitable result of the present system of administering out-door relief.

It usually costs an effort to save, even for persons who are in a fair position; some, it is true, seem to be naturally thrifty, but such are the exception. In the case of the weekly-waged, it must of course be a great effort to be thrifty anyhow, at first; and as careful habits appear to them to be absolutely opposed to their interests, is it to be wondered at that they live from hand to mouth as a matter of course, and fall upon the parish at the slightest excuse? Scarcely any one feels in the least degree degraded by so doing; in fact, in most villages those who do not receive parish relief in some shape or other, at some period of their lives, are so rare that they form quite the exception, and are regarded by their fellows as rather peculiar for not doing so. Considering that the present system of relief has brought about these feelings, is it surprising that the parish dole is eagerly sought for by so many; that it is the natural expectation of all during old age; and that throughout life, in all its stages, the effort of

almost every one is not to keep off the parish, but to grab at as much out-door relief as can be obtained?

We have, then, in all parts of the country:—

1. Persons living from hand to mouth, and constantly bordering on destitution at the least difficulty, knowing that a system of relief exists which is bound by law to help them and to keep them.

2. Practically an unlimited supply of this outdoor relief, dispensed largely at the discretion of the relieving officer, on no very definite or fixed principle beyond that which is laid down by law—namely, that only the destitute are to have it.

Can it be wondered at that the result is—

1. That few, very few comparatively, ever think of saving and being thrifty, but naturally regard such a work as one of supererogation, the parish existing especially to look after those who neglect to look after themselves?

2. That those who save and are careful are so on the sly, as a thing not on any account to be known, lest they should have to spend their own money in time of sickness, &c., and be refused the parish allowance?

Is it remarkable, in fact, that they are made to become, not only paupers, but hypocrites into the bargain?

It may be said by some that the price of food is very high, and that the wages in certain industries are very low; so much so, that the people engaged in these occupations cannot help themselves even if they would. No doubt it is true that some wages are low, but it must be remarked that they are now much higher than they were, that they are steadily rising, and that really the very system of the Poor-law helps to keep them down, particularly in agricultural places. The rates are paid largely by the farmers, landowners, and others in villages, and there can be no question but that the various Poor-law allowances have a very decided influence on the wages. I may give an instance of a workwoman within my own knowledge. She was a good needlewoman, and after being some little time in the house at work for twelve hours a-day, her board being found, she was asked what was owing to her. "Sixpence a day," she replied, a sum which would do little more than pay her rent, even if she were in constant employment. The truth was, as I found out afterwards, that she had parish allowance, and some one paid her rent for her.

Again, is it a fact or not, that persons cannot afford to put by small sums? I boldly assert that it is not a fact. Look at the recent meetings of the agricultural labourers in Dorsetshire, the poorest place, they say in England; in order to keep the meetings at all within bounds, twopence was charged for admission, and this was found to be almost useless, for the numbers were so immense. Let any one get up an attractive magic lantern show in a village, and the people will crowd in at 1d. or 2d., or even more. Take a few van loads of the poorest children and their friends for a summer treat, and see how they clear the stalls of the hawkers who cater for them. Last summer I was at a village fête in one of the poorest and most remote villages, and the amount of money I saw going surprised me not a little. I gave a concert the other day at one of my penny banks, and charged 2d. admission. I received more money than I had ever done on one evening from depositors. I don't say this to object to such amusements, far from it, I think they are excellent, but to show that people have money to spare in spite of all that is said by them and for them to the contrary. But while on this topic I must revert to the old subject of drink and its consequences.

I am not going to advocate or to denounce teetotalism, but merely to look matters in the face, and to inquire how far the working classes possess the means of putting themselves in a better position. A tithe of the receipts of the public-houses properly expended would render the Poor-law altogether needless. If every man gave up one glass in ten no Poor-law would be wanted. In my little book, "One Square Mile in the East of London," I showed that one-sixth of the amount expended in drink in one year in that poorest part of London would build all the schools which were required, at a cost of £75,000; and that one-twenty-third would maintain them without any Government grant at all. In a little book I am about to publish,* I go somewhat over the same ground with regard to the drink in a remote agricultural village, and the result is very striking, considering the popular notion as to the poverty of the agricultural labourer. Seven public-houses, taking at least £3,000 a-year, exist in the parish of 1,500 souls. Calculating that half this expenditure is for necessary and wholesome purposes—and there are several special reasons which render this an excessive estimate, for nearly all the farmers who employ the villagers brew beer themselves for their men's consumption during work—it follows that no less than £1,500 a-year is wasted in this small village; a sum which would give a pension of £20 a-year, or nearly 8s. a-week to every person in it of the industrial class over sixty years of age.

These facts show that it is possible for extensive provision to be made, even by those who are usually looked upon as hopelessly poor; and although I will not go so far as to say that the reason why things remain as they are is entirely due to the Poor Law, yet it is my earnest conviction, after very careful consideration, that the cause which is more responsible for it than any other is the out-door Poor-law system as now carried out. As I have endeavoured to show, every man is encouraged to remain in a state of hand-to-mouth existence, and to spend his earnings as fast as he gets them, so that he may never have any difficulty in obtaining parish relief whenever he can manage, either fairly or by evasion, to come within the rules which enable him to apply for it.

Having thus endeavoured to point out what I conceive to be the fatal blot on our system of outdoor relief—namely, the premium which it holds out to poverty and destitution—I will now proceed to indicate as briefly as I possibly can the means which I think would tend to erase it. In doing so I am fully conscious of the great difficulty of the task, and I trust that my remarks may bring out suggestions in discussion which will make this gathering of real and practical value.

The main idea which I wish to suggest and to

* "The Seven Ages of a Village Pauper." Chapman and Hall, 193, Piccadilly.

make obvious that it can be carried out in practice is, that it shall be to a man's advantage, and not, as at present, to his disadvantage, to be careful and thrifty.

Our noble chairman hit the mark exactly in his address, to which I have already referred, when he stated:—

"It would not do to tell any man that if he did not lay by he or his children would starve, because that was not the case. The proper thing to say was that if he did lay by his old age would be more comfortable, and his children would be in a higher position than that which he had occupied."

If this very simple reform were established, I do believe that in a few years a vast improvement would take place throughout the country. No doubt many will say that this would be a low motive, and that people should be taught to do their duty from a sense of right rather than because it is to their advantage. No doubt this is so, but surely it is unreasonable to expect an amount of virtue and self-sacrifice among the poorest and most ignorant which is but too rarely exhibited even among those whose advantages have been very much greater?

The out-door relief consists of two chief items—namely (1st), money and orders for provisions, which is practically the same thing, and (2nd) free medical attendance. I will dwell upon the suggestions I have to make as to each separately.

Firstly, as regards *money relief*. As before stated, this is given to those who are sick or old, to widows, and to those who, from any cause, are so fortunate as to be successful in inducing the relieving officer to recommend their case to the guardians. *I would suggest that out-door relief in money or kind be never given, except on proof of previous thrift—that tangible evidence of thrift or the results of thrift be made the sole standard of eligibility for out-door relief.* That when a person applied for relief the officer, instead of asking him whether he was destitute, or presuming him to be so, should ask him what he had saved. If the man said "I am a member of a club which allows me 2s. 6d., a week," instead of that fact, to a great extent, *disqualifying* him from obtaining aid as it does now, though he cannot exist on it—it should *qualify* him, and from that very circumstance he should have a certain amount added to what he already had. If he showed that he had bought a deferred annuity which now brought him in say 2s. a-week, then that so much should be added by the parish on that very account. If an old man produced his Post-office Savings'-bank book with £20 to his credit, that the amount or part of it should be invested in an annuity and so much added to it by the parish.

In the case of old people there would be no difficulty in carrying this out, and children or others would also be practically encouraged to help to make up the amount, so as to enable their parents, &c., to obtain out-door relief. At the present time, children in but too many cases stand aloof, and do not help their parents, or only do so on the sly, lest the old people's parish allowance should be withdrawn. Practically, therefore, the existing system discourages them from coming forward as they should. Sons, who are legally bound to help to support their parents, too often avoid doing so, and escape the clutches of the law by removing to such a distance that it is not worth while for parishes to incur the expense of sending after them. Were the plan proposed to be adopted, children would be induced to help their parents, in order to prevent them from being sent to the union-house; a course of proceeding which we may be thankful at the present time is disliked. People who had brought up families would thus be able to look forward in their old age to some return from them; and those who had not had these expenses might reasonably be expected to be able, from their own earnings, to save enough themselves to qualify for sufficient out-door relief as above described, to enable them to live in comparative comfort.

Those who could not show any results of thrift in this way would, as a class, be the undeserving, and would have to keep off the parish altogether, as best they could, and in old age they would have no choice but to go into the Union-house.

As regards widows and younger persons in temporary distress, from sickness or other causes, a somewhat different arrangement, though similar in principle, would have to be adopted. Instead of proving their destitution, as at present, why should they not bring their Post-office Savings' book to the relieving officer, showing what they had put by, and how it had increased regularly each week or month? Why should not widows be asked if their husbands had been insured, or if they could show some evidence of previous thrift in support of their claims for out-door assistance? A long illness might have drained their savings, but if they had been allowed out-door relief during that illness under the system just proposed, it would be evidence that they were deserving cases for the out-door help to be continued for a time. If they could do nothing of the sort, but had evidently been thriftless, it would be better and kinder, with a view to reduce poverty and distress, to decline any assistance but that given in the union-house.

Cripples and persons who had been permanently in a state of inability to work might be the exception to the rule; and the help they at present have might, perhaps, be continued, and even more liberally, for no one would wish that their unfortunate lot should be rendered still more unhappy by any sort of harshness.

One great advantage of some such scheme as I propose is the facility with which its extension could be managed. At the present time, except with the greatest possible care, the money spent on out-door relief has always a tendency to grow, and its growth represents so much increase of poverty. If the amount given to each person be decreased, an outcry of starvation is raised, and how to keep the rates down without inflicting hardship is the enigma which has continually to be solved by the guardians as the representatives of the ratepayers. This difficulty would disappear with the adoption of some such scheme as is suggested. Suppose the parish doubled the savings of old persons up to a maximum of say 2s. 6d. a-week. That is, for those who had any sum up to 2s. 6d. a-week of their own, the parish added as much again. And also, suppose some corresponding proportionate amount was allowed on similar terms, as previously explained, to younger persons in cases of illness, &c.; it might be found that in a year or two the rates for out-door relief had increased; this would

be distinct evidence of an increase in the well-being of the people, for their savings would have increased in a like proportion. The maximum of 2s. 6d. might be reduced perhaps to 2s. In a year or two this amount might be found excessive—a fact which would further prove undoubtedly the still more independent condition of the people. Instead, then, of doubling the savings, a third perhaps, may be added, and so on. If it be not too Utopian to suggest such an idea, it does not seem impossible that out-door relief might in time in this way be abolished by the people themselves.

I know I shall be met with the assertion that it would be easier and more simple to abolish out-door relief altogether, and at once. Many persons regard this as the surest and best cure for the present condition of things. I cannot think so, much as I should like to be able to cut the Gordian knot. The more, however, I examine the matter the less I like this cure or believe it, under the present condition of things, to be wise or right.

Out-door relief has become an integral part of our social system. It has become the prop to the foundations of our social fabric. For many years we have been adding to and strengthening this support, and the old buttresses of self-reliance, thrift, and carefulness, have become quite rotten and decayed. This, I assert, that we, the better educated and better to do, have brought about—not the unfortunate sufferers—by the unwise system. To cast away the main stay of out-door relief would, at the present time, be to shake the building to its centre, if not to bring it down about our ears. We must first rebuild the old supports anew; we must erect buttresses of thrift, carefulness, and temperance, side by side with those of out-door relief, before we can touch those now standing. If this were done, it may be that in time the present supports, which seem so deeply sunk, may be so neglected that they likewise will decay away, and our social edifice will then be left fortified with the only reliable battlements of providence, thrift, and individual independence.

Secondly, as regards medical relief. As already stated, this in principle is at present administered exactly in the same way as out-door money relief. Destitution is the qualification which must be superadded to sickness before medical relief can be obtained; and every one seeks to make out the best case he can for such relief when he wants it, and it is usually given almost as a matter of course. How, then, can it be expected that provision should be made for sickness? If the breadwinner is laid up, that alone, provided his family be destitute, is sufficient qualification for medical out-door relief. Though illness comes at all times, and often without warning, it is one of those calamities which we all know we are liable to; so that every one, by joining a club, may easily and at a trifling cost insure medical attendance for himself, should he ever want it. What good, however, can a medical club be? It merely implies a man paying voluntarily for what he now gets for nothing. It is useless to urge on persons the importance of joining provident medical clubs and such like, when they can spend the money they are asked to pay to these in any way they like; and with very little trouble, and far less personal effort, obtain in sickness out-door medical relief almost for the asking.

London, I must acknowledge, is at present an exception to these remarks, for until the free hospitals are reformed, and I trust that steps are gradually being taken to bring this about, it is practically impossible to induce provident habits as regards medical attendance. In other populous places, however, where provident dispensaries or medical clubs are established, I think the parish medical relief might be abolished altogether, except, of course, that which is given within the walls of the union infirmary, and to the old persons in the receipt of out-door relief under the system I have proposed. In villages and sparsely-populated districts there are but few provident dispensaries or medical clubs. The solitary medical officer generally holds the appointment of parish doctor, and he has, for the reason we have already given, little to induce him to form a provident medical club of his own. He is probably pretty well aware of the persons he has to deal with, and he is not likely to be so deluded as to suppose that they will join his club for the gratification of paying him when they regard him as paid by the parish for looking after them for nothing.

Would it not be possible for the parish authorities to form, through their relieving officers, provident medical clubs, working perhaps in towns in connexion with some provident dispensary, and in villages independently? The rules might be very simple, and somewhat as follows:—

1. Any weekly-waged man paying monthly or quarterly a sum of [ ], in advance, to have the right, in the event of sickness, to receive medical advice.

2. The relieving officer on his visit to receive the contributions to the medical club.

3. No medical relief of any sort to be given out of the union-house, except to members of the medical club.

The amount of payment required might vary. In populous districts a penny a-week for each, and a reduction even of this amount where there were several in a family, would remunerate a medical man handsomely, as compared with what the parish now pays. It might, however, be good policy, at all events at first, for the parish, if necessary, to supplement the payments to the doctor, by charging a very small sum to each one joining the club. I may give an instance of an agricultural union, respecting which I made careful inquiries during last summer. Presuming that three-fourths of the inhabitants are of the industrial class, and supposing they all joined such a club and paid each a farthing a-week, or one shilling and one penny a-year, the receipts, without a farthing from the rates, would enable the parish to treble the salaries of all the medical officers, who now receive £340 a-year between them, that is, to pay them £1,020 a-year, and to add 30 per cent. to the salaries of all the relieving officers for their trouble of collecting, instead of taking, as they now do, the £340 a-year given to the medical men out of the rates.

The moral result of such a system on the people themselves, however, would be far more important than the gain to the pockets of the ratepayers; and I am bold to assert that there is not a parish in this country so poor and so distressed but that the inhabitants could make the effort indicated, and who would not very rapidly feel and

acknowledge the benefit of it were it introduced by law.

In considering the carrying out of any changes the greatest care and caution would always have to be exercised. We must remember that the evils of the present system have taken deep root; that those who will be affected by any alteration are not those who are to blame. It would be difficult indeed to put the saddle of blame on the right horse; for if those who established the system are free, we must all own to our share of blame for having allowed it to go on for so long, seeing as we may the results it has been producing. Any change would have to be introduced gradually, and with great consideration. Having allowed the present system to continue during so many years, we must not turn suddenly round and change it, without considering the concurrent effects which our former legislation has produced; and before any change could come into operation there would necessarily have to be a transition period of several years.

For the scheme I propose as regards money relief, ten or twelve years would be required before it could be completely introduced. Those who are at present receiving out-door relief on account of old age would have to be allowed to continue it, and it would also have to be granted to new applicants who are above a certain age, or whose cases, from any cause, might be considered exceptional. For younger persons, of course, it might commence sooner; and for those who are beginning life the scheme might come into force at once, not only without hardship, but with great benefit to themselves chiefly, and to the community as well.

The scheme I have sketched out for medical relief might be more quickly introduced, and would inflict no hardship if carried out as soon as a sufficient time had elapsed to allow all a full opportunity of understanding it.

An objection to such a scheme as I have proposed may be made on the ground that in carrying it out some deserving persons would have to go to the workhouse. No doubt some exceptional and deserving cases might be found who would suffer; but that must necessarily be the case where changes are made in the working of any of our institutions. It is even the case now under the existing arrangement, with all its laxity; and I doubt much whether a greater number of instances of similar hardships are not now in the house than ever would be under the system I propose. It should be the duty of the ministers of the different religious bodies, in their daily visitations and by personal influence, to prevent and to relieve by private charity, of which there is ever an overflowing abundance, such cases, so that they should never come on the parish at all.

It may be said that such a scheme would practically only help by out-door relief those who really should be altogether above relief. If all were perfect, and if every one acted from right motives, no doubt this argument would be important, though perhaps then we might abolish the poor-law altogether. We are, however, not all perfect, and as I have already stated, the plan of levelling down and making destitution the passport to relief, tends to drag down all those who are just above the pauper class; whereas, that of levelling up, and making thrift the condition of relief, offers a premium to thrift instead of to poverty—all would know that they could get no help whatever, except in the house, unless they had been thrifty and careful.

Some may think that the effect of such a system would be to drive thousands to the union-house, and that out-door relief would only be reduced at the cost of an increase of in-door relief. Doubtless some few would go into the house who now keep out, but the number would be insignificant if the change were introduced gradually. Any relieving officer knows full well, that under the present system thousands of names would disappear from the books of the parish altogether if applicants for out-door relief were told that they must "go into the house." It is found that an order to "the house" is generally a most effective means of getting rid of those who try to "ride the parish," as it is called—that is to continue on the out-door list when they might be off it. The class who would suffer would be those who are now improvident or who habitually spend everything in drink, and who—earn what they may—never have a farthing in their pockets. These, no doubt, in sickness, would only find help in the union-house; and although all would pity their wives and children, yet I hold that it is more humane to teach this class of persons their duty by the stern discipline of the union-house, than to encourage them to continue in improvidence and vice, as they now do, by the system of out-door relief. The families of such persons could hardly suffer more than they do at present, and the most efficient and certain way of reducing the number of such families to a minimum would be to let it go abroad throughout the country that no aid but admission into the workhouse could be had by such as these. A few families might suffer if the clergy and others omitted their duty; but—just as even at the risk of being hard upon one or two individuals, we decline to give alms indiscriminately in the streets, because we know practically that such indiscriminate almsgiving really encourages and increases the very poverty and idleness which some think they are in this way relieving, and so indirectly augment suffering—so if we decline to administer out-door relief altogether to all cases of hopeless improvidence and vice will it certainly tend to the diminution of such cases, and consequently in a like degree will it promote the increased happiness and well-being of the community in general and of the poorer classes in particular.

It would indeed be found in practice, that by diminishing out-door relief in-door relief would be reduced at the same time. For the first year or two after the introduction of such a system as I propose this result would be difficult to trace; but inasmuch as nine out of every ten of the inmates of the house are examples of the consequences of thriftlessness, it is certain that before long any system which tended to increase the careful and provident habits of the community would in like manner influence the number who were obliged to obtain the shelter of the poorhouse. Further than this, as the adult inmates have almost invariably been on the out-door list before they took the further step of entering the house, it will be evident that in diminishing the ranks of the out-door poor we shall tend, and that

in no small degree, to reduce the material from which the in-door paupers are recruited, and consequently to diminish the number of in-door paupers themselves.

My time is now drawing very nearly to a close, and, although I have tried to make my remarks as short as possible, the subject is so large that it is most difficult to curtail them very much. Before I conclude, I would wish briefly to recapitulate. The main points I have endeavoured to establish are:—

1. That the wage-earning classes could, if they wished, place themselves very largely out of the pale of poor-law relief.

2. That the action of the poor-law in its out-door branch, not only tends directly to prevent their depending on their own exertions, but gives them a strong motive for not doing so.

3. That by making all out-door relief depend on previous habits of thrift, a strong inducement would be given to all classes to acquire provident and careful habits, which are most essential to the general weal.

4. That as the results of thrift are tangible, so the relieving officer's duty would be rendered simple, and the increase or diminution of pauperism would not be subject, as it is largely now, to his individual judgment and discretion.

5. That if the change just referred to were made—namely, if thrift were made the qualification for out-door relief—no premium for deceit and fraud in concealing thrift would exist, but it would be the interest of all to save, to teach their children to follow their example, and for their provident habits to be known.

6. That such a system has the germ in it of the gradual reduction of out-door relief, and that by the only sound method, viz., that of the improved condition and wealth of the lowest wage-earning classes by their own individual efforts.

In conclusion I would merely endeavour to illustrate, by what seems to me a fair simile, the difference in the working of the present system as compared with that of a scheme such as I propose. It seems to me that the community may be compared to a large mansion, with apartments of all ranks and conditions, from the state-rooms to the lowest cellar; that by neglect and carelessness we have allowed our cellars to get very damp, and indeed half full of water; that this is undermining the foundation of the entire structure, the soundness of which is so essential to the whole building; that, awaking to the danger, we have established a number of pumps to force the water up and so to get rid of the evil; that these pumps are worked by persons of all sorts, and that though some may be making an impression on and reducing the water, others, by indolence or indifference, or other causes, are letting the evil increase, and allowing the very water which is removed to return to swell the mischief, and to percolate through places above the original mischief, which were hitherto sound. No doubt, if all worked the pumps properly, in time the cellars might be dry; but even then we should have to keep the pumps in order and the men at them ready for future inundations, or to prevent the dampness from again gradually increasing. A wise owner would not be content with this mode of cure. At the cost of some trouble, and in spite of loss, inconvenience, and damage, he would sink a deep drain below the level of his foundation; he would so arrange the drainage that dampness could not accumulate; he would, in fact, draw the water off by the natural law of gravitation, and thus his cellars would be permanently dry.

So we must act in the matter of Poor-law relief. We must make it not only sound in theory but sound in practice. Theoretically, as I have said, no doubt the present system may be correct, but practically it is fatally unsound. We must depend on the people themselves. Poverty, like the water in the cellar, must not be allowed to enter and then be taken out. The structure of the building must be such that it is natural for it to flow away. As we make it easier for the water to flow away from the cellar than to remain, so should we make it better worth a man's while to be thrifty and industrious than to be wasteful and indolent. If we can do this, then the forward movement will be sure, however slow; and though we shall never get rid of poverty and distress until mankind becomes recast in a different mould altogether, and until human frailty has disappeared, yet we may hope to reduce poverty and wretchedness to a minimum, and to remove the foul blot of pauperism which now so sadly disgraces and disfigures the richest country in the world.

DISCUSSION.

Mr. G. Bibley desired to endorse the view expressed by Mr. Bartley, that a great deal of destitution was brought about, not only by absolute intemperance, but also by drinking habits, which gradually led to it. To show the good results which would follow the absence of incitement to drink, he would mention that some few years ago a large proprietor in the county of Tyrone, finding he could not get his rents, and that the people were in a very sad condition, determined on abolishing all the public-houses on his property, and the effect was so good that many neighbouring proprietors followed his example, and in a short time poor-rates diminished, and respect for the law so much increased, that there were children now living in that district who had never seen a policeman, in fact there had not been an arrest for three years. This was a fact worth pondering over. Some few years ago, taking a interest in the question of pauperism, he obtained the permission of the St. Pancras Guardians to hold a social meeting of the paupers of that parish in the Vestry-hall, when he addressed them and talked to them, and he found they nearly all of them attributed their position to having formed bad associations, and to the drinking system fostered by public-houses. The association for building houses for the working-classes, presided over by Lord Shaftesbury, felt this so much, that they did not allow public-houses on their properties, and he hoped the legislature would see the wisdom and necessity of using more stringent measures for the repression of that which was proved to be so great an evil.

Mr. Alsager Hay Hill thought the great issues involved in the discussion were liable to be overlooked by side questions being raised. Mr. Bartley had raised a very important question, namely, whether the principles that the poor-law of the country had been founded upon, for which, in a great measure, Mr. Chadwick was responsible, were sound or not, namely, whether relief was to be acquired by reason of the positive destitution of the individual, and the consequent danger to society, or whether by reason of certain virtues, small or great, upon the part of the individual. He submitted that if the fundamental principle of the poor-law of the country

was to be impeached, they were approaching a revolution of which they would not see the last for some time to come. Mr. Bartley had followed the example of many philanthropists of the day, and had laid down a doctrine which he would be utterly unable to support, namely, that the improvidence of any class of society had increased during the last few years. He could lay his finger upon the statistics of certain great trade societies, which were entirely self-supporting, and many other societies, also the Post-office and other savings banks, and he would ask whether Mr. Bartley could, in the face of that, challenge the country as sinking into improvidence instead of rising from it? It was proposed to establish the test of providence, and to say a certain eminence should be attained in the direction of virtue, to be publicly crowned by the richer class; but that he submitted was a most unhealthy doctrine. A large number of the charities had been started on that principle, but they had signally failed. Every one knew that a large number of provident institutions had been established by the clergy upon the principle that, if people subscribed a small amount, a certain percentage should be added, but the result had been that they had been obliged to limit the deposits. Applying precisely the same principle to the vast poor-law system, and taking human nature as it was, it would be presumed upon, abused, and a very large number of persons would be dependent upon the provident dower, as they had been upon the out-door relief. Who was to ascertain whether a man had done his best or not in laying by enough to provide a paltry 2s. or 3s. a week? He believed there was hardly a wage-earner, except dock labourers, who could not, in one way or other, provide at least 6s. a week for his old age. Many gentlemen in London thought it impossible to live on less than £300 a year, and in agricultural districts the labourers would say they were unable to live on less than 6s. a week. Who was to be the relieving officer to say to what extent this principle should be allowed to prevail; who was to say whether 9s. or 7s. was to be the starting point? He had seen advertised an excellent work, entitled "How to Live upon Sixpence a Day," but he thought no diffusion of such literature would, for a very long time, induce people to believe that they could live upon 6s. or 7s. a week. But assuming that a certain allowance was given to a man for being provident to a particular point, his relatives would retreat from him and say, "See how virtuous he has become; by his thrift and his providence he has not only been able to secure 2s. or 3s. a week, but a crown of glory has been allotted him by the guardians of the district." And his relatives would not come forward and support such a person. Was not that the practical issue of the question? Mr. Bartley had put it that the relieving officer was now the sole judge of what the man should have; he wished he was, for then they would not hear of guardians awarding at one time 3s. 8d. to a poor widow, and at another time 2s. to a large family. He happened to be connected officially with a number of relieving-officers, and knew that if they had the discretion, imperfect as their decision would be, it would be far better than that of the guardians. Mr. Bartley had told them that if the law were put in force there would be such disasters that this Christian country would not submit to; but he was perfectly certain that the undeveloped Christian charity distributed throughout the country would prevent cutting off the out-door relief. Where this test had been applied, and they had called upon persons to go a considerable distance for the purpose of obtaining work, they had found they would not go; they had suffered no injury and mortification, except perhaps the mortification of finding the relieving officer a person somewhat shrewder than themselves. Out-door relief might be cut off after due notice given, as in the case of the Act of Parliament respecting agricultural children, which would come in force within a year, by which a considerable portion of the agricultural community would suddenly be deprived of a part of their income; but he would ask Mr. Bartley whether he thought the agricultural labourer would really be allowed to suffer. The effect of the Act lately passed had been that he, as a sober man, could not drink a glass of beer on Sunday except at a particular hour, and although he found it to be a privation at first, he could now do without it. He hoped the discussion would not be entangled by any teetotal paradoxes. He had attended two or three discussions of the Social Science Association, at which a gentleman from Ireland had stated that crime, vice, and drunkenness were stamped out at Luton merely by strict action upon the part of the magistracy, but he thought there was a little satire in the statement when he found that an extensive brewery on co-operative principles was being established there. He hoped the discussion would be reduced to the question whether or no the great principle upon which the Poor Law of the country was founded, viz., the principle of destitution and relief in the interest of the State, should be put aside or not.

Mr. Winterbourne thought if the suggestions in the paper were carried out they would not have a wonderful reduction in the quantity of paupers, but it would, at the same time, introduce another class under the garb of impostors—those who had some private means of subsistence which they would keep secret, who would go to the guardians and show evidence of being thrifty, and so make out a case for relief. There were one or two important points which Mr. Bartley had not touched upon, namely, something being wrong, what was the cause of it, and what should be the cure? There was a large amount of pauperism in consequence of want of thrift, but what was the cause of this want of thrift? Simply, that sufficient opportunities were not given to enable men to save their money. With regard to Post-office Savings Banks, and other banks established for minding the small earnings of the lower classes, the rate of interest, which was simply ridiculous, was the bar. If large employers of labour were to suggest to their employés to put aside a certain amount, and give them, say, five per cent. interest, it would be an excellent thing, and would enable men to look after themselves. With regard to benefit societies, he thought men were afraid of them, because many had turned out nothing more than impostures. The reason why men went to the public-houses was not only from love of drink, but for comfort, in consequence of their wretched homes, which required improving. If comfort were given in any other form he thought it would be appreciated, and suggested that life assurances, by means of weekly payments, should be instituted.

Sir Baldwin Leighton had listened with great pleasure to the paper, but he thought the difficulties of applying the thrift test would be found much greater than at first sight appeared. At the same time, after giving some attention to this subject, he believed this was a principle which could be applied, and he had advocated something of the sort in a paper read to the Social Science Association at Leeds. He there pointed out that it had been adopted in the Union of Hatcham, in Shropshire, which the authorities, he believed, had referred to as almost a model union. Some years ago, when the Charity Organisation Society was formed, he met Mr. Hill, as a member of the Council, and he remembered a discussion as to the propriety of introducing a thrift test, to distinguish between worthy and unworthy applicants, but there was then a great difficulty in getting the principle even understood, for he remembered a clergyman asking if it was a religious test which was meant. It must be confessed that though clubs of various kinds and trade societies had much increased, still the English were, on the whole, what Defoe decribed them, "A dispendious people," much more so than continental nations. Still it appeared possible, that the poor-law might be made a means of raising them by encouraging habits of thrift; and he hoped the society of which Mr. Bartley was hon. secretary would urge this matter

on the guardians, and also on the poor-law authorities, with a view to some difference being made in the treatment of those who had shown, by their own careful habits, that they were deserving of public assistance. He would also suggest that working men themselves should be invited to co-operate in the movement, for he knew many of them were quite alive to the improvident habits of their fellows.

Mr. O'Leary, as a working man, and one therefore who knew a great deal of the working-classes, thought sufficient attention had not been paid to the important question of emigration. There was a constant flow of population from the rural districts towards the manufacturing towns, and from Wales to Staffordshire and Durham; but men rarely left their own neighbourhood until they were completely broken down, and he could not see how the proposed test could be applied to a man in a strange district where he had come in search of work, and where, perhaps, he might be struck down by sickness. The only course in such cases would appear to be immediate relief, irrespective of the thrift test. He thought there was sometimes too much lecturing of the working-classes on providence and temperance, when those in higher classes required to be taught the same lesson. At the same time he had seen the immense evils of intemperance, and thought more should be done to prevent it. He knew a street in a London district, inhabited entirely by workmen, where there were nineteen public-houses in a distance of about a quarter of a mile, and in Limerick he had found them even more numerous. In the Archdiocese of Cashel all the public-houses were now closed from 7 on Saturday evening to 7 on Monday morning, and this tended greatly to the benefit of the inhabitants. He believed the organisation of the working classes amongst themselves would do more than anything else to encourage habits of thrift and economy, because workingmen generally managed their own affairs pretty well, but they did not care much for being constantly lectured by others.

Mr. R. Dudley Baxter thought this was not a theoretical, but a practical question. They were asked whether a new principle should be introduced into the poor-law management, whether they should alter the principle of destitution, as it had been called, as the title to poor-law relief, and introduce a new-fangled principle of working by rewards; the real question was, whether this was a practical test. He had been much gratified by a great deal of the information contained in the paper, but was sorry to find that some of the old vices of the poor-law system had not disappeared from the present administration. The great vice of the poor-law administration was, that when you had people coming for relief you gave them that relief, not because they were destitute, but on a principle of charity, by supplementing wages. This singular result followed, that a man who had a little property in a parish, a few cows, or anything of that kind, really could not get work, because the farmers said they were obliged to employ those people who had been having their wages supplemented out of the Poor-law. Mr. Bartley had said this existed now in a very modified form; it was not that a man could not get relief because he had property, but there was a temptation not to keep property, in order that when he got into a state of destitution he might obtain relief at once from the parish. If such was the case, it was a very bad thing; but how could it be avoided? Supposing the thrift test were introduced, there would still be the same quantity of people on the parish; and how were they to avoid out-door relief in that case? If in the East-end of London there was a scarcity of work, there would be plenty of people applying for relief, and how could they possibly insist on their producing their savings' bank book, or any other proof of thrift? It could not be done, and they would be obliged to return again to the old system of out-door relief. At present the difficulty was, to decide if a man was destitute enough to have relief, and that was the line for the parish officer to go by; but, under the proposed system, the border line of difficulty would be put a good deal higher, and they would have to relieve a certain number of people who produced their bank-books. But where was it to stop, for it might be said an applicant had got too much for help to be given. If it went on too far the rates would be supplementing incomes to an absurd extent, and would be introducing quite a new class of paupers into the country, and this would increase the poor-rate to an alarming extent. No one in the kingdom had done more than Mr. Chadwick towards the amelioration of the Poor-law, but the question was, had the principles he laid down been acted up to? Those principles were, that out-door relief should be as far as possible discontinued, but he was afraid the rule of enforcing thrift had not been adhered to sufficiently, and they had had sentimental considerations coming in. He thought the present Poor-law system had erred in following out the unwise maxim that it was better to give a little frequent out-door relief than a large occasional amount of relief in the house. At the time the Poor-law was introduced in 1834, the poor-rates were about seven to eight millions for a population very much less than at the present time, but the greater part of it was swallowed up in supplementing wages by out-door relief, and so on; but as soon as the Poor-law Commissioners carried out the law, the rates dropped from seven to four millions. He thought they could not introduce the question of thrift, but should carry out the principles of the old Poor-law, as they had been carried out in Ireland, where pauperism was not so great as in England. In some parishes the relief was only one-third of what it was in other places; in the north it was somewhere about 4s. or 5s. a head, while in the south it ranged from 8s. to 9s. a head, thus showing that in one case a good system was going on, and in the other a bad system. In some places the poor were taught to look upon the parish as their home. He was much afraid that by rewarding thrift they would be introducing an unpractical system, and that carrying out the indoor relief test was the only true way of diminishing the nnmbers dependent on the poor rates. The poor man should be taught to work for himself, which could not be done without a little pressure, and he should be led to save and make himself independent, so that habits of frugality might be introduced into the country. It was a question which affected the well-being of the poor in every parish and city, in London as well as in the country. If they could introduce in England the frugal habits which existed in other countries, we should rise very quickly in the scale of nations, but if we adopted a system which turned out to be a mistake we should retard the progress of improvement, diminish the independence of the people, and lower England in the scale of nations.

Mr. Edwin Chadwick, C.B., had come not to speak himself but to hear others, and to observe the progress of opinion, particularly that of the noble lord who had promised to have attended. There was, indeed, time only to touch cursorily upon one or two points. Evils were spoken of as essential to a compulsory system of relief, that were owing to mal-administration, and to the dereliction of correct administrative principles. In all extensive communities circumstances would occur in which an individual, by the failure of his means of subsistence, might be exposed to the danger of perishing. To refuse relief, and at the same time to punish mendicity when it cannot be proved that the offender could have obtained subsistence by labour, is repugnant to the common sentiments of mankind. It is repugnant to them to punish even depredation apparently committed as the only resource against want. In all civilised countries such conditions must be met. In even prosperous new communities where there was no compulsory provisions for relief they were driven to adopt some. The

North American States had been compelled to do so' and in the Australian colonies they were tending to do so. The problem which he and his colleagues had to solve was whether a compulsory provision for the relief of the destitute could be administered on a sound and well-defined principle, and whether under the operation of that principle the assurance that no one need perish for want could be rendered complete, and the mendicant and the vagrant repressed by disarming them of their weapon, the plea of impending starvation. The answer was that they might. Tho chief labour of investigation fell to himself. The originality of the measure he submitted was that, so to speak, it eschewed any originality, that it was founded upon actual practice. They found scattered examples in different parts of the country where the administration had happened to fall into the hands of enlightened individuals, from whose long concurrent and successful practice in different parts of the country, and under varied and well-observed conditions safe rules generally applicable were deducible for general application. One rule as respects the able-bodied was that the situation of the recipient saved from perishing should not be made, really or apparently, so eligible as that of the independent labourer. Every penny bestowed that tends to render the condition of the able-bodied pauper more eligible than that of the independent labourer is a bounty on indolence and vice. The workhouse or the Union-house was, for all ordinary occasions, the most convenient means of applying the rule; but not for extraordinary occasions, affecting whole communities, such as famines. Besides the rule, that relief should only be given to the able-bodied in return for useful labour where it could be obtained, there was the rule, necessary for a public system, that the destitution, which served as the title to relief, should be entire, and not partial; and so with the relief. Proceeding upon the trial, he had examined the modes of administering relief, by the wage classes themselves, from their own funds, in their benefit and friendly societies. They acted upon the rule that the recipient must be wholly on or wholly off "the box." They appointed a police of visitors of their own to see that he was not in work; they would allow of no pretence. If work were allowed, or partial relief, it opened a door to fraud, against which the utmost vigilance was needed. Now this rule of theirs went against all partial relief in aid of wages, which is fraught with the greatest mischief, and against all out-door relief on ordinary occasions, or other than extraordinary occasions, which renders the enforcement of the rule impracticable. And this practice, duly consulted, militated entirely against the plan of out-door relief, well intended and specious as it was, proposed by Mr. Bartley. Merit of any kind cannot strictly belong to a system of public relief, and must be relegated to family and private charity. Less than a bare subsistence cannot be given to the unthrifty and undeserving; more cannot be given with safety, under a public system, even to the thrifty and deserving. Relief can only be given to them under the common conditions. To do otherwise, as shown by experience, was to open the door to extensive frauds. The principle of a compulsory provision of relief, as laid down, was best carried out in Ireland, where indoor relief was the rule, and out-door relief the exception, and where correct principle had sustained the country through very severe trials. Ignorant people talked of the system as "stern." Was it stern to provide for the poor Irishman, in danger of perishing from destitution, an asylum in which he would be saved from that fate, in which he and his family would have better food and lodging than in their own cabins? Was it stern to provide medical relief by asylums for the poor Irish families, in cases of sickness and destitution from sickness, and give them treatment there, in cleanly, well-ventilated places, better than could possibly be given in mud hovels? It had been declared that to open any system of relief in Ireland for the able-bodied would be ruinous. His inquiries as to the administration of out-door relief to Irish labourers in England enabled him to express a competent opinion that it would not be so, and when properly conducted it had not been so. The public relief in Ireland did not cost more than three-halfpence per head of the population, and when properly conducted it was cheap as an insurance charge—cheaper and more secure than the insurance of private benefit societies. And so it might be made everywhere by competent administration, which under existing political conditions, of the rule of changing political service, without special aptitudes and undivided attention, was found very difficult to get or to maintain. The cost of a dereliction of tried and proved principle was now several millions of extra charge to the ratepayers—great demoralisation, discouragement to thrift, injury to production, and harm to Arts, Manufactures, and Commerce. Vaticinations as to what could not be done—that this or the other measure would shake society—were answered by reference to fact and experience as to what was well and safely done. For example, some geometrical and abstract reasoners in political economy declared that to abolish out-door relief to the able-bodied, or to discontinue relief in aid of wages, would be to throw large masses upon the labour market, and to reduce wages by excessive competition. Fleets would be required to remove the superabundant population. The measure was carried, and, lo! wages, instead of falling, rose, as his observations of the like operations on particular systems had enabled him confidently to anticipate. Labour being rendered productive and thence profitable, more was wanted. But nothing was so deplorably slow and difficult to get now as the perception and action on correct administrative principle.

The Rev. J. B. Faunthorpe thought one important feature had been omitted in the discussion. It appeared that the present test for out-door relief was utter destitution, which was a degrading one, but the one proposed, viz., that of thrift, was an ennobling one, but no one seemed to have dwelt upon the great moral advantage which would arise from substituting this ennobling test for the degrading one. It was evident that if a working man could save at all, he would put by more than would merely yield him 2s. 6d. a week; probably he would be enabled to save so much as would keep him in old age in a fair state of respectability, according to the station in which he moved.

Mr. Bartley, in reply, said it would occupy too long to take up all the points mentioned in the discussion, but he could not pass over some of the remarks of Mr. Hill, who had brought very cleverly before the meeting the weak points of the paper, even twisting some of them in a very ingenious manner. No one was more alive than he (Mr. Bartley) was to the progress of savings banks, provident societies, &c., for he had made this subject his particular study, and he knew well that they had increased, and were increasing. Still he asserted boldly that the total amount invested in these institutions was but as a drop in the ocean, in comparison with the sums recklessly thrown away every year. The total amount in the Post-office Savings Banks was 19 millions, while the amount spent in alcohol in one year was 100 millions. He believed that Post-office Savings Banks, and all similar schemes were most excellent, and he was doing his best to get them introduced into every village and hamlet in the country, but the people seemed to want more inducement. Mr. Hill said this was a proposal for putting poor people on a pinnacle of thrift, and giving them a reward for being good; but what was the present system? A premium on improvidence and destitution. He wanted to do something to encourage those who did the best for themselves. If England were a new country he should be one of the last to propose the introduction of such a system, which he believed to be radically wrong, as all out-door relief was; but the poor-law system was already established, and to turn round and put a sudden

stop to it because, as Mr. Hill said, the quickest surgery was the kindest, was a sort of logic he could not understand. These poor people had been taught to depend on out-door relief, and we could not now turn round and inflict a cruel injury upon them because a mistake had been made. He believed some such plan as he had proposed, by which, as the last speaker had observed, the noblest qualities of human nature would be developed instead of the most degraded ones, was the only good principle by which the condition of the masses could ever be improved. He did not know that the experiment, or anything even remotely approximating thereto, had ever been tried, but was glad to find from Sir Baldwin Leighton that such an attempt had been made, because, after all, practical experience was the strongest argument; and he hoped more extensive experiments of the same kind would be speedily instituted.

The Chairman said if he had not misunderstood the paper and the remarks, there was one point which had been somewhat missed. He did not understand Mr. Bartley to propose the substitution of thrift as the test in the place of destitution at this time, and in this country, but he asked whether thrift should be taken as a disqualification—whether, if you found a man laborious, thrifty, and a family about him, with a home worthy of the name, stricken down by some severe illness, so that the bread-winner of the house was unable to labour, such a man ought to be deprived of assistance; whether the law would prevent that man being pauperised, so that you would break up his home, and in the end take him into the workhouse. Destitution must be relieved; it forced itself upon every one, and must be met where it existed. There was an old saying and a sacred one, "The poor shall never cease out of the land," and therefore it was useless to dream of a Utopia in which there would be no poverty. It was impossible to prevent old age, paralysis, and other diseases which rendered the strong man's arm nerveless, or the consequences of disease, superinduced by intemperance and vice; and it would be impossible in such cases to leave nakedness, disease, and destitution unrelieved. Not only a Christian state, but one founded simply on the four cardinal virtues, would forbid such action. The test of destitution, therefore, must always be preserved; but he understood Mr. Bartley to suggest the wisdom of taking such cognisance of thrift and moral conduct as should not deprive those who had practised it of the relief when in real trouble, though they were not actually destitute. He understood Sir Baldwin Leighton to say that this had been tried and found successful. His own experience in a purely agricultural population, at the time of the new poor-law being first introduced, showed him that it might be carried out too strictly; and he must say that the duty of a child supporting his own parents did not relieve a Christian commonwealth of the duty of relieving destitution or old age; nor ought the possession of a trifling amount of property to disentitle the holder to such assistance as would enable him or her to live. All were agreed as to the value of thrift, but he also thought the time was come to say that all organisations, whether of labour or capital, were legitimate and wholesome, and ought to be under the protection of the law. He had no fear of them whatever. Such organisations were traceable up to the earliest period of English history; for the early guilds were simply the precursors of trades unions and unions of capitalists. He looked, therefore, without any misgivings on the spread of such organisations, and believed it would tend rapidly to that which Mr. Bartley desired, viz., that the lower classes should rise gradually, ripen and mature themselves by thrift, self-help and mutual help, so as not to be dependent on public assistance. He concluded by proposing a vote of thanks to Mr. Bartley, which was carried unanimously, and the meeting then separated.

CANTOR LECTURES.

The fourth lecture of the second course of Cantor Lectures for the session, "On the Chemistry of Brewing," by Dr. Charles Graham (University College, London), was delivered on Monday evening, February 9th, 1874, as follows:—

Lecture IV.

At our last meeting I discussed the nature of the changes produced by diastase—the soluble albuminous matters in malt—upon the starch of that malt. And I pointed out to you that, first of all, a starch paste was formed; then, afterwards, that starch paste was converted into dextrine and into sugar. I then referred to the statement of the German chemist, Musculus, and pointed out to you that he had asserted that the nature of the change was of this kind, that three parts of starch broke up and formed two of dextrine and one of sugar. Now, that is perfectly true as regards the first moment of time. The conditions, however, essential to such a mode of breaking up the starch are, first of all, either that there shall be a large amount of starch, or that there shall be a small amount of diastase, or else that there shall be a short digestion and a small quantity of water. Now, in an infusion which I made, I pointed out to you that in the course of fifteen minutes we had 5·48 per cent. of glucose and 8·82 per cent. of dextrine formed, and in the course of fifteen minutes more we had an increment of 1·66 of glucose and 0·83 of dextrine.

Cold Water Infusion of Malt.

	15 min.	30 min.	Difference.
Glucose	5·48	7·14	1·66
Dextrine	8·82	9·65	0·83

Thus, even in this case, where the digestion was excessively short, yet so large was the amount of dextrine dissolved that the starch broke up, not in the way that Musculus pointed out, but in the reverse ratio. There was a larger amount of sugar and a smaller increase of dextrine. If we take the English infusion method, with its high initial temperatures, that is where the temperature of the malt and water in the mash-tun is as high at the commencement of the operation as at any period throughout the operation, we shall learn somewhat more of the effect of temperature upon this interesting reaction. Thus, we may refer again to this table of experiments made in the English mashing process—

English Diffusion Process.

	Temperature in tun. 140 deg.	150 deg.	160 deg.	170 deg.	175 deg.
Sugar	35·5	30·50	29·4	20·8	15·6
Dextrine and starch	32·5	34·11	34·3	41·1	—

We see that at 140° we have 335 per cent. of the glucose formed. As the temperature increases, so the amount of sugar decreases, until finally, at 170° it is very much decreased. We learn from that series of experiments, therefore, that the higher the initial temperature, the less active the diastase, and the less extract in a given time, the less sugar formed. On the other hand, by starting with a low initial temperature, and raising it in the course of an hour to the temperature indicated, and then keeping it at that temperature for two hours, we have a gradual increment of sugar, and not only so, but we have also a gradual increment of the total extract.

Malt Infusion.—Low initial temperature

	100 deg.	110 deg.	120 deg.	130 deg.	140 deg.
Sugar	24·79	30·0	32·2	35·7	37·5
Dextrine	34·00	29·2	27·3	24·1	26·5

You will see under the temperature of 100° we have 24·79 per cent. of glucose, at 110° 30 per cent., and so on, until finally at 140°, it has risen to 37·5 per cent.;

therefore, we cannot but see that a low initial temperature is best for the solution of the diastase; but for a given time, the diastase, when dissolved, attacks the starch most vigorously, at a temperature of about 140° to 145°. Thus, then, while the temperature of 140° to 150° Fah. is very advantageous for the rapid conversion of starch into sugar and dextrine, yet I would ask you to bear in mind the experiments quoted in my last lecture, by which we found that for a given time the temperature of 165° to 167° Fah. was the best for the rapid conversion of dextrine into sugar.

In considering the practical bearings of the facts now before us, I think the following deductions may be made.

1. Barley malt, when well prepared, contains an amount of albuminous bodies—the so-called diastase—produced in the germination process, greater than is needed for the conversion of starch formed in the malt.

2. Time is an important element in the changes produced, and the longer the time at a low temperature, the more diastase is dissolved, and hence, in subsequent stages, the more starch converted and more sugar formed.

3. The action of the diastase at first—or when the mass of the diastase is small compared with the mass of the starch—is to form dextrine sugar in the ratio of two to one. In malt, however, we have so large an amount of diastase, that even in a short digestion we obtain an amount of sugar greater than the ratio of one to two.

4. In the English infusion process, with its initial temperature varying between 145° and 155°—but generally not higher than 150°—we have an amount of glucose and dextrine indicated by an equal ratio; the amount of sugar and dextrine therefore is about one to one. I have here taken four samples of worts for which I am indebted to the kindness of different brewers, and I have determined the amount of sugar and dextrine in each particular mash. In No. 1, there is 11·9 per cent. glucose to 9·29 per cent. of dextrine; in No. 2, from the West of England, 11 per cent. sugar to 8 per cent. of dextrine. In one from Edinburgh, 11·9 per cent. to 11·79 dextrine (practically 1 to 1); and in the fourth, which is one taken from a London brewery, we have rather more dextrine. There was a reason for it, but the ratio is almost 1 to 1.

5. As we increase the initial temperature above 150°, so we decrease the total extract, and also the ratio of the sugar to the dextrine; whereas, when we decrease the initial temperature below 150°—within certain limits—we increase the total extract, and also the ratio of the sugar to the dextrine.

6. The limits of these varying ratios cannot, on the one hand, exceed two of dextrine to one of sugar, or, on the other hand, two of sugar to one of dextrine; and the ratios produced in any given time in any particular mash experiment, depend on the varying conditions which may be taken as the functions of the experiment. First, the ratios depend upon the relative masses of starch and diastase. As I pointed out just now, the more starch the less sugar will be formed in a given time; and the more diastase, the more work will be done in a given time. Secondly, it depends on the temperature of the infusions; and, thirdly, it also depends, to some extent, on the quantity of water employed. If you make an infusion with a very small quantity of water, you will, in a given time, not produce so much sugar as when the infusion has more water, because the production of sugar from dextrine requires the absorption into the molecule of so much water.

Now, first, as regards the increase of the sugar ratio. If we take the analysis of the malt made by Mr. Christopher, already quoted, and take the glucose, and deduct one-tenth from the number there stated, and then add the amount left to the dextrine and to the starch, we may consider that in the malt we have 62½ per cent. of starch. Now in the experiment represented in table No. 3, this particular malt was infused in cold water; during the first hour it was raised up to 100°, in order to dissolve as much diastase as possible, and then during the next two hours it was kept at a temperature of 140° to 145°, which I look upon as being the keystone of the infusion process. Then it was raised to the temperature which the German brewers call the sugar-forming temperature, namely, 165° to 167°. In one case, the previous conditions being the same, it was kept at the high temperature for two hours, and in the other for a period of six hours, and we found that in the one case, there were thirty-nine parts of sugar to 27·36 of dextrine, and in the other 2·67 of sugar has been obtained to 2·36 of the dextrine. In other words, there has been a conversion of so much dextrine into sugar by an absorption of water. That experiment was carried on for six hours. Further than that, I have carried it on for many hours, and failed to obtain any further production of glucose; hence therefore the number you see there, 41·65, represents the greatest amount of sugar that has been formed from that particular malt that I worked upon. Now, if instead of taking 41·65, I were to consider the action upon 100 parts of starch instead of 62·5, we should find the result would be equal to 66·6; in other words, out of 100 parts of starch we should get exactly two-thirds of it as sugar, and no more. Now, if we look at Table E we shall find exactly the same results. Here we have 41·6 of sugar, which is practically the same result as the other; consequently, beyond this per-centage I failed to go. Again, in this particular example of the brief cold infusion, where we have an increase of 1·66 of sugar produced, there was 0·83 of dextrine. You see that there must be some very strong reason why it is that one cannot produce from 100 parts of starch more than 66·6 of sugar, the other 33·3 being dextrine. Since I performed this experiment I have had my attention directed to the interesting and highly instructive researches of Mr. Sullivan, and he has been able, by some work undertaken from a totally different point of view, to supply the explanation of this remarkable fact, that we cannot get from 100 parts of starch, by the action of diastase, more than 66·6 of sugar. His explanation is this—that from the 100 parts of starch there is formed 100 of something else which is not a mixture of sugar and dextrine, but a truly definite compound, which he calls maltase. It is a sugar, not like grape-sugar, but intermediate in molecular structure between that and starch. It is practically, therefore, a sugar belonging to the cane series. This sugar is white; it is soluble in water, and it is not so soluble in alcohol as glucose itself; and it withstands the action of diastase and water, even when the action is carried on, as I carried it on in one case, for many hours. It is, however, very readily converted by dilute sulphuric acid and water at a high temperature (from 80° Centigrade to 100° Centigrade) into ordinary glucose. When this maltase is acted upon by the solution of copper which I described to you before as Fehling's solution, it represents only an amount of reduction equal to two-thirds of that which would take place if 100 parts of glucose were taken. Now if we take the starch in the malt as 62·5, and multiply it by 66, and divide by 100, that will give us exactly the amount of glucose which I have got in these different experiments. I think, therefore, the work which has been carried out from a different point of view to that of Mr. Sullivan is very interesting, inasmuch as it corroborates his statement. The sugar thus formed in the mashing process is a peculiar sugar, which under the action of the potash and the Fehling solution breaks up into glucose and into dextrine, two parts of one and one of the other.

We find, therefore, that the action of diastase cannot go beyond producing what I have termed the ratio of two of sugar and one of dextrine. In ordinary mashing processes, at the first moment of time you have the reverse ratio, viz., 2 of dextrine and 1 of sugar. As the process goes on, the ratio becomes more equal, until at last, in the English mashing process, you have the ratios as

about 1 to 1. Under certain conditions, by supplying more heat and continuing the action somewhat longer, you reverse the original ratios. The brewer may thus, within certain definite limits, vary the ratio of the dextrine to the sugar at will.

First, then, as to the practical methods by which he may increase the ratio of sugar, I can only give one or two suggestions, though, of course, one might vary the processes almost infinitely. First of all, if he starts with a low initial temperature, he may in that way secure that there shall be a large amount of the active principle, dissolved diastase. Then, so soon as he has obtained a thorough solution of that diastase, I propose that he should raise the temperature of the mash up to 140° or 150°. This he may readily enough do in various ways, by adding hot "piece liquor" or steam in the underback, by means of a coil; or he may make use of a mode of circulation by a circuit of pipes, through which pipes the wort may be warmed, and then may be allowed to flow on to the top of the "goods" again, so as to raise the temperature. My attention has been called to the fact, that there is some such mode in use, carried out by Mr. Oxley, an engineer, at Frome. However, it is no great matter which plan is adopted. After digesting a certain time at this temperature, it should then be raised to 165°. You may say, Why? Can you not obtain sugar as rapidly at 145°? No, you cannot. For a given time, providing you have previously started low, you can produce more sugar at 165° than at 145°. Then, lastly, by raising it to this temperature of 165° you have the additional advantage of having a high "tap heat."

Now, upon the present plan of high initial temperatures, one can readily enough increase the ratio of sugar by simply adding it, and for that purpose one may employ ordinary cane sugar, which is converted in the main into glucose by the action of the diastase, if you add it in the mash tun, as probably none of you do; or it may be partly converted into diastase by the action of the acids of the wort when you boil the sugar with the wort. If the cane sugar be added without that previous conversion to the fermenting tun, it requires somewhat more yeast than glucose sugar, because the yeast has to do a greater amount of work. It has to break down the complex structure of the cane sugar to the more simple one of the glucose. Common cane sugars, however, contain a great deal of very dangerous putrefying albuminous bodies, and for store ales it would be better to destroy those, and at the same time to convert the cane sugar into grape sugar—in fact, into invert sugar. Invert sugar is the sugar made by the action of acids upon cane, and consists of dextro-glucose and levo-glucose. My attention has been called to an error which I made some time ago on this point, in stating that the Anglo-Bavarian Company, of Southampton, manufactured glucose from cane sugar. I am told that it is another firm which does this, the Messrs. Hills and Co., of Southampton. However, the glucose sugar can be made, not only from cane, but also from starch, and I do not see why the brewer should not make his own grape sugar, as the process of converting cane sugar or starch into glucose is a very simple one. After converting, by means of dilute acid, all you have to do is to throw down that dilute sulphuric acid by means of chalk. You may fear that, as in one of the samples here, you may leave a small quantity, say a half per cent. of gypsum in the sample, but that is no drawback to the fermenting process; on the contrary, it is rather an advantage than otherwise. But whatever plan you adopt, whether you use raw cane or a poor cane, or whether you use glucose made from cane or from starch, you, of course, practically reduce in the final wort the amount of albuminous compounds.

As regards increasing the dextrine, one might suggest a variety of plans, but I shall only name one or two. Dextrine, when in a large quantity, after the worts are fermented, gives the advantage of roundness and full-mouthed flavour, and therefore is preferable for porters and stouts, and certain classes of ales. One may obtain a larger amount of dextrine in the wort, firstly, by modifying the Bavarian method. If you make an infusion at about 100° to 120° Fah., and then, after the infusion has sufficiently dissolved out the diastase, boil a portion of the wort together with the goods, you will in that way destroy a large portion of the diastase, and, as I told you just now, by so doing you will, by reducing the amount of diastase, practically increase the ratio of the starch. That boiling process converts the insoluble starch into a paste of starch, and, to a great extent, into soluble starch, so that when it is run back into the mash tun it is rapidly converted into soluble products containing much dextrine, approaching the decomposition which Musculus pointed out, of two of dextrine to one of sugar. The second plan is this—diastaste instead of being killed in part, as the last method would do, may be wholly rendered inert. Therefore, if you were to infuse at 100° to 120°, and raise up to 140° tolerably rapidly, and so soon as the infusion is complete at that particular temperature, then heat it up very rapidly to 175°, and allow a digestion to go on at that temperature, the whole of the disastase would be rendered less active, and at that particular temperature it will produce dextrine and not much sugar. Thirdly, instead of killing some of the diastase or rendering all of it inert, one may add unmalted grain, barley, or maize. In so doing I strongly urge that the unmalted grain should be previously dried upon the kiln, at least at a temperature of 212° to 250° Fah. By heating the grain up to a temperature as high as that you will do several things. First of all the albuminous matters will be rendered less soluble. Secondly, they will be partly decomposed in the presence of the moisture of the grain, and they will produce empyreumatic matters. You may remember that I told you that in producing pale kiln-dried malt, the colouring matters were obtained by the destruction of the albuminous matter, not from the destruction of the starch and sugar, as is nearly always asserted. These colouring empyreumatic matters are obtained mainly from the destruction of the albuminous matters. At higher temperatures, and only at higher temperatures, are they formed by the destruction of the starch itself. In the air-dried malt we have 13·5 albuminous matter, and in the pale kiln-dried this has been reduced to 10·4. The some thing occurs in ordinary grain, which contains some ten per cent. of mixture. If you take that grain and dry it for some length of time, at the temperature of 212° to 230°, you obtain colouring products; you render the albuminous matter inert, and in short you have obtained in the raw grain practically a malt, except that it does not contain diastase.

Last week I had on the table a diagram indicating the composition of an infusion made from maize, which stated that the ratio of the cane sugar to dextrine was exceedingly small. That unfortunately was an error, brought about by the fact that I was not myself able to check the results, and it was not until I had seen the nature of the fermentation of the yeast produced, that I had occasion to notice the error. I thought it was partly due to the production of dextrine at a high temperature, but the real composition of the maize malt I had last week, when infused, gives 34 parts of sugar, and 30·69 of dextrine; while the soluble albuminous matters are at least three times as large as are obtained from barley malt. Maize malt, therefore, cannot be used as a substitute for barley malt. On the other hand, when you are using barley malt, you cannot use very much cane sugar. I am speaking now of the production of running porters and ales. You have not, in fact, sufficient albuminous matter to give a strong and vigorous yeast crop, but by the employment of some of this maize malt you may use a very much larger amount of sugar. For the purpose of store ales I should be rather inclined to dread the use of it, or at any rate—I am not speaking from actual knowledge—I should be inclined to submit it to a process of long boiling, and will explain presently why.

Before passing to the boiling of hops, it may be well that I should make a few remarks upon one or two mechanical arrangements. First, with reference to the very useful instrument called Steele's masher, or rather mixer—for I hold that the term masher is a misnomer. This instrument mixes up the water with the malt before it is poured into the tun, but I regret to say, in many instances, that the old fashioned rakes or real mashing instruments are being gradually done away with. The result of that is, that the malt and the water fall to the bottom, and afterwards you find below in the underback, and also resting on the top of the underback, a large quantity of dense, heavy, starchy matter; and if you were to make a section of the tun, the processes going on in different parts would be exceedingly different. The infusion which is going on at the bottom is not the same as at the top, therefore I consider that it is necessary to adhere to the old system of constantly stirring or mixing the mash. I in no way disparage the use of these very valuable mixers or mashers, as they are called, but I think they should be used in conjunction with the old fashioned rakes or mixers in the mash tun itself. Secondly, as a chemist, I maintain that malt should be ground, not merely cracked. If a chemist wants to obtain the best infusion, or the greatest amount of action in a given time, he tries to have his materials as small as possible. I do not say that anyone here is content with merely cracking the malt, but I have seen many cases where I did not consider the division was sufficiently fine. I should, therefore, recommend that the malt should be more ground, only taking care not to make it too fine. Then, lastly, and I know this is a very doubtful point, and likely to meet with much criticism, I think where you are using the English high initial temperature method, the infusion ought not to begin higher than from 140° to 145°, and then afterwards the temperature should be raised up to at least 150°. For myself, I should raise it even higher. In all cases, the tap heat should be at least 150°, and if you have started with a low initial temperature, you may safely raise it to a much higher temperature than this, in fact, up to the German tap heat, which is 165° to 167°.

The sparge heat ought never to be, in the present method of infusion, higher than 170° to 175°, in order to avoid that which sometimes occurs, viz., disintegration of the cellulose. Lastly, there is one chemical reagent throughout the whole of the mashing operations, until the final sparging is complete, which you ought to have ready at hand—a solution of iodine in water or in spirits of wine; and no mashing process should be considered complete, no matter whether it be the infusion method or the German decoction method, so long as the slightest blue action is obtained with iodine.

I come now to the subject of boiling. So soon as the wort is tapped it must be boiled. It must be boiled in order to prevent acidification. Now here is the advantage of having the high tap heats. The higher the heat at which you run off the wort the less likely are you to have acidification setting in. The worts, when drawn, contain in addition to the dextrine and glucose, and soluble albuminous matters, also acids, lactic acid and some succinic acid. The objects of boiling are first of all to expel air, and, secondly, to precipitate some of the albumen, and at the same time to destroy the activity of the remainder. Unboiled worts, after fermentation, no matter how vigorous the yeast may have grown, never produce sound ales. Worts, therefore, must be boiled, and the action must be somewhat prolonged, because in the prolonged boiling the albuminous bodies are broken down in complexity, their activity is destroyed, and at the same time are produced colouring matters, as has been done with malt. The temperature of boiling is about 212°, and that is a much higher temperature than we find to have been the case in the productien of the pale kiln-dried malt. In the malt we obtain, as I pointed out just now, a partial destruction of the albuminous matter, and colouring products were produced in that case as they are in the boiling of worts by the destruction of a portion of the albuminous matter, not from the sugar; in other words, we have a caramelisation of a part of the albumen. Now, as no sound beer can be produced from unkiln-dried malt, so I hold that no sound beer can be produced from unboiled worts, and for the same reason. It was an old maxim and a good one, that for running ales, which are to be used almost immediately, a short boiling is ample; but for store ales, which have to be kept for a long time, long boiling is required. In the case of the store ales you must guard against the destructive agency of these albuminous matters, and, as you have been specially careful to do that in your kiln drying, so must you be careful to do it in boiling. In the boiling process, if there should have been by chance any insoluble starch carried over with the wort, that will be converted into soluble starch, but not into dextrine, for soluble starch is not converted into dextrine by the action of boiling. Next, if you have run any insoluble starch into the copper, that starch will be found throughout the whole of the subsequent stages; lastly, dextrine in the boiling process is not converted into sugar. I know that the general opinion of brewers is that dextrine takes up water, and is converted into sugar. It may be so, but in the two or three experiments I have performed for the purpose, I have not found any appreciable absorption of water and production of sugar from dextrine, even in the case of two or three hours' boiling. Another and very important reason for boiling is for the purpose of dissolving the constituents of the hops, and one of those constituents assists in the precipitation of albumen. We see, therefore, that throughout the whole of these stages we get rid of some of the albumen, first of all in the mashing process, secondly in the boiling and cooling, and finally in the fermentation.

Now, as regards the hops. Among the order *Urticaceæ*, or the nettle family, we find the *Humulus lupulus*, which is employed by the brewer for his purposes. "Hops," however, as known to the brewer, are the stobiles of the female plant. These stobiles consist of scales which surround the fruit, and these scales are covered with a tenacious yellow waxy substance, the "powder." This powder contains the bitter principle for which the hops are used. The male plant, of course, not containing that, is not employed. Now, the amount of powder compared with the total weight of the hops, varies from 10 to 15 or even 20 per cent. Before proceeding to discuss the chemical properties of the hops, I may mention some of the different kinds that are grown for the brewer's purpose. As regards the English kinds I need say nothing. Amongst French hops those grown in Alsace are perhaps some of the best. The Belgians are much inferior, especially those grown near Alost, which are rather coarse. The finest hops, perhaps, in the world, are those grown in Bohemia. Perhaps in so saying I may stir up some English prejudices, for we no doubt consider some of our Kent hops as good as any, but you must bear in mind the German brewer does not permit these best hops to come to England, for he is prepared to pay a much higher price than an English brewer, and we shall hereafter see why. Amongst these Bohemian hops, the finest of all, as regards delicacy of flavour, are those grown near Saaz; they are not so valuable for the purpose of cleansing and producing store ales, but they are excessively fine in their delicacy of flavour and aroma, and hence are used after fermentation. As regards Bavarian hops, the well-known hops grown near Spalt stand in the very first order for their value in cleansing and beer-keeping qualities. Next to them come those grown near Kinding, Wolznach; then come those of Weingarten, Stirn, and Hersbruck. I have on the table samples of some of these kinds, for which I am indebted to the kindness of Messrs. Wickens and Co., Wolton and Sons, and Wolcotton and Co. On the table there is a sample of Wurtemburg hops, which are rather fine.

The Baden-Baden hops rank next to those which I have mentioned, and amongst the finer kinds are those grown near Schwetzingen, Sandhaaven, Friedricksthal, Hockenhein, and Walldorf. I have given them in the order of their value to the brewer. Hops, to be kept for any length of time, require to be dried; but I need not go into that part of the operation. But in this drying process the hops are now nearly always submitted to the action of sulphur—I mean to the action of sulphur that is being burnt, and, therefore, not to the action of sulphur itself but of sulphurous acid. In the year 1855, a commission was appointed by the Bavarian Government, of which the celebrated chemist Liebig was a member, to investigate this question, whether sulphuring was injurious to the hop and also to fermentation. For two years the investigation continued, and was assisted by many practical brewers. It decided two things, first, that the sulphuring of hops was an advantage; and secondly, that it did not prejudice the fermentation process. So much for the action of sulphurous acid. But sometimes sulphur itself is employed, and this is done while the plant is growing, for the purpose of destroying the various diseases to which the hop, like the vine, is liable. It is also used in the sophistication of hops with malt extract. I have a sample here which is supposed to have been sulphured with actual sulphur, while it was growing, and here I believe is a sample that is supposed not to have been. Now I will explain to you a method which you may adopt, for the purpose of detecting whether any given sample has been submitted to the action of powdered sulphur while growing in the gardens, or mixed with sulphur and malt extract, or in any other way for the purpose of sophistication. If you submit hops to the action of hydrogen, while that hydrogen is being liberated by the decomposition of the spirits of salt or hydrochloric acid, the hydrogen, if it finds itself in contact with sulphur, will unite with it, and form sulphuretted hydrogen, that gas which one finds in drains. After a very short time indeed it is no use to look for the presence of sulphurous acid in hops. However, I have told you, according to the opinion of the commissioners appointed by the Bavarian Government, that action is beneficial; but in a very short time the sulphurous acid is converted into sulphuric acid, and, therefore, is no longer there as sulphurous acid. The powdered sulphur, when added as such, remains unoxidised, and in the sample before us, I think I shall be able to prove its presence to you. The method of testing is this:—Here is a small flask with a funnel and a delivery tube, put a sample of the hop into it, having previously mixed it with water, and then add some zinc and close the apparatus, with the delivery tube passing into a vessel containing a solution of acetate of lead or ordinary litharge, dissolved in an excess of vinegar, and then pour down the funnel tube some acid. In making this experiment, you must bear in mind that zinc often contains sulphur, and that hydrochloric acid may contain sulphur, so that you must either obtain perfectly pure chemicals, or else you had better always make a blank experiment with zinc and acid before adding the hops. Having placed the hops, &c., in the flask, I pour down some of the hydrochloric acid; it will gradually be attacked by the zinc and form hydrogen. The hydrogen which comes over, will, if there be any sulphur at all, as sulphides, &c., gradually produce sulphuretted hydrogen, which will make its presence known in this other vessel containing the solution of acetate of lead. We will now leave it to act for a short time. Hops are most active when new. By slow oxidation the oil in the hop is converted into other products, amongst which is valerianic acid. This acid produces an unpleasant smell and flavour, and not only so, but it also has the disadvantage of reducing the amount of oil, and therefore less of the resins are dissolved with the associated bitter principles. Hops are sometimes (I do not say in this country, but in other countries,) adulterated, and one common plan is to mix old with new, and then sulphur them both, or rather sulphur the old hops first. Another plan is to powder the hops with yellow resins, which gives a richness of appearance. Another plan still, is to water them with a very strong malt extract, which gives to hops a viscous, sticky appearance; and then, lastly, those who carry it on still more scientifically, mix a strong solution of gentian, or some other bitter root, with gum and ochre, and the hops in this way are "improved" in bitterness, in colour, and in stickiness. Unsulphured hops may be readily distinguished from the others by the fact that the stem is always darker than the corresponding stobiles. I see, on looking at the experiments commenced just now, that neither of these samples is absolutely free from sulphur. But this one, for which I am indebted to the kindness of a gentleman in London, who managed to obtain it for me, has produced an undoubted precipitate of the black sulphide of lead. This other sample is not above suspicion, but still there is not much. Had the hop been entirely free from sulphur we should not have had any action at all. Amongst the leaves and powder of the hop we find four important principles, the essential oils, resins with the associated bitter principles, and lastly the tannin. I will take them in their order, the essential oils first. The essential oils form about two per cent. of the weight of the whole powder. It varies in different analyses. There is, however, none in the leaves. These particular oils are not sulphur oils, they do not contain sulphur. One of them distils over at 212°, the other one requires a very much higher temperature for its volatilisation. By the oxidation of these oils other products are produced, and among them is that very disagreeable valerianic acid which is characteristic of old hops. If a sample of new hops be distilled you will not find any of that acid. The essential oils are not only of importance as regards the aroma, but also because it is through them that the resins and the bitter substances are dissolved. The resins and the bitter substances form a combination with the oil, and through that combination they became soluble in water. In the boiling process that combination is broken up, and the oil is partially volatilised and part of it remains in the wort. The separated resins and bitter substances are then dissolved by the glucose in the liquid. If they be not disassociated from the oils then they are lost entirely, or nearly so, in the cooling process.

Now, long boiling of itself is disadvantageous, by getting rid of a part of the delicate aroma of the oil, but at the same time it makes perfect this disassociation. The resins form about two per cent. of the weight, but there is some discrepancy in the analyses, because it is rather difficult to determine the per-centage of some of these bodies. These resins are the solvents or the carriers of the bitter substances, and they are soluble in glucose. In the fermentation process the glucose is broken up, alcohol is formed, and a part of these resins, together with some of the associated bitters, are separated out of the liquid along with the yeast. Another portion, however, and in most cases the major portion, is dissolved by the alcohol. By oxidation these resins become insoluble. So long, however, as we have any oils remaining we have a sort of guarantee that they will dissolve in the boiling process, and therefore a kind of guarantee of the goodness of the hops.

The bitter substances which we find in the hops may be obtained by making an alcoholic extract of the hops, and evaporating that down so as to get rid of the larger portion of the alcohol. Then, by subsequent long boiling with water, we disassociate the oil from the resins. A portion of the oil volatises. If, then, you evaporate that down, and precipitate the tannin and oxalic acid by means of chalk, and then afterwards evaporate the filtrate from the precipitate, and treat that with ether, in order to dissolve up a portion of the resin still left, and then finally evaporate down the remainder, you will have a bitter substance left. Of course, this is not a very neat process. The substance we obtain is yellow, soluble in

water to a slight extent, but very soluble in alcohol, and intensely bitter.

The remaining important constituent of the hop is tannin, and its importance depends mainly on the property which it has of precipitating albuminous matter. If you take a wort made from barley malt, and add a solution of tannin to it, you obtain a precipitate of albuminous matter. If this be boiled, it will gradually redissolve, and finally it will be almost clear, but upon cooling again it will be re-precipitated. My assistant will perform this experiment, and you will see the result. Hops are hardly the cheapest source of this precipitating agent for albumen, because in them we have only some 2 to 3 per cent., varying with the quality of the hops. If we take about 2 per cent. as an average, we have a very small amount of tannin. In some cases in Germany a very much cheaper source of tannin has been employed to precipitate a part of the albumen, but not all. Care is taken that there shall be only a portion of albumen precipitated, I mean of that which can be, because there are still some soluble albuminous matters which are not precipitated at all, and they make use of a solution of ordinary Bombay catechu, which contains about 50 per cent. of tannin. Unless it is specially prepared, it has the drawback of giving coloured products to the worts; but if the tannin were precipitated by acid, we should get rid of this colouring property, and should obtain tannic acid itself. If that be used in small quantities in the case of strong malts, it might to that extent replace a portion of the hop, but, of course, not as regards the resins or the bitter principles in the oils.

Now, I will briefly refer to one or two points as to the action of the constituents of the hop. We are now in a position to take up one or two questions, the subject of very much discussion and dispute amongst brewers. First of all, there is the old question, Is long boiling at all necessary, and how long shall a wort be boiled? I think from what we have seen of the action of high temperature, in the presence of moisture, upon the albuminous matter of barley malt while on the kiln floor, and from what we have seen take place in the mashing process, you will agree with me that the chief object of boiling is not to precipitate albumen. It is an object, and an important one so far as it goes, but the main object is while you are precipitating a portion of that albumen, which is, like the white of egg, precipitable by heat, the other portion, and the very much larger portion, which is not so precipitated, shall be broken up by this cooking process; therefore, I consider that boiling is necessary; not merely a quarter-of-an-hour's boiling, or half-an-hour's boiling, which is quite ample to precipitate the white of egg albumen, but the long boiling, which is necessary in order to make the wort produce a good store ale. That amount of time will of course depend upon the malt you are using, and the nature of the trade. You must bear in mind that in this process we are practically caramelising and breaking down the complexity of these soluble albuminous principles in the wort. We produce albuminous bodies which have very much less energy in producing change. Therefore I hold that, except where one employs the German *dickmaisch* and *lautermaisch* methods, where you have long and repeated boilings, it is necessary to boil somewhat long, in order to obtain the advantages which the German obtains in his process, the advantages in fact which one obtains in ordinary domestic culinary operations, where one boils milk, or the juice of meat, for the purpose of preventing its undergoing change afterwards. A second malt question is, should all the hops be added at first, and at once, or only in parts? Some hold that it is, on the whole, the simpler and better plan to add the hops at once, others hold that it is better to add them little by little, or, at any rate, in two or three parts, a portion being added some half-hour before the boiling ceases. Like most other disputed questions, there is something to be said on each side. If the hops are being used in a long-boiling operation, you produce from the scales of the hop a rank bitter. I myself attach but little importance to the loss of that volatile oil. I hold that it is absolutely necessary you should break up the associated compound of the oil and resin, because if you do not you lose the great advantage of the hop. I therefore attach but little importance to the unavoidable loss of oil, but long boiling destroys the delicacy of the bitterness, and you produce a rank bitter mainly due to the leaves. On the other hand, if you adopt the other system, and boil the hops in parts, so that just towards the end you have used your last part, you often do not produce this decomposition which I have laid so much stress upon, viz., of the resinous bodies and the oil. On the whole therefore, I should be inclined myself, at any rate, where I was going to boil for a long time, not to add the hops at first, but to add the hops after, perhaps, the first half-hour's boiling, and if you like you may remove the scum which has formed, then afterwards add hops, and boil for an hour or an hour and a half, as the case may be. As regards the amount of hops, that you must decide for yourselves; it depends upon the nature of the trade, but I cannot help thinking that in the product of our own bitter ales we use far too much hops. It is said we must use a large quantity of hops in order to prevent change and decomposition in the ales. I do not see why it must be so. In the Bavarian system they use a very much smaller proportion in what we would call their running ales, made for immediate consumption, which are brewed in the spring and summer; they only use about one half to one per cent. of the weight of the malt used, so that for every 100 lbs. of malt used they would use about half a pound, or in some cases three-quarters, or even one pound of hops, which is a very small quantity. Even for store ales, for the lager beer, the amount used, depending of course a good deal on the nature of the hops, varies from 1 lb. per 100 lbs. of malt to 1½ lbs., and in some cases, though that is considered to be a very great quantity, 2 lbs. per 100 lbs. of malt. I think those acquainted with practical brewing in our country will say this is a small quantity, compared with the amounts used here. Hops are used abroad not only in the boiling process, and as they are with us in the barrel, after the fermentation is complete, but there are two other curious ways in which hops have sometimes been employed worth mentioning. In the first place, they have been used in the mash tun itself—the object being, doubtless, to prevent the solution of so much of the soluble albuminous matter. Another method of using hops was to add them in the fermentation tuns. Both are very singular modes, especially the first.

At our next meeting I shall discuss the subjects of cooling and fermentation.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

The sixth meeting of the Committee for Building Contrivances and Materials, was held at the Royal Albert-hall, on the 11th instant, Mr. John Bird in the chair. There were also present, Major Du Cane, C.B., Mr. John Elger, Mr. John Grant, Mr. D. Kirkaldy, and Mr. T. Roger Smith. Captain Clayton, R.E., attended the Committee.

The sixth meeting of the Committee for Leather, Saddlery, and Harness, was held on the 12th instant, Sir Watkin Williams Wynn in the chair. There were also present, Messrs. H. H. Flemming, J. D. Mc Dougall, W. Christie, W. Rickatson, and W. Southey, and Capt. Fenn.

The Committee for Architectural Designs held its first meeting, at the Royal Albert-hall, on the 14th February. The following gentlemen were present:—Mr. James Fergusson, F.R.S., Mr. A. Waterhouse, Mr. T. Hayter Lewis, Mr. Roger Smith; Lieutenant H. H. Cole, R.E. attended the meeting. The Committee recommended that a special collection of designs for scholastic buildings be invited for this year's Exhibition, the collection to include designs for colleges, schools, museums, and libraries. It was further suggested that this be followed in future years by commercial, ecclesiastical, municipal, and domestic designs, in order that each year should have a special feature in the class of architecture.

The Committee for Photography held its second meeting on 18th February, 1874, at the Royal Albert-hall. The following gentlemen were present:—Messrs. Hugh W. Diamond, M.D., F.S.A., R. A. Thompson, and G. Wharton Simpson. Lieut. H. H. Cole, R.A., attended the meeting. The Committee, after disposing of the business relating to this year's Exhibition, made the recommendation that a special collection of photographs should be formed for the Exhibition of 1875, to illustrate the history and processes of the art of photography.

The following are the regulations to be observed in regard to wines (other than those sent from duty-paid stocks) forwarded to the Exhibition of 1874:—

1. The wines may be removed to the Exhibition without payment of duty, on bond being given by responsible parties to pay duty, at the close of the Exhibition, on the quantity and quality removed from the bonded warehouses, or imported for the purpose of being exhibited.

2. That in the case of wine removed from bond the quantity, &c., be ascertained, and the bond be given before the wine is delivered for conveyance to the Exhibition; and in the case of wine imported and removed without examination, that the bond be required so soon as the wine has been examined after arrival at the Exhibition, unless the duty be paid at once.

3. That the duty due on all wine so removed may ultimately be received by the Officer of Customs stationed at the Exhibition, should the parties so desire.

4. All persons who may remove wine to the Exhibition are to be at liberty to pay the duties on the wine before its removal, in lieu of giving bond.

The following notice has been issued as to the Loan Exhibition of Ancient Lace made before 1815:—

1. Intending contributors to the Loan Exhibition of Lace should apply for forms, which they are requested to fill up with a precise description of the specimens they propose to lend.

2. When filled up, these forms should be forwarded as soon as possible to "The Secretary of the Executive, London International Exhibition Offices, Upper Kensington-gore. London, S.W."

3. The specimens themselves should be each numbered, and these numbers should be quoted in the descriptions given on the forms.

4. Contributors will be requested to cause their specimens to be delivered at the Offices of the Exhibition, addressed to "The Secretary of the Executive, London International Exhibition Offices, Upper Kensington-gore, London, S.W."

5. The receipt of the specimens will be duly acknowledged. Those which it may not be possible to exhibit will be returned as the owners may direct.

6. All specimens should be sent in on or before the 15th March, 1874.

The Loan Exhibition of Lace will include specimens of Lace made before 1815, and will comprise:—*a.* Pillow Lace, the fabric being made wholly by hand (known as Valenciennes, Mechlin, Honiton, Buckingham); Guipure; Silk Lace, called Blonde when white, and Chantilly, Puy, Grammont, and Black Buckingham, when black. *b.* Lace, Needle-made; Brussels (Point Gaze); and Point d'Alençon, Venetian Point, &c. *c.* Lace made of gold, silver, and coloured thread.

A Case will be reserved for the exhibition of Italian, German, French, and English old Sampler Lace Books.

The arrangement of the Loans will be personally superintended by a Sub-Committee of the Ladies' General Committee.

EXHIBITIONS.

AMERICAN INTERNATIONAL EXHIBITION.

The ground-plan of the Exhibition which accompanies this notice has been kindly lent by the proprietors of the *Engineer*, in which paper it appeared last week.

The Director of the Centennial Exhibition of Philadelphia, Mr. A. T. Goshorn, has issued an official circular, of which the following is an extract:—

"The exhibition will be held in buildings erected for the purpose in Fairmount-park, Philadelphia, and will be opened in April, 1876, and closed October following. Full diagrams of the buildings and grounds will be furnished to State Boards, showing the location and area assigned to each state and territory. As soon thereafter as may be, the State Boards are requested to notify the Director-General whether they desire any increase or diminution of the space offered them.

"By the 1st of March, 1875, the Director-General will acquaint each State Board with the amount of space at its disposal, and the State Board shall at once apportion it among the exhibitors of its district. Before October 1, 1875, the State Boards must furnish the Director-General with detailed plans of their allotted space, showing the space of each single object to be exhibited, and also with lists of the exhibitors, and all other information necessary for the preparation of the official catalogue.

"Liberal reductions in rates for transportation will be made on railways and water lines in the United States. The exhibitors or State Boards must provide for all the expenses of transportation, unpacking, setting up, repacking, and removing at the close.

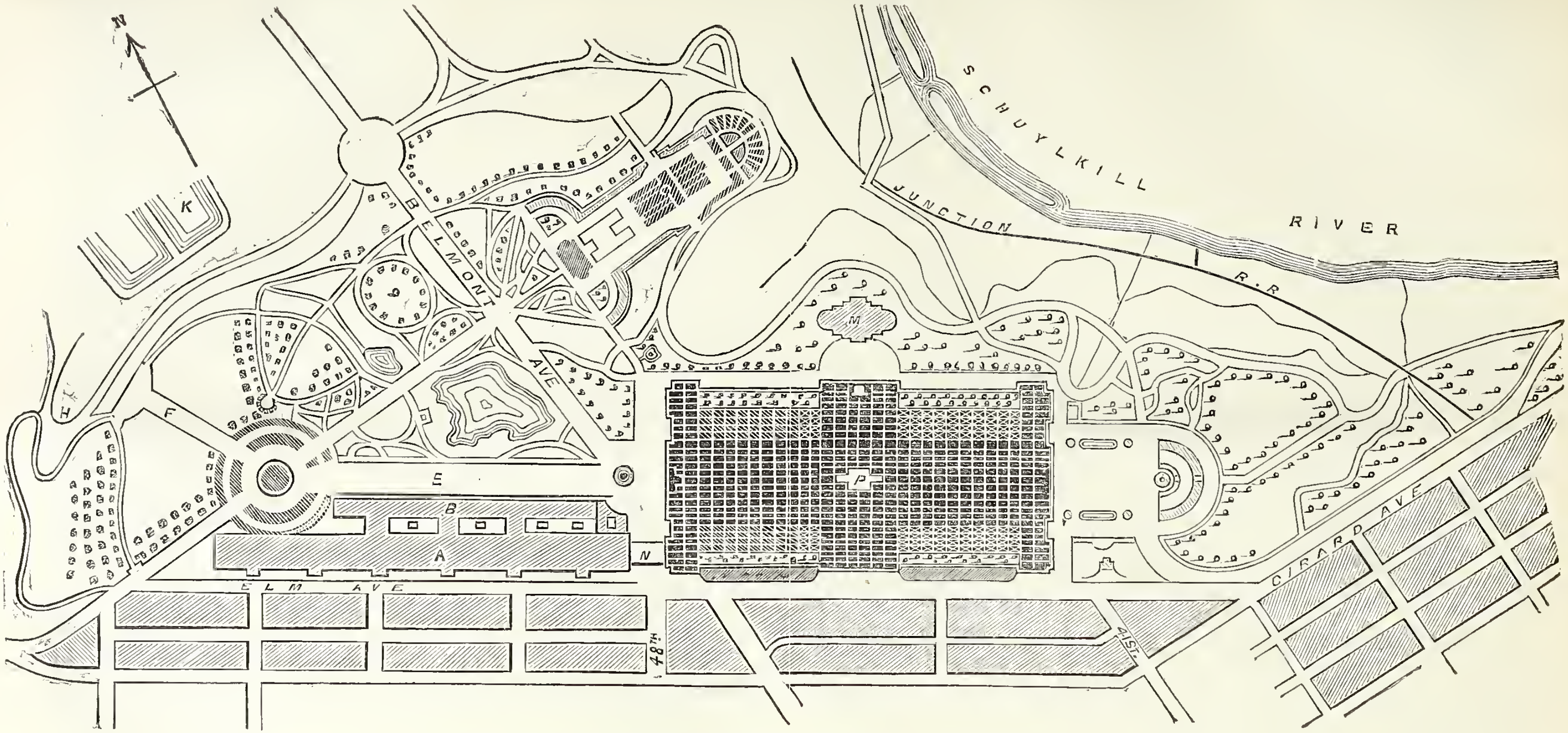
"An official catalogue will be published by the Centennial Commission, containing (1) the name of each exhibitor; (2) the name of each article exhibited; (3) the group and class to which the object is referable; (4) the location of each article in the buildings or park; and (5) an alphabetical index of exhibitors' names.

"Exhibitors will not be charged for space. Steam-power and water will be supplied gratuitously. It will be necessary, in making application for either of these, to state the quantity required, and the manner in which it is to be employed. The exhibitors or State Boards must provide, at their own cost, cases, shelving, counters, fittings, &c., and all counter-shafts, with their pulleys, belting, &c., for the transmission of power from the main shafts in the machinery hall.

"The Centennial Commission will take precautions for the safe preservation of all objects in the exhibition; but it shall in no way be responsible for damage or loss, or for accidents by fire or otherwise. Exhibitors or State Boards may insure their own goods, for which favourable facilities will be arranged.

"The State Boards, or the individual exhibitors, or agents, shall be responsible for the receiving, unpacking, and arrangement of objects, as well as for their removal at the close of the exhibition. Articles that are inflammable, explosive, or in any way dangerous or offensive, will not be admitted; and if introduced, will be immediately removed.

"Objects sold can in no case be removed before the close of the exhibition.



BLOCK PLAN OF THE PHILADELPHIA EXHIBITION BUILDING, 1876.

A. Machinery Hall.
B. Agricultural Hall.
C. Conservatory.

E. Centennial Avenue.
F. Terrace.
H. George's Hill.
M. Art Gallery.

N. Covered way between buildings.
O. Belmont Reservoir.
P. Main Exhibition Building.

"Photographic or other reproductions of articles exhibited will only be allowed upon the joint assent of the exhibitor and the Director-General. But general views of portions of the building may be made upon the Director-General's sanction.

"Each person who becomes an exhibitor thereby acknowledges and undertakes to keep the rules and regulations established for the government of the exhibition. Special regulations will be issued concerning the exhibition of fine arts, the organisation of international juries, and awards of prizes, and on other points not touched upon in these preliminary instructions."

Space enough is to be left between the avenue and the buildings for the piazza, or covered promenade, which extends round them. The area of ground in the part appropriated to the purposes of the exhibition is 450 acres. Of these, the grand pavilion will cover $3\frac{1}{2}$ acres, and the edifice is to be constructed with a capacity for expansion, so that it may be made to extend over 44 acres; the machinery hall will occupy $9\frac{1}{2}$ acres; and the agricultural hall $4\frac{1}{2}$ acres. This temporary structure for the technical part, chiefly built of iron and glass, is to be relieved by a stately permanent "Memorial Hall," which will constitute the department of the fine arts.

The two departments, technical and fine art, are to be connected by a broad covered way 175 feet long. The Memorial Hall will occupy a commanding site on a raised terrace, and all the surroundings are favourable to the effective treatment of the design. The ground plan is cuneiform; the arms of the cross having a width of 123 feet; length through the longer arms, the ends of which are semicircular, 420 feet; extreme depth through the shorter arms, the ends of which contain the main front and rear entrances, 320 feet. No partition will separate the aisles or galleries from the central nave, open passage being allowed between the supporting columns.

It is proposed to use coloured or stained glass for the windows in the dome, and to use the central rotunda for a general resort for visitors, and not for exhibition space. Four large stairways lead out from the rotunda up to the galleries. The four towers are utilised for additional stairs to upper portions of the structure. The style of the building as designed was proposed by the architects for the following reasons among others:—On account of the graceful lines and proportions for general and detail design; because it gives full liberty to make ample and large openings, and therefore more light than many others; because it admits of being finished in a very elaborate, or in quite a simple manner, according to the material selected and the amount of funds appropriated; also because it allows an effective display of sculpture and paintings. It may be called Venetian Renaissance. It is also proposed to erect a tower 1,000 high, which is to far outstrip all previous erections in any part of the world.

The designers are Messrs. Clarke, Reeves and Co., civil engineers and proprietors of the Phœnixville Bridge Works, of Phœnixville, Pa. The material is American wrought iron, made in the form of Phœnix columns, united by diagonal tie bars and horizontal struts. The section is circular, and is 150 feet in diameter at the base, diminishing to 30 feet at the top. A central tube, 30 feet in diameter, extends through the entire length, and carries four elevators. The latter are to ascend in three and descend in five minutes, so as to be capable of transporting about 500 persons per hour. There are also spiral staircases winding round the central tube.

The bracing runs in every direction, so that the tower will be as rigid as if made of stone, and yet will expose very little surface to the wind. The proportioning is such that the maximum pressure resulting from the weight of the structure, with persons upon it, and a side wind force of 50 lbs. per square foot, will not strain the lowest row of columns over 5,000 lbs. per square inch. The four galleries are roofed over and protected with wire netting, in order to prevent accidents. The estimated cost of the fabric is one million dollars, and the necessary time for construction, it is stated, need not exceed one year. The site has not been as yet definitely located, but it will probably be in Fairmount-park, Philadelphia, in proximity to the buildings of the Centennial Exposition. By calcium and electric lights from the tower, it is suggested that the latter, with their adjoining grounds, might be brilliantly illuminated at night. The summit of the spire would also form a magnificent observatory, while the view of the surrounding country would be unparalleled.

"It is hardly necessary (says a New York paper) for us to point out the very appropriate character of the design in connection with the object of its erection. That the hundredth anniversary of our national existence should not pass without some more permanent memorial than that of an exposition, which, within a few months from its close, will have disappeared, seems to us eminently proper. It is clear that, within the coming two years, no monument of so imposing a nature, or of so unique and original conception, can be constructed of any other material than iron, nor, indeed, can we hope to erect a fabric more completely national in every feature. Not only then shall we commemorate our birthday by the loftiest structure ever built by man, but by an edifice designed by American engineers, reared by American mechanics, and constructed of material purely the produce of American soil."

The Grand Pavilion, or main exhibition building, which constitutes the Technical Department, is to have a length of 2,075 feet, and a width at the centre and ends of 1,000 feet. The length of the Agricultural Hall will be 1,400 feet, and of the Machinery Hall 2,275 feet. The latter is located directly on the Elm Avenue, within a very short distance of the Pennsylvania railroad. A siding will be made by which heavy castings can be run directly into the hall, while waggons, containing machinery, can enter the department from the street, without traversing the park roads. The Grand Pavilion has similar easy means of communication from the highway and the railroad.

The following figures show the comparative dimensions of six exhibition buildings:—London (Hyde-park), 1851, 88,934 square yards; Paris (Champs Elysées), 1855, 112,450; London (Brompton), 1862, 202,920; Paris (Champs de Mars), 1867, 481,500; Vienna (Prater), 1873, 2,530,400; Philadelphia (Fairmount-park), 1876, 3,070,000.

The Executive Committee of the Centennial Commission, appointed in connection with the Philadelphia Exhibition of 1876, have referred to the American Iron and Steel Association the responsibility of collecting, classifying, and analysing the iron ores, fuels, fluxes, and refractory materials of the country, for the Exhibition.

Trinidad Exhibition.—An industrial exhibition was announced to be held in the island of Trinidad last month, which was to include live stock and staples of commerce, the produce of the island, provisions, fruits, flowers, and native manufactures, including jewellery, basket-work, and matting; pottery, fibres, and furniture. It was organised and made by the Committee of the Society of Arts, and was to be held in Prince's-buildings, Port of Spain. Silver and bronze medals and money prizes were to be awarded by competent jurors.

Exhibition in New Zealand.—An exhibition has been opened in Nelson, New Zealand, with great success. It is said that although it is not likely to equal in importance the admirable International Exhibition held at Otago in 1865, still it is calculated to do much good in bringing prominently forward the varied indigenous resources of this rapidly improving colony, which is making such giant strides in promoting immigration, settlement, and railway communication.

The Dome of the Vienna Exhibition.—On Monday evening, the 9th inst., Mr. J. Scott Russell, C.E., F.R.S., read a paper at the Royal Institute of British Architects "On the Central Dome of the Vienna Exhibition Building." After a few opening remarks, in which the lecturer deplored the general ugliness of works executed by engineers, and expressed his hope that the rising generation of architects and engineers would derive mutual advantage by an interchange of special studies, and by a closer alliance of their individual professions, Mr. Scott Russell proceeded to describe in detail the curious and interesting structure which formed the subject of his paper. The iron dome, or rather cone, at Vienna, may fairly claim to be the largest vaulted roof in the world. It occupies nine times the superficial area covered by the dome of St. Paul's, eight times that of St. Peter's at Rome, and seven times that of the dome of St. Sophia at Constantinople; in other words, it is no less than 360 ft. in diameter and 1,080 ft. in circumference. It is carried on thirty columns, erected at intervals of thirty-six feet all round. The cone is raised at an angle of thirty degrees, the length of the slope on all sides being two hundred feet. The roof is formed of three hundred and sixty iron plates tapering uniformly upwards from the circumference to the apex of the cone. These are riveted like the plates of a ship, each row of plates covering one degree of the circle, and each bottom plate being one yard wide between the lines of rivets. The conical roof thus constructed has no visible external wall, but is surrounded by a circular building which may be described as the central nave of the Exhibition carried round under the outer circumference of the dome. The roof, therefore, as seen from outside, crowns the large low buildings by which it is surrounded, and seems to grow out of them. Passing on to the mechanical principles of conic dome structures in iron, Mr. Russell proceeded to describe the the nature of the material and the various modes of its application, giving statistics as to the strength of iron under tensile and compressive forces respectively. From these he argued that the conic form in certain proportions makes the cheapest and strongest roof on the largest possible scale, consisting as it does of the minimum of material disposed in the most advantageous way. In dealing with this portion of his subject, the lecturer caused some amusement by boldly questioning the advantage of employing girders and roof-trusses of the most usual and accepted forms, alleging that they were "mere modifications of ingenious waste," whereas every atom of iron in the Vienna roof did its own work without counteraction, disagreement, or redundant strength. Mr. Scott Russell then gave a mathematic analysis of the method on which the dome was constructed, describing how and why he had eliminated from its design every particle of superabundant material. He recounted the various accidents which might have affected its stability, and showed how he had provided against them, declaring that the cone would stand after it had been pierced through all over, even supposing its outer and inner rings cut through, and the outer chain of the cone itself severed. He expressed his belief that only complete disintegration could bring it down, and that it would cost more time and labour to destroy than to construct it. The concluding portion of the paper was devoted to a history of the Vienna Exhibition building, and the official part which his Excellency Baron Schwartz von Senborn had taken in realisation of the scheme. Mr. Russell also took occasion to acknowledge the assistance which he had received from Mr. G. C. Holmes, a young engineer of Crewe, and from Mr. Crace.

It is stated by *Iron* that Professor Ansted has accepted the management of the Laurium mines.

The Government of South Australia intend appointing a Conservator of Forests, and are prepared to go to considerable expense in forming plantations of trees in suitable localities.

THE RESOURCES OF HUNGARY.

The information furnished by Consul-General Monson, upon the trade and commerce of Hungary, for the year 1872, has not only supplied a void which we have hitherto felt in regard to that important portion of the Austrian dominions, but it arrives at a moment opportune for recent exhibitors, who can thereby be placed in possession of facts which they could not obtain otherwise than through official sources. This absence of information has arisen from the circumstance that not until the close of the year 1871 had the British Government decided upon establishing a representative at Pesth. Of all the important European powers, Great Britain and Russia alone had, at that date, no consular officer resident in the Hungarian capital, although, for the preceding five years, the autonomy of the Trans-Leithan provinces of the Austro-Hungarian Empire had been complete; a constitutional government distinct from, and independent of that at Vienna had during all that period been theoretically in working order, and as a consequence an immense stimulus had been given to the commercial activity, not only of the country in general, but of the city, which is as much the industrial as the political centre of the eastern portion of the empire. With regard to the internal administration of Hungary, it must be borne in mind that, with the exception of the foreign policy, the common finance, and the common defence, there is no community of administration between the two divisions of the empire. In all matters of internal government Hungary is, both theoretically and practically, independent of Austria. But this independence is of so recent a date, that not only is general necessary legislation still greatly in arrear, but the ministerial departments are none of them as yet in thorough working order. Parliament has not spared itself, as far as the duration of the sessions is concerned; but the constitutional organisation of a country like Hungary, subject as it is to the hindrances imposed by the divergencies of race, language, and interests, is a task not speedily to be finished. In spite, however, of these drawbacks, and owing greatly to the wise selection of highly capable men to preside over the subordinate divisions of the various ministerial departments, the administrative machine works far more smoothly than might have been anticipated.

The population of the Hungarian kingdom, we are informed, consists of 15,860,123 persons, among which there are 5,009,678 engaged upon the cultivation of the soil or in the forests, and 780,546 in industrial and commercial pursuits. The large number, viz. 36 per cent., in the former pursuit shows that agriculture is the main occupation of the people. Unfortunately, a succession of bad harvests, commencing with 1869, have pressed like a heavy burden on economy and industry. The reason for this year's failure was partly the unfavourable weather in spring, and partly the appearance of rust, causing everywhere great damage. Another, and the principal reason, for the meagreness of the crops, was the inundations in the district of Banat, where the most valuable corn-producing lands were destroyed, and several hundred thousand acres of land of the best quality remained uncultivated. In consequence, the export of wheat almost ceased entirely; an inland trade only was done, which exercised a disadvantageous influence on the price. Rye, barley, and oats were equally affected; but the Indian maize corn crop was in every respect satisfactory. The wine also suffered in quality, and the quantity was hardly the half of the yearly production. The extent of land cultivated in vineyards in Hungary, Transylvania, and Croatia, chiefly the former, was 658,000 acres; thus, of the whole wine producing land in the Austro-Hungarian empire, which amounts to 1,278,000 acres, about the half is situated in the Trans-Leithan provinces. The average production of the year 1872 was 22,290,000 pails (eimers), of which 17,600,000

empire consisted formerly on an average 300,000 centners. were from Hungary. The yearly export of spirits of the According to later dates, however, from Hungary alone were exported in 1868, 401,000 centners, in 1869, 491,500 centners, valued at 6,400,000fl. and 7,500,000fl. How important the distillery business is in Hungary is shown by the statistics published by the Minister of Finance, and from these it will be seen that in 1869, 1,030 larger and 67,183 smaller distilleries were in working. The greatest part of the latter, belonging to farms, amounted to 65,610. In the same year there were 83 ale breweries, producing 95,600 pails. The mining resources consist of gold, silver, copper, iron, coal, and other metals, their productions being valued at 16,547,000fl. The railroads in 1870 were in length 460 German miles, and the travellers numbered 4,642,255 persons. The number of vessels employed in the navigation, chiefly for the corn trade upon the Danube, was 1,600, of which 149 were steam-vessels, representing 12,571 horse-power.

The development of the resources of the country have been much retarded by the want of facilities for internal communication. On the great Hungarian plain, the best corn-producing land in the kingdom, the roads are far too often still in a primitive condition. There is, in fact, no stone—no good road-making material throughout a large extent of Hungary. Much has been done of recent years in the way of railroads and canals, much is doing, and much remains to be done. The Ministry of Public Works is occupied with schemes for perfecting and making more available the railway system. The railways have been constructed with too much attention to local wants, and without sufficient regard being paid to the requirements of the through traffic and connection with the railway systems of other countries. It now becomes necessary to supplement the existing lines by connecting-links, so as to make a real railway network throughout the country. Besides this, the government have a project for a direct line from Pesth to Semlin and Belgrade, which, when the Servian railways are completed, will, it is hoped, become a portion of the direct international line to Constantinople. Of the canals, one of the most important, namely, the Wanz Canal, originally constructed by the government to connect the rivers Danube and Thaiss, by Zombar and Neusatz, is now being improved, chiefly with English capital and enterprise, by a company formed under the auspices of General Türr. With the resources which nature has placed at the disposal of Hungary, with all the cereal, arboreal, and mineral wealth at her command, it would be expected that, under the blessings of a free constitutional government, the financial condition of the country would be prosperous. It need not, however, be a matter of surprise, with the various causes of depression, that there should be a general feeling of apprehension, and that the public should take a gloomy view as to the immediate prospects of the country. A stranger, nevertheless, visiting Pesth for the first time, would be struck with its appearance as an important commercial city, with the animation and activity upon the quay and in the great thoroughfares, with the constant stream of traffic upon the river, and the evidences of wealth and prosperity evinced by the lofty and handsome buildings, the new and wide streets, paved in many cases with asphalte, which meet the eye in every direction. Much of the poorest and worst portion of the town is being opened out by new boulevards, intersected by tramways. The Hungarian magnates are not behindhand in lending their aid to beautify and improve the town; and in the neighbourhood of the museum and of the House of Parliament an aristocratic quarter is springing up, in which the hotels of the great and noble families equal in architectural magnificence any of the private residences of Paris or Vienna.

Consul-General Monson, in conclusion, observes likewise, that the English traveller will find in no European country so warm a welcome as in Hungary, nor will he pass any long time therein without being convinced that the sympathy and liking for England and the English so universal is a thoroughly genuine sentiment. Admiration of English institutions, and a desire to introduce or imitate them as far as practical, are topics of not unusual conversation between the Hungarians and their foreign visitors. Gratitude for English sympathy in former troublous times, and the conviction that the political and commercial interests of the two countries are and must continue identical, are widely spread. The English language is cultivated by adults, and very generally taught to the young; and the Magyars, with a versatility and with linguistic capacities startling to our insular unintelligibility, and which render them polyglot to an extent even surpassing the Russians and Poles, devote themselves to the study of English literature in preference to any other. The extent to which the Anglo-mania for the sports and pleasures of the chase permeates all classes of society, furnishes also an addditional guarantee that Englishmen visiting Hungary will find among the hospitable Magyars an addition to the amusements which are the characteristics of country life in England, but which are comparatively rare elsewhere on the Continent.

COMMERCIAL GEOGRAPHY.

The Syndical Chambers of Paris brought about, a short time since, the formation of a commission, to advise with delegates from the Geographical Society of France on the subject of geographical education for commercial purposes. The principal persons who have taken part in the conferences are M. Meurand, Director of Consulates, the honorary president of the Geographical Society, MM. Corlambert, Mannoir, Williams, Martin, Paul Mirabeau, and C. Hertz, members of the same society; the president and officers of the Syndical Chambers; M. Segnier, member of the Tribunal of Commerce of the Seine; and M. Molterie, president of the Syndical Chamber of Instruments of Precision.

The Commission is now occupied with the draft of the programme of studies, which is yet incomplete, but of which the following are the principal points:—Statistics and charts of commercial geography; study of its particular application to practical astronomy and the meteorological conditions of the various regions of the globe; research for mineral, vegetable, and animal riches likely to give rise to industrial enterprises or commercial transactions; indication of foreign industrial processes which may lead to the improvement of those of France; determination of hygienic conditions on various points of the globe; studies of commercial routes existing or to be formed; explorations to be undertaken with both a scientific and commercial point of view; economical relations with foreign countries; study and exposition of the documents furnished by the *Annales du Commerce Extérieur*, tariffs of import and export; general modes of exchange and correspondence; problems relative to the development of French colonisation, and to the colonisation systems of other civilised nations; active propagation of the study of commercial geography in the schools and amongst the public.

The subject of the first clause, namely, the formation of a chart of commercial geography, has been fully discussed, and the following points established as forming the base of the plan:—1. That all centres of population shall be indicated in which France has consulates or vice-consulates. 2. All countries where Frenchmen are naturally established. 3. All the sources of, and all the markets for, raw materials actually employed in Parisian industry and commerce.

A report was read by the president, at the last meeting, to the following effect:—

"We must not forget that at present the fruitful activity of our country should be principally directed to the pacific development of our scientific and commercial conquests; to this end the co-operation of men of science

with merchants and manufacturers is indispensable. The two commissions have, therefore, decided on the formation of a permanent commission of commercial geography, delegated by the Geographical Society and the Syndical Chamber of Paris. The duty of that commission will be to direct and encourage the application of geography in the general interests of commerce and industry, its decisions being submitted to the supervision of the two bodies from which it springs. By these means it is hoped that the noble work of aiding in the moral and material prosperity of France will be largely assisted."

FIRE AT THE PANTECHNICON.

The following appeared in the *Times* of the 17th instant:—

" *To the Editor of the Times.*

"Sir,—The charge of a Public Record office more than a quarter of a century ago, and the South Kensington Museum in late years, forced me, in concert with the late Mr. Braidwood, to study the question of how to prevent fires, and to form a simple conclusion. That conclusion was that there is no security to be had other than vigilant watching, with means of instantly extinguishing a little fire as soon as possible after it arises. Any fire ought to be extinguished in two or three minutes. The watchmen should be numerous in proportion to the area of the building, with fire-buckets, not hung up, but filled with water every day ready for use. A hydrant, with constant supply of hose and water, should be within easy reach. If these measures he taken a great fire never can occur.

" It is for every possessor of property to judge for himself if he will run the risk or pay the cost of the watchmen.

"Such a place as the Pantechnicon ought to have had two or three watchmen on every floor, properly superintended. It would seem to be worth the while of the fire insurance companies to maintain a staff of trained watchmen, who might be engaged in premises where valuables are deposited.—I am, &c.,

" Henry Cole.

"February 16."

LOAN MUSEUMS.

In an article on the recent fire at the Pantechnicon, the *Daily Telegraph* has the following remarks :—

" At the present day we may regard with proper pride our abundant treasures of art both at South Kensington and in Trafalgar-square ; yet it is elsewhere that we must look for the bulk of our pictorial and plastic riches. Our gaze must be directed even beyond the historical galleries of Stafford-house and Bridgwater-house, of the Marquis of Westminster or Lord Overstone. A glance at the Landseer exhibition in Burlington-house, and its preceding displays of works of the old masters, and a survey of the Bethnal-green Museum, will tell us where are our richest picture-mines and who are the owners of those precious deposits. They belong to unobtrusive lords and gentlemen, rarely heard of in politics, and even better known in the hunting-field or in the pursuits of literatnre than in the great giddy world of London. Formerly the exclusiveness of our social institutions kept these gems in a great measure from the public eye, but of late the owners of private collections have manifested a noble and liberal alacrity in submitting their works of art to public inspection ; and the Manchester and Leeds exhibitions of art treasures, with the recurring loan exhibitions at South Kensington, have proved how completely, in matters of art, the barriers of pride, prejudice, and jealousy have been broken down between class and class, and how ready and willing the wealthiest and most accomplished of our connoisseurs have become to minister to the intellectual gratification and conduce towards the instruction of their fellow-countrymen."

CORRESPONDENCE.

VISITORS TO PUBLIC MUSEUMS.

Sir,—Why are the returns from South Kensington Museum and Bethnal-green Museum omitted last week ? Surely these institutions are not going to imitate the old-fashioned British Museum, and refuse to give them. Allow me to suggest that in future the reason be stated, such as " refused," " not sent," &c.—I am, &c.,

A Member.

LAURIUM MINES.

Sir,—Though not personally acquainted with Mr. Merlin, her Britannic Majesty's Consul at Athens, I should accept with perfect confidence his statements regarding all matters of trade and commerce.

In technical questions connected with the working of lead-mines, the resources of mines yet unopened, and in the facts connected with the history of Laurium in modern times, he is, of course, dependent on others. In my communication to you, I spoke from personal investigation in the district.—I am, &c.,

D. T. Ansted.

THRIFT TOKENS.

Sir,—The earliest notion conceived in childhood of the use of money is its instrumentality in procuring indulgences. Its alternative purposes, when stored up and fructified, are rarely apprehended until injunctions to thrift seem rather irksome than otherwise. Nevertheless, the simple analogy of sparing grain from immediate consumption, to be husbanded for possible needs or for reproductive culture, is capable of being appreciated by very young persons.

Moreover, the recipients of wages, from which something, however small, might be spared for provident objects, need to be reminded at the right moment of the duties and advantages of thrift, and afforded improved inducements and facilities for its exercise.

It is suggested that a form of small change, available for gifts for children, or for fractional payment of wages, should be provided in manner to serve alternatively with the bronze coinage, the new kind suitable to be saved up, the common sort for currency as heretofore, in both forms merely tokens, that is to say of little value in themselves, and lawful only for making up sums of one shilling each, beyond which no creditor is obliged to accept them. But the new tokens, designed especially for thrift tokens, would be legal tender only at Post-office Savings Banks, just as postage stamps, although used occasionally for remittance, can be refused for any such purposes, and as revenue stamps are restricted to the several purposes of their issue. Revenue stamps available for receipts are issued in quantities at the rate of thirty for 2s. 5d. ; and thrift tokens, if issued on like terms, would be available in lots of twelve for a shilling deposit in any savings bank ; but scarcely for payment to vendors of sweeties or of drams, inasmuch that the tokens, obtainable at first-hand at $3\frac{1}{3}$ per cent. discount, are not legal tender as current money. Thus, traders who might take inconvenient quantities of thrift tokens, would have to push the sale of them in a manner to afford a premium upon provident designs.

Thrift tokens, if not metallic, might somewhat resemble railway tickets ; and, if in the form of double or return tickets, they might admit of being deposited in convenient quantities, and rapidly stamped ; one half ticket paid in, the other half retained as a voucher, until occasion serve for nominal accounts with its somewhat troublesome book-keeping.

But whatever the form or routine, a child, enabled to

compare a bronze penny token with a thrift token, would distinguish between their uses, and be amenable to good guidance, whereby its money-box, or say rather thrift-bag, could be made to influence a whole life.

In like manner receivers of wages, afforded option to take thrift tokens at the pay table, could give immediate effect to prudent impulses which may not always resist delays, and temptatations hitherto found too powerful. —I am, &c., Jacob A. Franklin.

INDIAN TEA.

Sir,—In my letter upon this subject, which you were so good as to insert in your issue of the 30th ult., I stated that no two samples of Indian tea are alike, that Indian teas run in lots of two chests, six chests, eight chests, twenty chests, and I endeavoured to show the necessity for greater uniformity of quality and for longer numbers of a sort.

Your next issue contained a letter in which the writer stated that he enclosed a catalogue of between 700 and 800 chests of Indian tea, in lots of 106, 92, 86, 80, 68, 67 chests, but he did not tell you that that catalogue was published a week after my letter was written—he did not say that it was one of the first (if not the first) of its kind; he did not send you the whole of the catalogues for the three months last past, for they would have shown you that I had satisfied myself of the absolute sufficiency of the grounds upon which I made my statements. I therefore send them herewith. The words, "bulked and re-filled," appear prominently in almost every one of them.

If Indian teas are of uniform quality, and in such long numbers as your correspondent seems to suppose, why are they almost invariably turned out of the chests, bulked (*i.e.*, mixed up together) and re-packed? And why, may I ask him, do these catalogues invariably commence with this condition, namely, "to be taken without allowance for any irregularity in quality?" I am sorry that your correspondent should so soon have forgotten the first line of the last paragraph of his first letter upon this subject; had he not done so, I think he would have been less ready to question the strictness of my veracity.

As to the adulteration to which I referred, and upon which your correspondent is sceptical, the following speaks for itself:—

(Copy.)

INDIAN GREEN TEA.

"Imperial ex Horse Guards."

The sample of tea submitted to me by Mr. Whitworth Jackson is unquestionably a faced tea, although to a very slight degree.
(Signed) C. Meymott Tidy, M.A., M.B., &c.
Medical College, London Hospital,
17th February, 1874.

Apart from the foregoing I have received several communications upon this subject; it is one of so much importance that I trust I shall not be trespassing too much upon your indulgence in asking you to allow this letter to appear in a forthcoming number of the *Journal.*

I am asked for my reasons for publishing the statement which your correspondent is pleased to call in question. They are these:—An outcry has been raised against adulteration; certain claeses of China tea have been denounced, and have, in consequence, fallen immensely in value, and the importers are heavy losers. If Indian tea is adulterated—and I have shown that it is—it must suffer in like manner, and who will be to blame in the matter? Let us see.

Adulteration is an ugly name for what is in many instances the indispensable addition of one substance to another in the course of manufacture; for example, flour is adulterated with yeast in the manufacture of bread. Adulteration has another meaning, namely, the corrupting of a thing for an improper purpose.

It is necessary, therefore, to draw a distinction between what is a good and what is a bad adulteration. There are two methods of doing so; the first is by invoking the intervention of the chemist; the second by appealing to the palates and purses of the public. If we wish to satisfy ourselves of the simplicity of a botanical curiosity, the first will be the better test of the two; but if we are cultivating and manufacturing tea with the view of establishing a profitable trade, the latter will be our safest guide.

Without incurring the liability to a charge of adulteration, it would be utterly impossible to produce some kinds of tea, which owe the particular properties they possess to a process to which they could not be submitted but for the action upon their substance in the course of manufacture of materials which are foreign to the tea itself—these teas command exceedingly high prices—it may, therefore, be assumed that the purchasers find in them a more refreshing beverage than they could obtain from tea as a drug (a mere medicinal simple). This species of adulteration is not a fraud; is it injurious? if not, are we justified in prohibiting it? if so, upon what grounds? The man who, to sell goods at a low price, procures "lie tea," or who purchases a cargo which has been sunk in the Thames, or the salvage from a fire at a bonded warehouse, and after colouring it with magnesia, Dutch pink, and Prussian blue, sells it as wholesome tea, deserves to be nailed by his ears to his own door post. But is there any reason why, in our efforts to get rid of him, we should cripple ourselves, or blindly follow the example of the man who set fire to his corn stacks to drive out the rats?

These questions suggest themselves, because the discussion which your society has been so successful in promoting has made Indian tea immensely popular. To maintain that popularity its manufacturers must be prepared to cater to the likings of the public; but if every incidental addition of some innoxious substance is to be interdicted, they will not be able to do so, and the manufacture of the teas which have hitherto commanded the highest prices will have to be abandoned; but yet, if we cease to study the requirements of the public, shall we not be in danger of losing its custom altogether?

No better teas ever were or ever will be produced than those we are now receiving from India. The tea referred to in my last letter was one of the finest that ever came into my hands; it possessed a piquancy and an aroma which could only have been produced by great skill in the art of curing tea; the high temperature to which it had been submitted would have burnt and scorched the leaves if a sprinkliug of gypsum or soapstone had not been used to prevent their becoming attached to the vessel in which they were heated. The remains of this substance, adhering to the surface of the tea, gave it the appearance of having been faced, or, as some persons erroneously suppose, coloured to please the eye.

On the 19th June, 1873, the Birkenhead County Magistrates decided that under the "Adulteration of Food Act, 1872," the mere facing of tea is an unlawful adulteration. It follows, therefore, that in supporting this Act we may be forging fetters which will prevent the development and expansion of the trade we are anxious to promote. After making no end of sacrifices for nearly half-a-century with the view of producing a saleable commodity, are we not now doing our utmost to shut it out of the market? Would it not be wiser to endeavour to prevent a possible miscarriage by seeking an "Adulteration of Food Act, 1872, Amendment Act," limiting the operation of its predecessor to the prohibition of the sale of any article of food or drink which would be injurious to the health of the consumer, or which had been adulterated for the purpose of fraud or deception? Such a definition of the term adulteration would cover and suppress every objectionable practice without prejudice to what may, for aught we know, be a desirable innovation.

The readers of your *Journal* are open and avowed enemies to every species of adulteration—so am I—yet the Indian tea, to which I have referred, was eagerly purchased almost regardless of cost, and in the very

teeth of all the arguments against the abomination of adulteration, is this not a more satisfactory test of its quality than any chemist could apply to it? If the public are anxious to have this tea—if they are willing to pay a higher price for it—who are we that we should stop the supply? If we have cut off our noses to spite our faces, surely we have no right to compel others to do the same.—I am, &c.,

Whitworth Jackson.

PATENTS AND CO-OPERATION.

Sir,—Your correspondent, Mr. Bartlett, seems to be slightly in error when he supposes that any observations of mine can have a tendency to set class against class, that is to say, Consumer v. Tradesman, any more than they have always been antagonistic and at variance, for the former would wish to buy cheap, and the anxiety of the latter is to sell dear.

I must have expressed myself but clumsily, if any one can suppose that highly respectable tradesmen who never advertise more than their names, addresses, and businesses, were referred to in my observations. I alluded to those only who advertise their goods as the best and cheapest in the world, and often mark their goods, as at, say 3s., with an invisible $11\frac{3}{4}$d. attached. See every newspaper and all publications, doubled and trebled in bulk by the addition.

Mr. Bartlett's last sentence conveys no meaning to me; only this, I know, that it is not standing behind their counters, but the furious advertising and placarding themselves and their goods before the world that debases hem from the ranks of gentility.—I am, &c.,

H. W. R.

Reading.

OBITUARY.

Sir Francis Pettit Smith.—Sir F. P. Smith, the curator of the Patent Office Museum, died on Thursday last, the 12th inst. Sir Francis was born at Hythe in 1808, and was the son of Mr. C. Smith, post-master of that town. In early life he devoted considerable attention to methods of marine propulsion, and at last, in 1834, he produced a model propelled by a screw at the stern, which he found so successful, that in 1836 he took out a patent for his invention. Considerable discussion has arisen as to the share that Sir Francis Smith had in introducing the screw propeller. The propeller described in the specification of his patent is of a very primitive sort, and it was afterwards modified in a memorandum of disclaimer, filed in 1839. The novelty of the invention consisted in placing the propeller in the dead-wood of the vessel, while the merit of the inventor lay chiefly in the earnest and vigorous way in which he pushed forward his plans. The screw had been proposed for purposes of naval propulsion even before the invention of the steam-engine, but it never seems to have been practically applied till Sir Francis Smith lent his energies to the matter. In 1855 a pension was granted to Mr. Smith (he was not knighted till 1871). In 1857 a testimonial of a service of plate and a sum of £2,678 was presented to him, and in 1861 he was made curator of the Patent Office Museum. It will be a matter of regret to all that, in spite of his decided services to his country, Sir Francis Smith was by no means in good circumstances when he died.

A Washington paper says that the United States Patent-office will soon be buried out of sight by models and specifications, as they are pouring in at the rate of over 600 a-week.

GENERAL NOTES.

Fresh Meat from Transylvania.—Two meetings have recently been held, at the Cannon-street Hotel, for the purpose of testing some imports of fresh meat and poultry from Transylvania. The second of these meetings took place yesterday (Thursday), when, as on the former occasion, a lunch was provided, consisting entirely of the meat in question. The results were, in the opinion of all present, extremely satisfactory, both poultry and meat being found entirely free from any unpleasant flavour whatever, and absolutely identical in taste and appearance with any freshly killed. The process of preservation is simple. The food is packed in boxes, these are placed in larger receptacles filled with ice, and the whole transported by rail across the continent. After the luncheon a discussion in each instance took place, and expectations were expressed that the food could be imported in large quantities and on a commercial scale.

Industrial Exhibitions in America.—According to the *Pall Mall Gazette*, a suggestion has been made to the Commissioner of Education in the United States to encourage "industrial exhibitions" in connection with the public schools of that country. It is proposed that the pupils should be induced to bring to the school once a week, or once a fortnight, some article of use made by themselves, to be exhibited and explained under the supervision of the teacher, in the presence of the parents and friends. The Commissioner, it is stated, entirely approves of this plan, which he considers to be a practical development and application of the kindergarten system, and is of opinion that the youngest children, by a wise direction of their instinct to make something themselves, may be taught several useful lessoms. He also commends the plan as a means of increasing the interest of parents and friends in the schools, and of receiving their visits at stated intervals, while it would furthermore arouse in the children such an interest in the daily work of the household, the shop, and the farm, as will teach them the value and dignity of labour, and fit them for usefulness.

NOTICES.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque, Post-office order, or Cheque Bank cheque, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

Public Health. A Popular Introduction to Sanitary Science, Part II. War, and its Sanitary Aspects, by William A. Guy, F.R.S. Presented by the Author.

Inaugural Address, delivered by W. A. Guy, F.R.S., before the Statistical Society, on the 18th November, 1873. Presented by the Author.

Guns and Steel, by Sir Joseph Whitworth, Bart., F.R.S. Presented by the Author.

Principles of Dynamics, by John W. Nystrom, C.E. Presented by the Author.

The Treasury of Languages. A Rudimentary Dictionary of Universal Philology. Messrs. Hall and Co. Presented by the Publishers.

S. W. Silver and Co.'s Handbook for Australia and New Zealand.

The Practical Magazine, for 1873. Presented by the Editor.

The following works has been purchased for the Library:—

Cooley's Cyclopædia of Practical Receipts. Edited by Richard V. Tuson, F.C.S.

Public Health. A Popular Introduction to Sanitary Science, Part I., by William A. Guy, F.R.S.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

The following arrangements for Wednesday evenings up to Easter have been made:—

February 25.—"On a New System of Cultivating the Potato, with a view to Augment Productiveness and Prevent Disease." By Shirley Hibberd, Esq. On this evening Lord Alfred Churchill will preside.

March 4.—"On Bells, and Modern Improvements for Chiming and Carillons." By George Lund, Esq.

March 11.—"On the Manufacture of Cocoa." By John Holm, Esq.

March 18.—"On the Channel Tunnel." By William Hawes, Esq., F.G.S.

March 25.—"On the London International Exhibition of 1874." By Henry Hardy Cole, Esq., Lieut. R.E.

Indian Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

March 13.—Dr. Leitner, Principal of the Government College of Lahore, will give an account of the Races of Dardistan (north-west of Cashmere), discovered by him. On this evening General McMurdo, C.B., will preside.

African Section.

These meetings are arranged for Tuesday evenings, at 8 o'clock, and the following arrangements for papers have been made:—

March 3.—"On the General Features of West African Trade from Senegal to St. Paul de Loanda." By Consul Thomas J. Hutchinson, F.R.G.S.

March 17.—"Remarks on the Geographical and Physical Character of the Diamond Fields of South Africa." By the Honourable Theophilus Shepston, Secretary for Native Affairs in Natal. Communicated and explained by Dr. Mann.

Chemical Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

March 6.—"On the Paraffin Industry." By Frederick Field, Esq., F.R.S. This being the opening meeting of the Section, Professor Odling, M.A., F.R.S. (President of the Chemical Society), will preside, and will give a short address on "The Importance of Industrial Chemistry."

March 20.—"On Anthracene and Alizarine." By Dr. Versmann.

April 10.—"On some Recent Processes for the Manufacture of Soda." By C. W. Vincent, Esq., F.C.S.

April 24.—"On Pyrites, as a source of Sulphur, Copper, and Iron." By Dr. C. R. A. Wright, F.C.S.

May 8.—"On Sugar Refining, with special reference to Finzel's Sugar Crystals." By Dr. Griffin.

May 22.—"On the Manufacture of Chlorine." By W. Weldon, Esq., F.C.S.

Cantor Lectures.

The second course is on the "Chemistry of Brewing," by Dr. Charles Graham (University College, London), and consists of seven Lectures, the remaining two of which will be given as follows:—

Lecture VI.—February 23rd, 1874.

On Fermentation. (Secondary.)

Lecture VII.—March 2nd, 1874.

The Beer of the Future.

A third course "On Carbon and Certain Compounds of Carbon treated in reference to Heating and Illuminating Purposes," will also be given during the Session, by Professor Barff, M.A. Further particulars will be given shortly.

All the above Meetings and Lectures are open to Members, each of whom has the privilege of introducing two friends.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Mon. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Dr. Graham, "On the Chemistry of Brewing." (Lecture VI.)
Royal Geographical, 1, Savile-row, W., 8½ p.m. 1. Capt. Jas. A. Croft, "Exploration of the River Volta, West Africa." 2. Dr. C. Millengen, "Journey in the Highlands of Yemen."
British Architects, 9, Conduit-street, W., 8 p.m.
Inst. of Actuaries, 12, St. James's-square, S.W., 7 p.m.
Medical, 11, Chandos-street, W., 8 p.m.
London Institution, Finsbury-circus, E.C., 4 p.m.

Tues....Royal Institution, Albemarle-street, W., 3 p.m. Professor Tyndall, "On the Physical Properties of Liquids and Gases."
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. Parke Neville, "On the Water Supply of the City of Dublin."
Anthropological Inst., 4, St. Martin's-place, W.C., 8 p.m. 1. Mr. T. G. B. Lloyd, "On the Beothucs, a Tribe of Red Indians, supposed to be extinct, which formerly inhabited Newfoundland." 2. Mr. T. G. B. Lloyd, "Notes on Indian Remains found on the Coast of Labrador." 3. Commander Telfer, R.N., "On Skulls found near Tiflis." 4. Dr. Sinclair Holden, "On a Peculiar Neolithic Implement."

Wed....SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Shirley Hibberd, "On a New System of Cultivating the Potato, with a view to Augment Productiveness and Prevent Disease."
London Institution, Finsbury-circus, E.C., 7 p.m.
Geological, Somerset House, W.C., 8 p.m. 1. Mr. George Maw, "Geological Notes on a Journey from Algiers to the Sahara." 2. Mr. Thomas Davidson and Prof. William King, "On the Trimerellidæ, a Palæozoic Family of the Palliobranchs or Brachiopoda." 3. Col. C. W. Jenks, "Note on the Occurrence of Sapphires and Rubies *in situ* with Corundum at the Culsagee Corundum Mine, Macon Co., North Carolina." Communicated by Mr. David Forbes.
Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m.
Archæological Association, 32, Sackville-street, W., 8 p.m.

Thur....Royal, Burlington House, W., 8½ p.m.
Antiquaries, Somerset House, W.C., 8½ p.m.
Society for the Encouragement of the Fine Arts, 9, Conduit-street, W., 8 p.m. Dr. Leitner, "Discovery of Græco-Buddhistic Sculptures at Takht-i-bahai in Yusufzai, on the Punjab Frontier."
Royal Institution, Albemarle-street, W., 3 p.m. Professor W. C. Williamson, "On Cryptogamic Vegetation."
Philosophical Club, Willis's Rooms, St. James's, S.W., 6 p.m.

Fri......Royal United Service Institute, Whitehall-yard, 3 p.m.
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting; 9 p.m., Mr. Francis Galton, "Men of Science, their Nature and Nurture."
Quekett Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.

Sat......Royal Institution, Albemarle-street, W., 3 p.m. Mr. R. Bosworth Smith, "On Mohammed and Mohammedanism."
Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,110. VOL. XXII.

FRIDAY, FEBRUARY 27, 1874.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

VISIT TO THE BRIGHTON AQUARIUM.

Arrangements are now being made for a visit of the Members of the Society of Arts and their children to the Brighton Aquarium, under the guidance of Mr. Frank Buckland, M.A., Her Majesty's Inspector of Salmon Fisheries, who will then deliver his Fourth Juvenile Lecture. Friday, the 10th of April, during the Easter holidays, is selected for the visit, and a ticket will be issued for 10s. 6d., entitling the bearer to travel first-class by special train to Brighton and back, with admission to the Aquarium and luncheon. Members desirous of securing to themselves and families the privilege of obtaining these tickets, are requested to send in their names not later than Saturday, March 14th, to the Secretary of the Society of Arts, with a remittance, and stating the number of tickets they will require.

PROCEEDINGS OF THE SOCIETY.

TWELFTH ORDINARY MEETING.

Wednesday, February 25th, 1874; Lord ALFRED S. CHURCHILL, Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Bland, Charles, White Horse-road, West Croydon.
Clark, Joseph, 69, Hamilton-terrace, St. John's-wood, N.W.
Deacon, George F., Engineer's Department, Corporation Water Works, Dale-street, Liverpool.
Gillett, William, White Horse-road, West Croydon.
Irvine, James, Messrs. Irvine and Wood, Dale-street, Liverpool.
Laws, John Milligen, 10, Askew-road, Shepherd's-bush, W.
Trickett, John, H.M. Dockyard, Keyham, Devonport.
Wickenden, Alfred Authorn, Cyprus-house, Frindsbury, Kent.
Wythes, George Edward, Copt-hall, Epping, Essex.
Zimmermann, Edward, 6, Great Winchester-street-buildings, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Abbott, William, 8, Durham-villas, Phillimore-gardens, Kensington, W.
Corbitt, William, Masboro' Works, Rotherham.
Coventry, Joseph, 11, Cecil-street, Strand, W.C.
Dunbar, J. A., M.D., 45, Gloucester-gardens, Hyde-park, W.
Gardiner, Henry John, 6, Orsett-terrace, Hyde-park, W
Garton, William, Southampton.
Pickford, William, 148½, Fenchurch-street, E.C.
Soper, W. G., B.A., the Priory, Caterham, Surrey.
Thompson, William, the Brewery, Chiswell-street, E.C.
Walker, William, Clifton-grove, York.

The Paper read was:—

ON A NEW SYSTEM OF CULTIVATING THE POTATO, WITH A VIEW TO AUGMENT PRODUCTION AND PREVENT DISEASE.

By Shirley Hibberd.

So much has been written and said on the subject of potato disease, that I can only hope to obtain attention by announcing that I am prepared to submit for your consideration and approval proposals which, I believe, will be regarded as tending materially towards a solution of the puzzling problem the disease forces on our attention. I shall be compelled to go over old ground, but it will be for the purpose of establishing new conclusions. Of the history of the potato, of the special characteristics of the fungus that accompanies the murrain, of the varieties and uses of the potato I shall have nothing to say, except, indeed, it may be incidentally, and for the necessary illustration of my argument. In all the many inquiries and experiments which have been described and reported until farmers and gardeners were tired of them, one important point which I shall presently bring under your notice has been overlooked, and hence the majority of proposed preventives of potato disease are of an empirical nature; they are, indeed, akin to what in connection with maladies that affect the human frame is usually denominated quackery. The essence of quackery is to consider the symptoms of neglect the cause of the disease, and in the case of potato murrain numberless plans have been devised, and have resulted in failure, because they were founded on a superficial consideration of the aspects of the case, instead of a clear perception of the real origin of the mischief. One advises that the plant be suddenly and violently robbed of every leaf and branch on the first appearance of the malady; the result of this treatment is that growth is suddenly arrested, and the crop is usually not worth digging. The mycologists make the best figure among the potato doctors, for they deal with a reality which they understand in part; but their microscopical and biological investigations have led thus far only to a more complete knowledge of symptoms, and a good conjecture as to the cause of the disease; for, as to the means of prevention, it appears that the more they know of the fungus, the more helpless they profess themselves to arrest its ravages.

I invite you, first, to consider the constitution of the plant. It is, as you know, a native of the warm temperate regions of the western continent. It has never been found wild in either a sub-arctic or a tropical clime, and it would probably soon become utterly extinct in this country if completely cast out of cultivation, and left to lead the life of a vagrant weed. Several species of wild

potatoes are met with in Chili, Peru, and Mexico; from which of these the cultivated potato has been derived it might be difficult to say, but this is certain, that they inhabit countries that are considerably warmer than Great Britain, and therefore we begin with a plant that is not perfectly adapted to our climate. The mean annual temperature of those parts of Peru where wild potatoes are found is 72°, the maximum 82°, the minimum 55°; the table lands of Mexico have a mean annual temperature of 62°, the lowest temperature in winter is 32°, and in summer the heat rarely exceeds 85°. As the mean annual temperature in London is under 50°, and the range of temperature during the summer months is considerable, it is evident that *solanum tuberosum* is out of its element here, for it needs the best climates of the south of Europe, where, indeed, the disease is scarcely known, and the tubers usually grow to a prodigious size.

In favourable seasons the potato is one of the most profitable of farm and garden plants in this country and the more northern parts of Europe. The health of the plant is in no way affected by a severe or prolonged winter, as it would be if left to grow wild; and, for the business now in hand, we need only consider the conditions to which it is subjected during the five growing months from May to September. You do not need to be informed that this is a most uncertain climate, the consequence, no doubt, of our environment by the "melancholy sea." In seasons when the temperature approximates to the average, and is agreeably equable, with a moderate and timely rainfall, the potato prospers, and makes an ample return to the cultivator, by a plentiful production, wholly clean, or very slightly damaged by disease. But in seasons characterised by a considerable range of temperature, or by a deficiency of heat, and an excessive rainfall, the crop is more or less damaged, and everybody appears to enjoy a monopoly of wisdom on the subject of potato disease which leads to confusion and ends in nothing. I must ask your attention to a few facts.

In the course of the 47 years ending with 1872, the mean temperature at Chiswick of the five growing months was 59° 27′. In the same period the mean rainfall of the same five months was 11·12 inches.

In the year 1845 (the year of the potato famine in Ireland), the mean temperature of the five growing months was 56° 50′, and the rainfall was 11·12 inches.

In the year 1860, when the sun was obscured for months together by rain clouds, and potato disease well nigh extinguished the potato plant, the mean temperature of the five growing months was 55° 63′, and the rainfall 17·89 inches.

These were the two worst years for the potato crop in our time. Let us now to compare them with the two best years.

In the year 1868 there was a long-continued drought; the pastures failed, the railway banks were everywhere on fire, and the potato crop was one of the cleanest ever known. The mean temperature of the five growing months was 62° 67′, and the rainfall only 6.95 inches.

In 1870 another drought occurred, but owing to the copious rainfall in the spring, the resultant inconvenience was much less than in 1868, and the potato crop was equally clean and considerably heavier. In the five growing months the mean temperature was 65° 39′, and the rainfall only 6·61 inches.

An extended series of comparisons all tell the same tale, but less strikingly, and on the present occasion it is desirable to arrive at conclusions as quickly as possible.

It must be observed here that a statement of the mean temperature of any given period may altogether misrepresent the thermometrical conditions that have prevailed, for a period of excessive heat may be suddenly followed by excessive cold, and the mean of the period may be altogether unaffected by the fluctuation. It is proper, therefore, to remark, that potato disease usually makes its appearance a few days after the mean temperature has been considerably lowered, or after a sudden and excessive rainfall, and is a quite common sequel to a period of electrical disturbance, so that "thunder weather" is commonly regarded as a precursor of the murrain. These facts being generally accepted, the question arises, What is the cause of potato disease? By one, and indeed by many, we are told that the cause is electricity. Another assures us that an insect has punctured the plant—it may be the *Aphis vastator*, or the Colorado beetle, but an insect is the cause of it. Another explanation is, that a fungus is the author of the mischief, and the particular fungus selected is the one now called *Peronospora infestans*, formerly known as *Botrytis infestans*. In my opinion—and I have been a student of the potato and potato culture over twenty years—the only explanation worth a moment's attention is that offered by the mycologist. Without doubt the fungus is invariably associated with the murrain, but it is a mistake to say it is the cause, for, in truth, it is but an effect—the cause is of a more subtle nature. If the disease invariably follows certain changes or conditions of temperature and humidity, and is unknown when such conditions do not prevail, why should we not regard the fungus as only a symptom, and accept the suggestion of facts, that the conditions which favour the disease are also favourable to the fungus? Where was the fungus in 1868 and 1870? It was, comparatively speaking, unknown, for the plant was healthy. In 1845 and 1860 the fungus found the plant a ready prey, for the plant was weakened by a low temperature and excessive humidity. The potato is here out of its element, and hence it prospers only in seasons that are better than the average, at least, so far as the five growing months are concerned.

I must now beg you to bear in mind that the potato is greatly influenced by sudden changes of atmospheric conditions when the crop is nearly full-grown and is entering on the period of ripening. It so happens that the ripening season—July and August—is also the season when atmospheric convulsions are most common, great heat being quickly succeeded by unseasonable cold, and the cold aggravated in its effects by a copious rainfall. If we are to save the potato, we must find means to carry it through these periods of trial, and, as I understand the case, that is the problem now before us. The potato, more than any other plant in cultivation in this country, is dependent for its health on continued solar heat. If we could produce artificial sunshine above the surface of the ground, and artificial sunheat below, we should

save the crop at times when sunshine fails, and the ground is disastrously cooled by a heavy rainfall. You will not expect of me anything in the nature of a miracle, but I will endeavour to show how a substitute for sunshine may be secured by a simple method of procedure, and at a cost by no means extravagant, considering the results that may be anticipated.

You are aware that in heavy lands it is customary, at least in gardens, to plant potatoes on ridges, in order that their roots may enjoy a maximum of ground heat, and be quickly drained of superfluous moisture by means of the troughs between the ridges. Now, it will be obvious that the advantage of the ridge and furrow system would be considerably increased were we to pierce every ridge with a tunnel, for this would ensure beneath the roots of the plant a body of imprisoned air, the non-conducting property of which would render it a storehouse of solar heat, maintaining the temperature of the soil nearly at the point it had attained before the weather changed, and, while favouring the rapid escape of surplus moisture, acting medicinally as well as nutritively to sustain the health of the plant. I shall endeavour to show how this may be done.

In the year 1864, having reasoned out the case in much the same way as I now place it before you, I prepared a plot of ground for an experiment, to test the value of my conclusions. I procured a quantity of common roofing tiles, laid them in lines on hard ground, laid potato sets on them, and then covered sets and tiles with prepared soil, so as to form a long ridge covering a shallow tunnel. The result was a remarkably heavy crop, the texture finer than the average, and without a trace of disease. I then resolved to improve on the plan, by providing a better tunnel than was possible with the nearly flat roofing tile. The result was the adoption of a tile made expressly for the purpose, and known to the few friends who have taken an interest in my proceedings as the "Hibberd potato tile." It is a foot wide and fourteen inches long, the form that of a low, flat-topped arch, four inches deep in the centre. I obtained a supply of this tile from Messrs. Scales, of the potteries in the Green-lanes, Stoke Newington, in 1865. There was no stint of clay or fire in making them, and they prove to be capable of wear and tear to a surprising extent, considering that they have to be roughly handled. The best way to use this tile is to lay down lines four feet apart, on hard ground, and as the sets are laid on the tiles, they are moulded over with earth from the intervening spaces. The result is a series of rounded ridges, so far separated that the potato plant enjoys abundance of light and air, lodgment of water is impossible, and in the event of a sudden lowering of temperature, when the tubers are ripening, the storage of earth-heat below the roots tides the crop over the time of danger, and prevents that engorgement of the tissues which constitutes the first stage of the disease and the nursery for the fungus. As a matter of course, the intervening spaces should be deeply dug and liberally manured, and planted with suitable crops. These must be such as will not rob the potatoes of air or light. The cultivator will have no trouble in determining how to utilise the furrows. In the garden they will be found admirably adapted for celery, late dwarf peas, brocolis, and winter greens. In farm practice it would probably be best to leave the furrows open, because the sorts of potatoes selected would profitably utilise the light and air, and in strong land really meet across the furrows.

Here, of course, we encounter the question, Will it pay? It must be confessed that the Hibberd potato tile is a costly thing, for Messrs. Scales cannot now produce it at a lower rate than from £6 to £8 per 1,000, and, for the sake of a datum, we may reckon that the cost would be £7 per 1,000, or, if laid in lines four feet asunder, £66 3s. per acre. The cost of the common ridge tile at the present time is £3 10s. per 1,000, but this is only 12 inches long, and the saving is less than appears. It would be good practice, however, to lay these a yard apart, the cost in this case amounting to £51 9s. Those who raise or speculate in new varieties, and who are familiar with the difficulty of obtaining a stock quickly, to ensure a high price in the market, will not regard the tile system as costly, provided only that it affords substantial help to save the crop in a bad season. As a matter of fact, if the tile system is properly carried out, it will in a run of years produce full double the weight of potatoes that would be produced on the same land without its aid; and it has this peculiar advantage, that by saving the crop in a bad season it provides the cultivator with something to send to market at a time when prices rule high, and potatoes are regarded as articles of luxury.

But we must test the tile system on the land of the man who grows potatoes for market. With a good season, good land may be reckoned to produce potatoes at the rate of eight tons per acre, which, at 120s. per ton, will be worth £48. If we estimate the crop on the tiles at sixteen tons, the total value will be £96, from which we must deduct £6, being 10 per cent. of the cost of the tiles for interest on the investment, which reduces the value of the crop to £90. This shows a balance of £42 per acre in favour of the tile system. But suppose we estimate the crop at twelve tons, the value will then amount to £66, showing a balance of £18 in favour of the tiles.

It will be observed that, in a hot and dry season like that of 1870, the difference in bulk and quality between a crop grown without and another with tiles, will be trifling, so as to show the least advantage of the tile system; while in a season characterised by a copious rainfall, the difference will be the greatest, for as a matter of fact, when disease prevails and there is said to be no crop, there is usually a prodigious production of tubers, and the misfortune is that the majority of them are worthless. It is in such a season the tile system will tell its proper story. The heavy rains that spread disease on every hand will benefit the crops that are protected by tunnels, and the enormous production that follows upon thunder weather in the height of the season will be saved for our use, when, if not so aided, they would simply rot and make the very atmosphere offensive. Let us then suppose that we have a forward genial summer, occasionally interrupted by electric storms and days of tropical heat and rain. In such a season the potato crops on well-drained fertile sandy soils are usually great, while on the heavy lands they come to nothing. But if, on these heavy

lands we employ tiles, we may expect to dig 20 tons per acre. The contrast in such a case may be put thus—

Produce of one acre on the flat	£0 0 0
Produce of one acre on tiles, 20 tons at 120s.	120 0 0

When a proper reduction has been made for interest on cost of tiles and loss by breakage, the balance will prove the potato to be one of the most profitable plants in cultivation.

It remains to be said that the tile system will not make sunshine, will not create heat, and will not check the rainfall; therefore, it will not be always successful, and I am bound to confess that I have taken diseased potatoes from tiles; but in a bad season, the tiles, with all their short-comings, have ensured a crop when, without their aid, there would have been none. Wheat, maize, and potatoes are, in a peculiar sense, the products of sunshine, and in such a summer as that of 1860, when the sun was obscured for months together, and the rainfall of the growing season, from May to September, amounted to 18 inches, there could be but a small production of such things, no matter what the conditions and contrivances adopted by the cultivator. I make no pretension to the discovery of an infallible specific, but I am satisfied that all who are interested in the cultivation of the potato should give the tile system a fair trial, during at least three consecutive seasons, to determine for themselves whether in these remarks its peculiarities and merits have been fairly stated.

DISCUSSION.

Mr. W. J. Goulton (Retford) said he had been growing potatoes for the last 25 years, to the extent of 200 acres on the average. He was very glad to find that scientific men were taking up this important subject, and hoped some good would result from it. He wished o know if Mr. Hibberd had made any calculation as to the cost of labour in using the tiles.

Mr. W. Botly had never listened to a paper, either at the Royal Agricultural Society or elsewhere, of more interest to the practical agriculturist. He had found, from practical experience, that the best place to grow potatoes was where a hedge had grown, and he considered that great good might be effected if all hedge rows were grubbed up, and the land planted with potatoes.

Mr. Amos Bryant expressed his decided conviction that the disease in potatoes was produced by a fly, produced from a worm found in oak-galls, which were imported for tanning purposes. He had a powder which would exterminate this fly, and he would undertake to grow potatoes for anyone free from disease, without the expense of tiles, or to cure the disease if not too far advanced.

Mr. Newton, having had considerable experience in both agriculture and horticulture, could confirm what Mr. Hibberd had said as to the value of drainage in the culture of potatoes, and though he did not quite approve of the tile system now proposed, he believed he was the first to introduce drain tiles into Virginia. The potato was a sub-tropical plant, and required plenty of sun. Within the last year he had seen two crops grown on the same land in Virginia without any manure, simply because there was abundance of warmth to evaporate the water at the time the plant was forming starch. Since the days of Dr. Lindley the potato disease had been known in Great Britain, but no certainty had been arrived at as to its prevention, though efficient drainage seemed most promising. The potato, being a sub-tropical plant, seemed to accommodate itself to its new home like the sub-tropical plants in Hyde-park, which only throve when there was good drainage, and the soil was kept warm by means of air. He had tried many experiments, like Mr. Hibberd, but did not believe there was any remedy for the disease. It simply came to this, if the soil were warm enough, and the sun sufficient to evaporate the moisture when the starch was forming, the disease did not appear; and he, therefore, recommended the thorough draining of the soil, and the cultivation of early varieties which would ripen before the approach of the summer thunderstorms.

Mr. R. J. Lecky wished to know how manure was applied under the tile system. Having lived for many years on the west coast of Ireland, he had watched this disease since 1845, and thought a very foolish mystery had been made of it. It was really very simple; the spores of fungi were constantly floating in the air, and whenever they found a suitable medium they would grow. In a damp, moist year there could be no doubt that these spores grew much more easily than in a dry year. Plants grown rapidly and well were less liable to disease than those grown slowly and badly, as they were not so much attacked by insects and parasitical fungi. It was all nonsense about electricity causing the disease. In his opinion the plant was attacked by the disease in the leaf first, as was constantly seen in every potato field; it began with a little black spot in the leaf, which became brittle, and from there it extended to the stalk, which also became brittle. Sometimes a field would appear entirely free from disease one day, and then, after a foggy night, it would be all covered with it. That simply arose from the rapid growth of the fungus, though what sort of fungus it was he could not say. It rapidly spread from the leaf to the rib, from the rib to the stalk, and then to the root, where it found its food in the starch. It had been often said, that when a field was attacked, if it were mowed down, the tubers would be saved, and he believed it was so; there were too many examples for it to be doubted. No doubt Mr. Hibberd's plan was a very good one, but it was rather expensive. Potatoes grew in all climates, in Normandy, in Iceland, and in the dampest parts of the west coast of Kerry, and the crop was very often good in that damp climate, the reason, no doubt, being that the temperature was high during the important part of the year. At Valentia the temperature during the five months referred to, seldom exceeded 70°, or fell below 55° to 60°.

Mr. Hale thought it would have been well if Mr. Hibberd had given the comparative results of growing the same kind of potatoes in the same soil with tiles and without.

Mr. Earley asked what would be the result of the tile system upon the crop, if during the chief growing season there were a drought; would it not be rather detrimental than otherwise?

The Chairman said he gathered from the discussion that there was a general concurrence of opinion that the disease was merely a fungus which grew upon the potato, and which was engendered from its being grown upon cold, damp soils. Of course, the first remedy was drainage, the second, to provide a warm soil, such as was natural to the plant. This being so, the method proposed by Mr. Hibberd seemed to answer, as far as his experience had gone, and it was certainly a rational one in every respect. His most powerful arguments were the statistics he had given, showing the different crops which had been produced in different years according to the meteorological average taken during the five months of the potato's growth, and proving that dry years produced the best crops. Looking at the enormous consumption of potatoes, it was most important that some means should be devised, if possible, for producing a uniformly good crop, and Mr. Hibberd eemed to have hit upon the right principle, because he

had shown that the potatoes grown upon the tiles far exceeded in weight, quality, and value, those grown in the ordinary way. There was no doubt he was right in protesting against overcrowding, for harm was often done by attempting to fill the ground too much, one plant crowding out the other, and robbing it of its proper nutriment. Air was, undoubtedly, one of the most powerful non-conductors, and the air having been once warmed, would retain its heat for a considerable time, notwithstanding occasional thunder showers. The material of the tile also was a good retainer of heat, and therefore, though there might be cheaper materials discovered for enclosing the air, he did not think they would prove so useful as tiles in retaining the warmth. There was a heavy outlay at the beginning, no doubt, but against that must be set the increased value of the crop. If this difficulty of cost could be overcome, no doubt the system would soon be largely extended, to the great increase of production. He had lately seen in the *Gardener's Magazine* an article describing a beetle now prevalent over some part of North America, which destroyed potatoes in a most marvellous manner, large tracts being quite devastated by it. It was necessary, therefore, to be particularly cautious in planting seed potatoes which came from America, lest this destructive insect should be introduced. In conclusion, he moved a cordial vote of thanks to Mr. Hibberd for his valuable paper.

Mr. Shirley Hibberd, in reply, said his only object in coming forward was to promote potato culture on scientific principles. He had not put down anything for the cost of labour, leaving such details to practical men who could deal with them quite as well as himself; but, according to his own experience, the cost of laying down the tiles was very small indeed; it would hardly add anything to the expense. Mr. Newton, although not professing to approve his system, really did so, because he approved of draining, and referred to the sub-tropical plants in Hyde-park, which had only been successfully cultivated on this very system, though brick rubbish was used instead of tiles for the purpose of enclosing the air. Another gentleman had asked how the manure could be applied. He might say, according to fancy. Sometimes on a nice sandy soil potatoes were planted on the manure and then covered over; and so with the tiles. They might be placed on the tile and then covered over with manure. And by this plan you might manure very strongly, because as the water was got rid of and the plant kept warm, it could assimilate more food. He had manured the ground after the potato was planted, digging it well, turning in plenty of guano and cheap potash salts, and then when it was all well chopped up, turning it over the plants. He was not particular to one particular form of tile, his object being to establish the principle, and leave every one to carry it out in the best and cheapest way he could. He had tried every possible experiment in potato culture, and could easily spend several hours in narrating his experience, but considered it better to keep to one point, and explain it thoroughly. Mr. Earley had put a very excellent question, and no doubt this plan would not be so advantageous in time of drought; but then in a light porous soil the tiles were not required, and in a heavy clay soil the drought would not effect the potato much on the tile; in fact, in 1868, he had a beautiful crop. It served to store up the sunshine against the time of bad weather. That was the vital principle. He himself did not grow potatoes for the wholesale market, but he would conclude by a few facts, showing the value of the system to a potato fancier. He then quoted several American journals to show that certain varieties were sold at 50 dols. a root, 180 dols. per bushel, and 5 dols. per lb., which was the price obtained by Messrs. Bliss for "Early Rose" in 1869; whilst, in 1870, the same firm refused 500 dols. for one peck of "King of Earlies." Now, 5 dols. per lb. was equal to £466 per ton, and at 8 tons per acre, that was between £4,000 and £5,000. He himself had grown "Early Rose" at the rate of 20 tons per acre—by a costly system no doubt, with a beautiful soil, fit to grow calceolarias or fuchsias, and with every care taken in the handling to put the potatoes the right way up—but at the same rate of 5 dols. per lb., that was equal to £9,320 per acre. These were big figures, no doubt, but they were strictly founded on facts, and were sufficient to show that the cost of tiles was not always a matter of very great importance.

CANTOR LECTURES.

The fifth lecture of the second course of Cantor Lectures for the session, "On the Chemistry of Brewing," by Dr. Charles Graham (University College, London), was delivered on Monday evening, February 16th, 1874, as follows:—

Lecture V.

At our last meeting I pointed out to you that diastase, when dissolved, acted upon starch, and that at the first moment of time—depending upon several factors, upon the amount of starch that there might be compared with the diastase, upon the temperature, the length of infusion, and the amount of water—there was a ratio of dextrine to sugar of two to one. I then went on to show you that that ratio gradually decreased, so that in the English process, where the mashing temperature is about 150°, the ratios were about equal, or one to one. I then pointed out that by carrying on the process longer, and also at higher temperatures, the ratios were finally inverted, so that we had two of sugar to one of dextrine, and that by the very able and suggestive researches of Mr. Sullivan, we had a clue to the nature of the phenomenon. We found that it could not go beyond this, because that particular substance which I spoke of as containing two of sugar to one of dextrine, really was not glucose and dextrine, but a sugar called by him maltose. This showed us how we could, within certain fixed limits, vary those ratios, though beyond those limits we could not go. I then pointed out to you how those ratios might be further altered by the addition of sugar, and in adding sugar, I mentioned that you might use cane; and this week, in answer to a request I made, I have received several samples of yeast, kindly sent me by different brewers, one or two of them coming from fermentations where cane sugar had been used, at least I suppose so. Whether that be so or not, at any rate there is this danger, that in using raw cane sugar we are liable to have a putrefactive fermentation set up, and to have ferments of a different kind to those which we shall see presently we ought only to have. I then suggested that you should yourselves convert either cane sugar or starch into grape sugar. With reference to the other alteration of the ratio, namely, the increment of the dextrine, I pointed out to you that not only could that be done by altering the nature of the mashing itself, and the length of the infusion, but also by the addition of unmalted grain. Now, it occurs to me that possibly this may give rise to some criticism, and I therefore beg of you to remember that I stated that the unmalted grain ought to be kiln-dried at a very high temperature. You need not be afraid of using that high temperature, because you are not dealing with albuminous matter in the presence of a large quantity of moisture, but only of such an amount as is natural to grain generally. Hereafter, when I come to lay before you some suggestion as to modifications in our future processes, I shall have again reason to refer to the use of unmalted grain. Of course I am quite aware that before we can use it we must induce the coming powers to alter the present laws with regard to malt. We then went on to the subject of

boiling, and although I knew full well I should meet with adverse criticism, I still felt bound to do so. I pointed out to you that by long boiling you not only precipitated that albumen, which is precipitated by a high temperature, which occurs in a quarter or half an hour, but that by the long boiling you degraded or broke down the molecular structure or complexity of the albuminous bodies, and by so doing you rendered them a less fit food for the ferments that you are afterwards to employ. It is quite possible that some—as was the case with a friend of mine, an eminent brewer—may have thought that I proposed or wished that you should boil your worts as long as the Belgians do. That is not so. While I was speaking so strongly of the necessity of boiling, it was rather with reference to the knowledge that has come to me within the last few months, that three quarters of an hour to one hour has been considered enough for that operation. I do not consider that a sufficient time; I prefer two hours or even longer if it be malt prepared from strong barleys. Then after speaking of different kinds of hops, we left off at the process of cooling which I have now to take up.

In the cooling process a precipitate is formed, which is due to two causes. First of all, it is due to the simple action of cold. A portion of the albuminous matter, the tannate of albumen, goes down, but the precipitate is partly due to oxidation. Occasionally, starch may be found in the precipitate, but I hope not with your worts. During a long cooling from a high temperature, where the worts are wholly cooled upon open coolers, they are submitted to the action of the air, and therefore to oxidation. Now, when the length of time is very great, the action of the oxygen is carried on longer, and the dangerous temperatures are those below 100° to 120°. More especially is it dangerous if there should be any soluble starch present. Albuminous bodies, by decay, set up decomposition, which I think is not here due to the action of vital organisms, and that decomposition is of this kind. You remember that the formula of grape sugar or glucose was C_6, H_{12}, O_6. If you divide that into two equal parts, you will have two molecules, containing each of them C_3, H_6, O_3. In other words, you will have lactic acid, so that you may look upon the production of lactic acid from glucose as being very much of this kind; if you conceive that my two hands together represent the molecular structure of glucose, all that apparently takes place is the separation of them one from the other, forming two molecules of lactic acid. There are no gases given off and no precipitate formed, but lactic acid is produced by a simple alteration of the molecular arrangement. And this particular action is the more liable to take place according as the period between 100° and 60° to 70° is prolonged, and according also to the amount of putrefying albuminous matter which may be present. Rapid cooling, therefore, is essential, and, fortunately, of late years, we have received from very skilful engineers a number of ingenious appliances by which we may even, on a warm, moist day, cool our worts rapidly. I speak of a warm, moist day, because those are the days when it is most difficult to cool rapidly. These instruments, of course, are very numerous, and I purposely refrain from mentioning any of them, in order that I may not be supposed to attach any particular value to one more than another. They are, however, based upon two distinct principles. In the first place, I believe the bulk of them lay claim to the great advantage of not exposing the wort to the action of the air, and those, therefore, who follow Pasteur's theory, will do well to keep the wort unexposed to the action of the air. Others, who may be looked upon as the disciples of Liebig, consider that a little air is good. I do not myself attach any very great importance to this point, because I do not think in so short a time as occurs in the cooling of the wort that a large number of germs—if Pasteur's theory be true—can be received there. I think many more may be received in the fermenting-tun before the fermentation is brisk. Secondly, the amount of oxidation that takes place is perhaps rather an advantage than otherwise.

The wort, after it had been cooled on the old-fashioned plan when it lay upon the cooler, was supposed by practical men to be sound and good if it fulfilled the following conditions; if it presented, on looking at it, a black appearance on the surface, it was supposed that the malt and wort had been well treated. If, on the other hand, there was a reddish hue, that was an indication of putrefaction. Now, this reddish hue might have been due either to the malt being bad, and itself containing the germs of putrefaction, or else to the wort containing starch, starch being very prone to decompose at high temperatures in the presence of albuminous matter. However, I suppose in most cases the cause of this reddish appearance is the impurity of the coolers employed, and this "fox," as brewers term it, is really due to putrefactive ferments, brought about very often indeed where there is putrefying albuminous matter left on the coolers. I should say that this goes on throughout the whole of the fermentation process, and it inoculates, as it were, the fermenting tuns themselves; so that it is a matter of considerable difficulty to get rid of this disease. The best materials to employ for cleaning such coolers are chloride of lime and quick-lime, or a mixture of them, not bi-sulphite of lime. The difference of action is very marked. Chloride of lime contains oxygen in a form that can be very readily given up, whilst sulphurous acid, on the other hand, is a material which takes up oxygen, and is a most valuable adjunct, when we require it, for the purpose of preventing acetification; but for the purpose of cleansing open coolers, or any other brewing utensils, it is better to use a material like chloride of lime, which oxidises or burns and destroys the impurities. Of course, after such action, you must employ boiling water to get rid of anything that may be left.

This cooling process is carried on until the temperature is brought down to about 66° or 64°, and in some cases a little lower. In Burton it is brought down to 57°, and in Bavaria, where they use the bottom fermentation process, it is brought down to 42°; of course they can only do that by means of ice, if they are working in spring or autumn.

I come now to the most important subject of all, viz., fermentation, because, after all, upon this depends perhaps more than on any other stages of the process, the goodness of the beer. A slight error in the previous malting, or even mashing, may not be very serious, but a slight error in the fermentation process is attended, as you know, with very serious results. Before going into any examination of the practical processes employed, it may be well if we devote a short time to the consideration of the theoretical views which have been held regarding fermentation. First of all, we may take the theory of Liebig and his school. His theory, and that of Gay Lussac, Geshardt, and many others—Mülder amongst them—is this, that under certain conditions a nitrogenous body, having an albumenoid character, breaks down and decomposes; its equilibrium is disturbed, and in that disturbance it is able to communicate a disturbance of equilibrium to the sugar molecule that may be found near it. Hence, therefore, they consider that the process of fermentation is entirely a chemico-physical one. Gay Lussac held that the oxidation of albuminous matter was an essential feature of the process, and it is to some extent true, only we find that fermentation will go on even when not in the presence of air. At the same time, air does seem to start the fermentation process. The other theory first of all arose about the year 1836. Schwann, a German chemist and physiologist, maintained that there was no real case of fermentation unless cells were present, unless living organisms were the agents of that change. Hence, therefore, arose the theory of its being a vital phenomenon. Not much was done to promulgate these views amongst scientific men and the

world in general, who still held to the old theory of Liebig, until Pasteur took up the subject and worked at it with that wonderful energy and scientific acumen for which he is so distinguished. The series of experiments which he carried out proved this point, viz., that fermentations are the results of vital processes. His experiments were carried on for years and with most interesting results. He maintains in opposition to Liebig, Gay Lussac, Mülder, and others, that the alcoholic fermentation—with which the brewer has chiefly to do—is not due to the decay, to the putrefaction of the cells—of which yeast is composed—but is due to the action of the living and growing organisms. You will remember that I pointed out that under certain conditions, one of which was that it must be soluble, and another was that it should be at a proper temperature, the diastase, which is a soluble albuminous body, and also the albuminous matter in the saliva, and many other animal secretions, were able to convert starch into sugar; and not only that, but when alcohol is acted upon by oxygen in the presence of platinum black, the alcohol is oxidised first to the state of aldehyde, and then to the state of acetic acid. These facts were brought forward in opposition to Pasteur, because these were two phenomena that were held to be distinctly phenomema of fermentation. As regards the conversion of starch into sugar, that is not from Pasteur's point of view a case of fermentation at all. The same action is carried on by dilute sulphuric acid at boiling temperature. You will remember that I pointed out to you how certain companies converted starch into sugar in that way. Vinegar or acetic acid, it is perfectly true, is also, under certain conditions, obtained from alcohol; and, doubtless, also another exception may be made, namely, that which I alluded to when I said that probably lactic acid is made from the molecules of sugar, which contain double the amount of each of the constituents of lactic acid. However, although we may have acetic acid formed without the agency of the ferment called "mycoderma aceti," and though lactic acid may be formed from sugar without the agency of the little organisms I shall have presently to speak of, and though these substances may, under certain conditions, be formed by purely chemical causes, yet we have not hitherto found out any purely physical and chemical means by which sugar may be converted into alcohol. As yet, we are obliged to have recourse to these small organisms, represented in these diagrams, in order to obtain the decomposition. So far, therefore, the weight of evidence rests with Pasteur, viz., that this phenomenon, which he would term a true case of fermentation, is brought about solely by living organisms, and not by putrefying organic matter.

Now if we were to take a sample of ordinary wort, and if we were not to boil it, because the action would take place rather quicker if we did not; but, even if we did boil it, and placed that in a glass beaker or bottle, in process of time, if we took a drop of that and placed it under a microscope, we should find a number of minute organisms. I have hero, under one of these microscopes, a drop of wort that was so kept. It was sent to me from Edinburgh for the purpose of being analysed, and was filled into a bottle just as it came from the tap, the tap heat at the time being something like 152°. It was closed completely by a cork, and sealed down. I was so much pressed with other work at the time that I was not able to attend to the analysis, but a few weeks ago I thought I would include it with the other examples of wort that I noticed, in order to show you the ratio of sugar and dextrine in the brewing process generally. I found that on applying the slightest force to the cork it was driven out with very great violence, and it was with great difficulty I was able to save some of the contents of the bottle. A very violent fermentation had been going on; an enormous quantity of carbonic acid had been produced, probably associated with some other gases, and there was evidence of alcohol being present. I placed some of it under the microscope, and found it charged with numerous little organisms, and so will it always happen, sooner or later, if you take a wort and leave it to the action of the air. In this particular case it was not left to the action of the air, except merely whilst it ran from the tap into the bottle, but still that had been sufficient for the purpose. These organisms are very interesting indeed. I have here a drawing representing those which are generally found in beer wort. You will find a number of little cells, some of them round, others slightly ovoid in shape, others joined together, others looking like long sausages joined together. These are the little organisms which cause the alcoholic fermentation, and they form, what may be known to you as the *mycoderma cerevisiæ*. The term *torulæ* has been applied to these little organisms, to distinguish them from another set also found in such infusions, which are called *Bacteria*. These latter are very various in their form; some are little tiny tubes, varying from 1-15,000 of an inch up to 1-2,000 in length, and one usually notices a little septum or division in the middle, dividing the little straight tube into two equal parts. Occasionally they are bent, and sometimes at this junction there seems a flexibility, so that one portion may bend upon the other. They are sometimes stationary, but as a rule they are darting about the liquid with great rapidity, some times in straight lines, but at other times they rotate, and sometimes they make slight oscillations to-and-fro; in fact they perform motions of all kinds. In addition to these you will notice, especially if you were to look at some sour milk, but you may also notice it in beer wort, a number of little organisms that look like the figure 8, two round circles together. These are found in some cases to be joined together to the number of three or four, sometimes a dozen or fifteen are joined in a line, looking very much like a rosary. The processs of reproduction in the *bacteria* is a very simple one. Where the division is, there often occurs a simple fissure, and the process generally is that of simple fission, dividing into halves. The size of the *torulæ* vary from minute specks up to the 1-2,000th of an inch in length. In the case of the *torula* the reproduction is different, and in working with the microscope you will see often an instance of what I refer to. In process of time you will find, on looking carefully at a cell, that a little projection appears, by and by this gets larger, and, finally, a bud is formed, and separates from the mother. It is a process of gemmation. Amongst German brewers there has been for a long time the idea that the particular variety of the *torula* cell that is found in the bottom fermentation process, which has a sort of ovoid appearance, is reproduced by a process of emission of little spores, and that these spores are carried by carbonic acid through the gyles into the air; in other words, they thought they were little fungi, and of late that has been distinctly proved. Such cells have been taken and placed upon a slice of potato. In process of time the little cell has thrown off a long filament, and at the end of the filament a micelium has been produced, proving distinctly that the *torula* cell is only a stage in the life history of a fungus of a very low organisation, so that what you have to do with are little fungi, or rather with links in the life chain of such organisms.

Pasteur, from his researches upon germs, has proposed a plan by which pure yeast may be formed. If you look presently at the various samples of yeast I have here under the different microscopes, you will find that in hardly a single instance do they contain pure and perfect *torulæ* cells, round or ovoid as the case may be; but you will in most of the samples find also *bacteria*, some looking like mere oscillary specks, others like tubes of various lengths, all of them indicating motion more or less rapid. I am sorry to say that in some instances you will find a considerable number of these organisms, the *maladie de ferment* of Pasteur, so called by him because they set up from the brewers point of view a diseased form of fermentation.

In order to get rid of these destructive ferments, he suggests that you should take a sample of ordinary yeast and add to that a solution of sugar. The yeast ferments, and after it has finished fermentation, or very nearly, the supernatant liquor is poured off and a fresh solution of sugar is added. This is carried on two or three times. Of course during this process the cells become weak and wanting in vigour, so the next process is to place them in a bottle or closed vessel and add a little wort which has been previously well boiled, so that in that way the cells may be re-invigorated. A new crop is thus obtained, containing none of these *bacteria*. That is to be decided by the use of the microscope. Then the next stage in the process is to get a larger crop of yeast. If you take a vessel made of glass or iron, or what you like, such as I have roughly drawn here, and put some wort into it, and then boil it, you will, by the agency of steam, thoroughly cleanse the interior from any small germs or any of the spores that may be flying about in the air. They are driven off through that tube. This represents a tap which can be shut off, and the steam can then be driven through this tube, which is under water. As soon as you have finished that, you close the other tube, and allow this to cool. To this indiarubber tube above is attached a glass stopper. You fill it with pure yeast that has been grown in the way I have spoken of. The stopper is removed, and it is put into the indiarubber tube, and, as soon as everything is tight, it is turned round until the hole there corresponds with the direction of the tube. A little of the yeast is passed in, it is then closed again, and fermentation in a short time is set up. I ought to mention that in the larger instruments he charges this with carbonic acid, perfectly pure, and free from germs. The fermentation is then set up, and in that way he obtains a crop of perfectly pure *torulæ* cells—the *Mycoderma cerevisiæ*.

However, you may obtain or gradually cultivate pure yeast, and when you have got it you may keep it pure by a simple process, that is, by taking care to ferment at low temperatures, and this you may do with a portion of your fermentation, such portion as is needed to give you a sufficient crop for the whole of your wort. Of course you must take care not to use the scum, or the unsound and foul yeast that comes off at first with all the various products in it. It ought to be kept cool until you require it. Amongst the varieties of *torulæ* found, though they are generally circular, we sometimes find them as in the Burton yeast, of an ovoid character; the great bulk of the Burton cells are ovoid, but as a general rule the English yeast cells are circular.

As regards this question of yeast, I think you ought on no account to use old yeast, or to allow your yeast to be exposed to the air, because if it be, it receives rapidly not only oxygen, and therefore undergoes oxidation, but also the minute organisms that are floating about. Yeast, therefore, ought to be washed and pressed, and kept in a closed vessel and cold. By keeping it in a closed vessel you avoid oxidation, and by keeping it cold you limit the chances of putrefaction. Another plan which the Germans employ when they are not able to use it at once is to press it, then mix it with sugar, and then put it into a vessel also closed and kept cool. Charcoal has also been used for that purpose. Perhaps the simplest process is to merely wash the yeast, put it into a covered vessel, and keep it in a cool place. The microscope, which every brewer ought to have and to use daily, will enable you to see whether the ferment which you are using is pure; that is to say, whether it has got the *torulæ* that you want, these particular cells that you require, or whether it is mixed with a great quantity of these *bacteria*, represented in the diagrams. But another point is required. The microscope will show you the purity of the organisms that you are using; but we require also to know the potential energy of a given sample of yeast, and the microscope will not tell us whether a given sample will produce active fermentation or not. It will tell us whether our *torulæ* cells be free from admixture with the *bacteria*, so injurious to fermentation, but it will not tell us whether these particular organisms have much vitality, and whether they are able to do a large amount of work in a given time. It has occurred to me, therefore, that it would be well at any rate to suggest the means by which, in the course of twelve hours, one might arrive, roughly speaking, at some knowledge of the comparative energy of two given samples of yeast, and I propose that you should take a sample of wort, using half a litre for each given experiment, and place this quantity of the same wort into the respective fermentation bottles. I have here performed this experiment on yeast that I received probably from some gentleman now present. I took the two samples of yeast and pressed them between blotting paper to remove the moisture, so that I might be able to weigh them with moderate accuracy. I took two grammes of each—equal to about 2 lbs. per barrel—and added them to the respective test bottles. The apparatus in each case was then closed. It consists, as you see, simply of a bottle with a short tube passing through the cork, but does not go down to the liquid. It is connected by a piece of indiarubber to a long tube, which also passes through a cork into another vessel, but does not touch the liquid. In the other bottle there is a long tube which passes down to the bottom of the liquid, and then comes up and passes into a measure glass, and in the measure glass it also goes down to the bottom. When the action is started, fermentation is set up more or less vigorously, according to the energy of the yeast, and carbonic acid is produced. Now carbonic acid may be taken with very great accuracy as a measure of the energy of the fermentation. The carbonic acid passing through this tube presses the top of this liquid, which is a saturated solution of common salt; the object of using this is, that this liquid shall not dissolve much carbonic acid. As it presses this, of course it drives some of the liquid into the measured glass. The conditions of the experiments are the same in the two cases, so that one is perfectly well able to decide in the course of twelve hours as to the respective power in decomposing of the yeast. When you start the fermentations you must keep the bottles in the same place, so that they may be submitted to the same temperature; and, finally, at the end of twelve hours, you will be able to obtain some insight into the respective energy of the yeast. It would be better if it were carried on for twenty-four hours. But sometimes you want a quick and rapid answer, and I suggest this to you as a rough means of ascertaining in a short time the potential energy of any given sample of yeast you may have to use.

The young *torula* cell, under proper food conditions, and under a proper condition of temperature, grows and consumes food, and the food is highly organised food, albuminous and saccharine substances. Some years ago, Pasteur found that the yeast cell was not able to thrive without albuminous food. He burnt some yeast, and putting the mineral ash into a solution containing pure sugar and some ammonia salts, he found it was not able to decompose ammonia. Hence, therefore, we have not to do with a vegetable, but with an organism that, in some respects, possesses the ordinary functions of an animal. In addition to the consumption of albuminous matter for the purpose of building up their own structure, they also rob the liquid of dextrine, with which dextrine they form cellulose. The formula, if you remember, of cellulose, is precisely that of dextrine. In doing this they take in a large quantity of saccharine liquid, they rob it of a certain portion necessary for the structure of their own cellulose, and eject certain excrete products. Those are carbonic acid and alcohol, and it was thought for a long time that these were the only products. However, many years ago Schmidt found

that there was an acid produced, succinic acid; and in addition to the formation of this acid, some few years afterwards Pasteur found that glycerine, which is a kind of alcohol, was also produced. In addition to these there is always heat produced. From 100 parts of sugar we obtain about 49 carbonic acid, and about 51 of alcohol, with a slight quantity of succinic acid and glycerine. Sugar, however, is not only capable of being broken up in this way, but Berthellot, some time since, showed that when cane sugar was mixed with chalk and water and a little decomposing cheese, one could obtain butyric acid, and from alcohol and grape sugar he got the same result. If starch was used instead of grape sugar, or cane sugar, the starch also produced alcohol, but without the previous formation of sugar, because during the process, he from time to time tested it in order to see if there was any sugar formed. According to Pasteur these decompositions were all due to the action of ferments, the action of organisms. He also, of course, assumes that the acetic acid formed by the oxidation of the alcohol is also due to the action of organisms. Lately, however, Mr. Horace Brown, in some interesting researches which he undertook in order to ascertain the influence of pressure on fermentation, found that in addition to these products which I have enumerated, there was invariably hydrogen and nitrogen gases liberated, and in addition to these he found that acetic acid was produced. This was so strange that he performed the experiment over again, taking special precautions that there should be no oxygen whatever in the liquid, and that it would be impossible for oxygen to get there. He still found he obtained the same products. True, it may be that a little oxidation is necessary to start a fermentation process, but afterwards these little organisms are able to go on without any oxidation at all. Air is not needed for the particular phenomena that occur. This hydrogen and nitrogen indicate that the decomposition is not so simple as had previously been supposed. Mr. Brown performed a great number of experiments, and carried on his researches with remarkable skill and benefit to science. The following conclusions may be derived from them. In the first place, he found that the fermentation products are not only alcohol, carbonic acid, glycerine, succinic acid, and acetic acid, but there are also hydrogen and nitrogen gases given off. Secondly, he found that as he decreased the pressure he decreased the amount of nitrogen and increased the amount of hydrogen. Now this nitrogen of course is the product of the decomposition of albuminous matter, and while he increased in this way the amount of hydrogen, he also found, as one would naturally suppose, an increase in the amount of aldehyde and in the amount of acetic acid. The formula of aldehyde and alcohol are $C_2 H_4 O$, and $C_2 H_6 O$. Now by taking away two atoms of hydrogen from alcohol you have aldehyde. If now you add one atom of oxygen to the aldehyde thus formed, you obtain acetic acid $C_2 H_4 O_2$. Thirdly, he found that water is decomposed by these organisms in the process, and he found that their power to decompose water was facilitated by a reduction of the pressure. Fourthly, he found that if he reduced the pressure there was a less amount of sugar decomposed, but that there was a greater amount of that which was decomposed converted into acetic acid and into aldehyde. Probably this acetic acid may not be due to any oxidation of aldehyde, but to a simple inversion, as it were, of the molecule of the glucose. Glucose consists of $C_6 H_{12} O_6$, and if you divide that by three, we obtain $C_2 H_4 O_2$, which is the formula of acetic acid, so that we can readily understand the conversion of sugar into acetic acid under some peculiar conditions, without the elimination or absorption of any gas.

I will now pass on to the consideration of some of the practical ways in which brewers carry on the fermentation process. First of all I think we cannot do better than glance at the mode by which the beer is made in the way I spoke of just now, where wort is self-impregnated with the ferments already described. That process, I understand, is practiced in Dorsetshire, and I did hope to have received a sample of the ferment thus produced. It is carried out also on a large scale in Belgium in the production of what they call Lambick beer and Faro beer, or that particular modification of faro called *bière de mars*. They take barley malt and mix it with an equal weight of unmalted wheat. Now wheat contains a large amount of gluten; the mashing is carried on by a modification of the Bavarian process, that is to say, they make a moderately cool mash starting at a low initial temperature, and then by repeated boilings they finally obtain a wort which, like the Bavarian wort, contains a large quantity of dextrine. The wort is then cooled, and so soon as it is cold it is placed in a number of barrels, the bung holes of which are left open. The barrels being filled, the wort is left to mature. Sometimes it may be weeks before the fermentation appears, but sooner or later fermentation is started; occasionally, when it is very obstinate, they add a little unboiled wort to stimulate it, much in the same way English brewers sometimes add a little malted barley for the purpose of stimulating sluggish fermentation. The fermentation goes on slowly for weeks, or even months, and, like the German system, it is generally of a bottom character; the bulk of the yeast falls to the bottom, but at the same time a portion is thrown out to the surface. After the fermentation has gone on for this long time, by-and-bye the beer becomes clear, and in this way the Lambick and Faro are made. For Faro beer, they boil their worts about six hours, and for Lambick, or *bière de mars*, they carry on the boiling process for twelve or fourteen hours. I am sorry to say that the product which is formed is not a very good example of the result of long boiling, for it is, I think, without exception about the most unpleasant beverage that anyone could possibly drink. It is excessively hard, and there is a large quantity of lactic acid present, though when it has once cleared itself, this lactic acid seems to guard it against any future attack of these small organisms. When it is once made, and I must say that sometimes it takes two years before the beer is fit to drink—and I have even heard of its taking four years—it withstands any future oxidation remarkably well. No doubt the slight amount of albuminous food that may still remain in it is in such a condition that it is unfit for ferment food.

Of the more common forms of fermentation, we have the English process, by which the fermentation is carried to the top, and the German process, by which the yeast is carried down to the bottom. With regard to our own system, the wort having been cooled is run into fermenting vessels. Formerly casks were used, but now much larger vessels are used, either round or square, and they are named according to their shape. The round ones, although perhaps more difficult to make, still present less corners, and therefore to that extent are rather more advantageous, because they can be more easily cleaned. When this is done the yeast is added. And this depends upon a number of what I may call factors. First, the age of the yeast (for the older the yeast the less vigorous it is), and also upon the amount of hops that had been added in the boiling process. It also depends to a considerable extent on the temperature to which the malt had been heated in the kiln-drying process; the higher it had been dried, the more yeast is required, whereas if it had been dried at a low temperature, or merely dried by the Belgian air-drying process, the amount of yeast required would be very small. It also depends of course upon the temperature at which the fermentation is started or "pitched," as it is called. The quantity may therefore vary between 1½ lbs. and 3 lbs. per barrel. If an unnecessary amount of yeast is added, it produces a very unfavourable effect upon the beer. If on the other hand too small a quantity be added, which may happen

from not knowing the strength of a given sample of yeast, the fermentation may go on sluggishly. It is then customary either to add yeast after the fermentation has shown indications of sluggishness, or else, as in some cases, some ground malt is added for the purpose of supplying soluble albuminous food for the nourishment of the yeast cells. The temperature at which the yeast is added varies of course very much in different parts of the United Kingdom, in fact it varies very much in London, so that it is impossible to say what the general rule is, but roughly speaking the temperature at which the yeast is added in London varies from 64° to 66°, and even up to 68°. In Burton and in Edinburgh they "pitch" their fermentations at 57° to 58°. Fermentation in England is carried on, as far as I know, usually above ground; at least I have never seen any instance where Englishmen have adopted the German plan of carrying it on underground. As the fermentations are carried on above ground—and in many cases, as I have seen, near the roof—in summer-time, if the roof has got a black surface of course it absorbs the sun's rays with rapidity, and therefore there is a considerable difficulty in keeping an equable temperature. On the other hand, in the winter-time it radiates off heat very rapidly. This, therefore, is a matter really requiring considerable attention, for it is quite impossible that you can have a quiet and steady normal fermentation if you have not got means by which you can keep up a regular temperature. After the addition of the yeast, in the course of a few hours a scum is formed, and after a time it increases; fermentation goes on, and the temperature rises, because, as I pointed out, heat is one of the products of the decomposition of sugar, and finally a vigorous yeast crop is produced. Addressing, as I am, so many practical men, I do not pretend to examine with much detail the various phases presented in the fermenting tuns, matters with which they they are, as a matter of course, better acquainted than I.

After a time the fermentation produces a most vigorous development of yeast, especially when the fermentation runs high; when left to itself, there comes a period when the light incoherent yeast gradually becomes more coherent and reduced in volume, and were it not removed it would again sink into the wort. This of course is avoided, in order to prevent the action of the alcohol upon the albuminoid matters of the cells, because many of them are dead. I should have told you that the production of this decomposition of sugar into various products is attended by decay of the ferment, and finally the cells die, so that we have in a sample of yeast, after it has done its work, not only living vigorous, active cells, but also those that have finished their chemical functions and have died; it is important to remove these, and this is done by a number of plans to which I will afterwards refer. In the London fermentations the temperature may rise to the extent of 12° and 15° Fah., and even more. At Burton they try to avoid any temperature higher than 70°, and the necessary reduction of temperature is brought about in different parts of England, not only by the process of skimming, but also by making use of attemperators. Where you employ a high temperature you may produce a beer that may look bright and please the customer, but you rarely produce one that will stand a long time or keep well: I do not mean to say that there are not cases where the temperature may even go as high as 80°, 85°, or even 90°, especially if you start with pure yeast, and where you may obtain a good product, but you cannot depend upon such a fermentation, and not only that, but the higher the temperature the greater the amount of decomposing ferment when the cell has done its work. Now these dead organisms are acted upon by oxygen, and so afterwards when you come to use that yeast for the next process, and the next, as you go on, instead of doing what Pasteur recommends you to do, to try to keep up the purity of your product and try to secure that your yeast shall only contain *torulæ*, and not *bacteria*, you in that way increase more and more the quantity of *bacteria*. Then you are obliged in time to change your yeast. Some are obliged to change their yeast pretty often, and the "water" of course is always blamed; but it may not be the water, it may be the nature of the fermentation, not the water, or "electricity." You change your yeast, but very likely you may change from bad to worse, because your neighbour from whom you procured it may also have been carrying on a similar process. Now I think, without stirring up any unfavourable criticism, you must admit that the Burton and Edinburgh brewers, as far as the particular article that they produce (and they of course like all of you must study the nature of their trade), do succeed not only in obtaining a good product, but also succeed in keeping up to a very great extent the purity of their yeast. I have here some samples which have been sent me by different brewers, and amongst them are samples from Messrs. Bass, Messrs. Allsopp, and Messrs. Younger, of Edinburgh, and there is one, I know not where it came from, except that it came from a Nottinghamshire brewery; there are also samples from brewers not so far off. These samples are placed round the table under microscopes, and I trust those who are interested in this question will pass round and look at them. No. 10 is a sample of very bad yeast, and I think when you look carefully at it, you will find a great number of the small *bacteria*, some twisting round and others darting through the liquid, and probably you will find they are very numerous, probably more numerous than the actual cells which you require. These organisms are at work producing lactic acid in the beer, and not alcohol. In No. 9 you will find a sample of German yeast—unfortunately it is a little old, because some delay occurred—and in examining it myself I noticed that there were a few *bacteria*, but when I have examined good German yeast previously I have found none or next to none. No. 8 is a sample of sour milk, and there you will find a number of these small round cells like the figure of 8, all of which have a gyrotory or oscillatory motion. In No. 7 you will find the English wort, with the self-sown *Mycoderma cerevisiæ*, and in No. 6 you will find a sample of this (W. H. B.) which is at work in this vessel, which works so vigorously compared to the other.

This particular sample was found under the microscope to contain very few *bacteria*, whereas another sample marked C. B., contained a great many. I purposely brought these two, because they were produced in the neighbourhood of London, and because I had previously determined by the use of the microscope that this one was not so vigorous as the other; in other words it contained a number of cells not producing carbonic acid. I found by this fermentation experiment, that the ratio of carbonic acid produced was as 3 to 5, *i.e.*, the purer yeast produced 5 volumes of carbonic acid, whereas the one containing so many *bacteria* only produced 3. No. 4 is a sample of yeast from a Nottinghamshire brewery; I do not know anything about it, but it is a very good sample. Nos. 3, 2, and 1 are samples received from Burton and Edinburgh. I particularly draw your attention to Nos. 1 and 2, from the Messrs. Bass and Co. and Messrs. Allsopp and Sons respectively.

The *Bund* states that a Swiss engineer has lately discovered a means of tempering drills for rock-boring machinery, by which they are rendered as hard as diamond, whilst at the same time they do not become brittle. The trials of these drills at the St. Gothard tunnel have surpassed all expectations, and it is said that they will last three times as long as drills hardened in the ordinary manner.

According to the Registrar-General's Report on the last census returns, India contains eight millions more men than women. This gives about twelve of the former to eleven of the latter, a proportion almost exactly reversed in the census returns of other countries.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

M. Ozenne and M. du Sommerard have arrived in London to make final arrangements for the representation of French Art and Industry in the present year's Exhibition. They state that French artists are making large demands for the admission of their pictures and works of art. The city of Paris will exhibit an extensive illustration of the municipal works of Paris, accompanied by models of public buildings, sanitary appliances, &c. This display excited much interest at Vienna. It is likely that the exhibition of French wines in the Albert Hall will lead to the introduction of many kinds at present little known in this country. The display of lace and embroidery promises to be attractive.

The sixth meeting of the Sub-Committee for Sanitary Apparatus and Constructions was held at the Royal Albert Hall, on the 24th instant, Dr. Hardwick in the chair. There were also present—Mr. C. Gatliffe, Mr. George Goodwin, and Dr. Ross. Captain E. G. Clayton, R.E., attended the Committee. The applications received up to date were read to the Committee, who adjourned until the 10th March, when the goods in this class will all have been received.

The seventh meeting of the Sub-Committee for Building Contrivances and Materials was held at the Royal Albert Hall on Wednesday last, Colonel Gallwey, R.E., in the chair. There were also present—Messrs. J. Bird George Godwin, H. Grissell, D. Kirkaldy, Joseph Moreland, and T. Roger Smith. Captain E. G. Clayton, R.E., attended tho Committee. After some discussion on Mr. D. Kirkaldy's scheme for experiments on strength of materials, the Committee adjourned until the 11th of March.

EXHIBITIONS.

Philadelphia Exhibition.—The following gentlemen have been appointed by the American Iron and Steel Association to collect, classify, and analyse the iron ores and coals of the United States for the Philadelphia Centennial Exhibition of 1876:—Prof. J. P. Lesley, University of Pennsylvania; Prof. F. A. Genth, do.; Prof. Persifor Frazer, Jr., do.; Prof. R. W. Raymond, Am. Inst. of Mining Eng.; Mr. Thomas M. Drown, do.; Prof. Fred. Prime, Jr., do.; Mr. Eckley B. Coxe, Philadelphia; Prof. T. Sterry Hunt, Institute of Technology, Boston; Prof. George C. Cooke, State Geologist, N. J.; Mr. James C. Bayles, Editor of the *Iron Age*; Dr. Robert Peter, Lexington, Ky.

Exhibition at Paris.—It is stated that there is to be an International Exhibition of Arts and Manufactures in Paris next year in the Palais de l'Industrie, which will be considerably enlarged for the purpose.

MUSEUM OF ORNAMENTAL ART IN DUBLIN.

The Lord-Lieutenant of Ireland (Earl Spencer), at the Art Meeting of the Royal Dublin Society, expressed his regret that he had been unable to give effect to the recommendations of Lord Kildare's Commission of 1868, which reported in favour of establishing an Art Museum in Dublin. This commission had been appointed by Mr. Disraeli's former government.

His Lordship said, "On former occasions I have spoken strongly in favour of having a central museum of ornamental art in Dublin, and I must freely confess to you that I feel rather mortified and diappointed that on this, which is perhaps—and I may say not perhaps, but certainly the last occasion on which I shall appear before you as the humble representative of the Queen—I feel rather mortified and disappointed that I have not been able to further an object which I have always conceded and felt is of great importance to the furtherance of art in this country. Last year I referred to this matter, but then there was a considerable difficulty in bringing on the subject because the House of Commons had shown itself more than ordinarily jealous of the expenditure on the Civil Service, and while a committee was sitting upon that we did not think it was a very opportune moment to press for a grant for the purpose of a school of ornamental art in Dublin. There are other difficulties in the way, arising from the great number of societies which have museums in Dublin, but I had always felt sanguine that with a fair field we should be able to obtain for you the advantage to which I have referred—a central ornamental art school in Dublin. I, therefore, much regret that neither the Marquis of Hartington—who was equally anxious on the subject—nor I have succeeded in our object. I sincerely trust that our successors may be more fortunate. I wish them every success in this object, and I shall ever envy them their better fortune if they are able to establish in Dublin such a museum, which I think of the greatest importance to all lovers of art in this country, and to all students of art within the land."

THE SOCIETY'S AFRICAN SECTION.

The following letter appeared in the *Spectator* last week, under the title of "Africa and Africa":—

Sir,—Sir Bartle Frere, in delivering his inaugural address recently at the Society of Arts, deplored "the inferior position which Africa now holds in the commercial and political world," and referred to "the ancient glories of the inhabitants of the northern coast, the principle nations of which had successfully contended in former years with the ruling powers of Europe." The natural inference from this would appear to be that that portion of the continent of Africa which is peopled by the Negro species—more than three-fourths of it—has degenerated from a former comparatively high civilisation which one existed along the northern shore.

Now it happens that at the present day the territory lying between Marocco and Zanguebar is connected with that extensive mass of land comprising western, central, and southern Africa; but within the historical period the southern part of what we now know as Northern Africa was washed by the ocean, which eventually receded, leaving its mark in that waste, the Sahara, thus effecting the union of northern Africa—which was at one time of such limited dimensions as to have been rightly esteemed by the ancients but an excresence from Asia—with the vast territory on its south and south-west, a country as distinct from Northern Africa in human species, fauna and flora as Europe is from South America. Northern Africa has absolutely nothing African, in the modern sense, about it except the name. In human species, fauna, flora, monuments, institutions, civilisation, and religion it is, and ever has been, intimately connected with Europe and Western Asia; and in none of these points is there the slightest evidence for believing that the Negro race was even remotely connected with those who held sway in Egypt and along the northern coast. Climate may do much in colouring the skin, but to take one point only, not all the vicissitudes of climate could change the shape of a white man's skull to that of a Negro's, nor even an ancient Egyptian's, Hindoo's, Chinaman's, Sandwich Islander's, South American Indian's, or North American Indian's.

The false system of geography, or, I should say, the no-system-at-all, which prevails at the present day, and compels us to look upon men and things continentally, has been one of the greatest drawbacks to the spread of accurate and scientific knowledge. Who that knows anything about the subject will question even this one point, that the fauna and flora of Northern Africa are part and parcel of the European and West Asian? And yet who ever thinks of applying the remarkable law which exists therein, that neither man, animals, nor plants can be arranged by continents, but fall in distinct areas lying in parallel directions, viz., north-west; marking out eight distinct centres of creation, with human species, fauna, and flora perfectly independent, but producing mixed races by overlapping.

A great deal has been said about the origin of lakes. Now let anyone interested in the subject lay down the land surface of the globe in the above manner, when two contiguous tracts rising

from the ocean would on their borders enclose portions of water, greater or less, according to the nature of the surface, and there would result a series of lakes, stretching in a north-west direction, such as we find in North America, Central Africa, Europe, and Asia. I affirm, with confidence, that there is no lake—group or chain—which does not lie along one of these unions of contiguous tracts. Such, on a small scale, are the Swiss and British lakes, taken as a whole, and such might have been the case with the Red Sea and Adriatic, had Africa joined Arabia at Aden, and Italy Turkey at the entrance to the Adriatic. Whether a lake would ultimately remain salt or become fresh, would depend simply upon the amount of fresh water poured into it by neighbouring rivers, and the presence or absence of an exit.—I am, Sir, &c.,

B. G. Jenkins.

FIRE AT THE PANTECHNICON.

The following letters referring to this subject have appeared in the *Times*, from Mr. Edwin Chadwick, C.B :—

Sir,—To-day, on a request that I should do so, I visited the site of the fire at the Pantechnicon, as a member of a special committee of the Society of Arts appointed to inquire by what structural, mechanical, engineering, and administrative means the occurrence of ordinary fires and extraordinary conflagrations in the metropolis may be prevented. I found the case fraught with large public instruction.

From inquiries I made from officers and men of the Salvage Corps, as also from officers of the Fire Brigade, I expect it will be found, on a closer inquiry than I was enabled to make, that, as respects the conditions external to the premises, no particular default attaches to any one; that the Fire Brigade arrived with good speed, and did their work with their wonted zeal and energy; that, as respects the supplies of water, as it happened there were no turncocks absent, or delays in supplying the first engines with as much water as distributory branch mains afforded, which, however, was stated not to meet the extraordinary occasion, or to supply properly all the engines which were brought to the spot. The genuine opinion I collected was, however, that with the head the fire had got when the engines arrived they could not possibly have saved the building. Their services were as usual, under the existing conditions, limited to preventing the spread of the fire. As it happened, there was not much wind, but it was agreed that if there had been a strong or a hurricane wind, the existing means were entirely insufficient to have prevented a devastating conflagration. Somewhat more wind would certainly have destroyed the east side of Lowndes-square, and with a hurricane wind the whole, and there was no knowing where the fire would have stopped.

I learnt that the time occupied from giving the alarm to the first effective engine (that of the Pimlico station of the Fire Brigade, which is about three-quarters of a mile distant) being brought to the spot, could not have been less than 15 minutes, and that the others must have come in succession according to their distances, of a mile and a quarter and a mile and a half, the mean distance being more than a mile; and that, with their best speed, they could scarcely have been brought to bear in less than 20 minutes. I had occasion myself officially to examine the late Mr. Braidwood, the organiser of the Fire Brigade, on the whole subject, when, in relation to the proposed establishment of fire-escapes, he propounded a practical limit of time for effective relief for protection of life, which is deemed equally necessary for the protection of property. "To have anything like an efficient system of fire-escapes, it would be necessary to have one with a man to attend within a quarter of a mile of each house, as the assistance, to be of any use, must generally be rendered within five minutes after the alarm of fire is given."

Captain Shaw, the present director of the Fire Brigade, after displaying in one of his reports the unprotected condition of some riverside warehouse property, says:—

"After this warning, which is by no means the first I have given on the subject, I sincerely trust that those interested in the riverside parishes will ascertain for themselves what time must necessarily elapse after the arrival of fire-engines before water can be thrown where required, and I should strongly recommend that in all cases when the time exceeds four or five minutes, they should take immediate measures for the protection of their property."

But, under existing engineering arrangements by experienced officers, less than half the limit of time stated by Mr. Braidwood would be occupied in bringing water to bear. For example, we learn on inquiry with respect to the means in use at the British Museum, that by a proper arrangement of hydrants attached to mains under high pressure, with hose and jets regularly exercised, water may be thrown on any part of the interior of the building in less than a minute and a half. At the South Kensington Museum the time required is a little over two minutes. There was no proper arrangement of the kind at this large building, as I learnt from Mr. Swanton, the most experienced director of the Salvage Corps. There were divisions of the building made by iron doors, which had been left open, and some of which would not shut.

Surely it should not be allowed to ignorance, or want of skill, or exclusive attention to common affairs, that buildings shielded often by the protection of full insurance should expose surrounding property to destruction, as in the present instance; but they should be required (and it may be required even for their own interests) to be placed under such securities as those I have instanced in respect to public buildings. It has been pointed out to me by Mr. Swanton that, if a fire were to break out in one of the new tall warehouses in St. Paul's-churchyard at a time when a strong wind bore upon the Cathedral, the external lead covering of the dome would be melted at once, and the fire get into a great stack of combustible material, where there would be no power of arresting it. The measures of security for the Cathedral would have to be taken in the nearest tall warehouse containing inflammable materials. The late Mr. Braidwood expressed to me his concern at the increasing growth of large and tall and ill-protected warehouses, and that he might see arising from them a conflagration which the existing means are utterly inadequate to prevent—greater than the great fire of London.

The reports on the great fires at Chicago and Boston show that in their origin they might have been stayed if water could have been brought to bear in two or three minutes, but that after a delay of 15 minutes, during strong winds, the fire got such head in the massive warehouses there, that it was impossible to stay those devastations.

In the instance of this recent fire, the conditions of the water supply as to the time of application were better than the average. In the instance of the fire at the Grosvenor-mews, were six people were burnt alive, and at an instance before that, when two people were burnt, we ascertained that it was three-quarters of an hour before water could be brought to bear, and in the last instance of the destruction of life it was at least 20 minutes.

On a careful consultation of special engineering science on the subject and of actual practice, we find that what is equivalent to two first-class hand engines under a system of constant supply at high pressure may be kept within reach of every house, and brought to bear for the extinction of fires in two minutes. We propose that on this system of constant supply, hydrants with hose shall be placed at not more than fifty yards distance, and that the apparatus may be kept in constant readiness, we propose that it should be kept in constant use for road and street watering and washing as in Paris. On such arrangements on this principle as are in use in Manchester, the hydrants would be brought closer for the extra protection needed for such buildings and accumulations of property as at the Pantechnicon.

On the occurrence of a fire, in one, two, three, or four

minutes, as much water-power would be brought to bear then as could be brought to bear under the existing conditions in more than 20 minutes.

On any extraordinary outburst in the large accumulations of combustible materials which manufacture and commerce are now making, occurring during a high wind, every hydrant in the immediate vicinity and approaches to the fire would be manned; and by telegraphing to the chief pumping stations, the entire force of an united metropolitan water supply may be brought to bear for the protection of the one endangered district.

On the evidence of Mr. Joseph Quick, the engineer of the Southwark and Vauxhall and the Grand Junction Water Companies, conversant with the particular details, all that may be done under unity of management, on a public footing, as has been recommended by Commission after Commission, and it may be done within the existing expenditure by consumers and ratepayers.

Colonel Beresford, with the support of Lord George Hamilton, members of our committee, is prepared to introduce a measure founded on the evidence obtained on the subject.

In support of the conclusion as to what may be done, allow me to state what has long been done in Manchester, on the system of constant supply on a public footing. "Here," as stated Mr. Tozer, the superintendent of the fire department, who had served in London under Mr. Braidwood, "the Fire Brigado and the Police act together, and under one general command render to each other mutual assistance, with great advantage over the separate organisation in London. People here run naturally, on the occurrence of any calamity, for aid to the police, and here, at every police-station, is a hose-cart, or a fire-escape on wheels, each containing 200 yards of hose and all necessary appliances for obtaining two effective streams of water from the mains—that is to say, a power equal to two effective streams of water from the mains, or a power equal to two hand engines of seven inch cylinders."

The pressure on the mains there gives mostly 80-feet jets from the hydrants, but for the taller buildings additional power is brought to bear by hand and steam engines. The police stations are about half the distance apart that the Fire Brigade stations are in London, and from constant supply at the mains, and there being no sending for turncocks, it appears that the relief is brought to bear in less than one-third the time it can be given in London. In consequence of this greater readiness of application, Mr. Tozer states that, out of 811 cases of fire, only in twenty-one cases was it necessery to use the larger engines to assist the smaller appliances.

As a rule, in London the engines arrive in time only to prevent the spread of serious fires. In Manchester, there has not been one case of the total destruction of property in three years, and there have been but three cases of loss of life in twelve years from a building taking fire. In Liverpool, the results are similar from similar conditions.

I may state that, from the evidence we have received, the committee are agreed that, if we could obtain no further advance than that made at Manchester, with a third less actual consumption of water (and the officers there agree that we may advance yet further), two-thirds at the least of the loss of life and property which now regularly occurs in the metropolis may be prevented, and security given against the serious dangers of large conflagrations. I am, &c.,

Edwin Chadwick.

East Sheen, Mortlake, Feb. 15.

In a subsequent communication Mr. Chadwick says:—

Since Mr. Braidwood's time the number of fire stations in the Metropolis has been augmented from 19 to 50. Nevertheless, Captain Shaw, in his report of 1872, states that whilst the houses and population have nearly doubled in the Metropolis within the last 40 years, the number of fires, "from 458 in 1833 to 1,494 in1872, has more than trebled:"—

"The lesson at present to be learnt from a careful study of the subject appears to be that although we cannot ascertain the cause, we should be in a continued state of preparation, so as to be able to bring into immediate operation all the means in our power to prevent or mitigate the consequences; and the whole attention of the Fire Brigade is incessantly devoted to this end, with what success the present report shows."

Truly so, upon comparison with the reports made of the working of different arrangements in other cities. Some years ago, Liverpool was dependent for protection from fire mainly upon the services of fire-engines and an intermittent supply of water. The late Mr. Rushton, the stipendiary magistrate, came to consult me as to what should be done for its protection against the increasing frequency of fires, which included a great many incendiary fires, on which subject he was to be examined before a Committee of the House of Commons. I recommended him to go in for the power of the direct application of water by hose and jet. He returned to me from the Committee to ask me whether I was perfectly sure of my recommendation, for it had been so much ridiculed at the Committee as to shake his confidence. I was perfectly confident. Eventually the principle was adopted, and I was told a story that, on the first great fire-engine coming thundering to put out a fire, when it was found that a man had already extinguished it by the direct application of water by the hose and jet, the men of the fire-engine were so much enraged, probably at the loss of their reward, that they thrashed the man for doing what he had done, and interfering with their practice. Under the system of immediate application the saving from great losses in Liverpool has been enormous. From Captain Shaw's reports it appears that the mean number of serious fires in the metropolis has been, for the last eight years, 221 annually. In his last report he states that "the proportion of serious to slight losses in 1873—166 to 1,383—is about as favourable as we have hitherto succeeded in making it," that is to say, about eleven per cent. Mr. Tozer, the superintendent of the Manchester Fire Brigade, states as the result of the system of nearer arrangements for relief:—"Where more than one-sixth of the property is destroyed the case is marked as serious, and the proportion so classed is three per cent."

On an impartial consultation of practical experience, there will be no doubt that at least three-fourths of the serious fires in the metropolis may be prevented. But it appears to be so difficult to get a simple principle impressed on the public mind, that I beg to be allowed to adduce an exposition of it, derived from the latest experience in America. It is given by Mr. Joseph Bird, of Boston, who, after 40 years of attendance on fires there, has written a book on the best means of their prevention. He states that the means by which buildings may take fire have increased much more rapidly than those for extinguishing fires. He says:—

"We know that fires are best managed if instantly attacked when small; yet we so arrange our fire-fighting systems that they cannot be thus attacked. We say, 'A stitch in time saves nine,' and then do not take the stitch. We say, 'Light blows kill the devil,' but we do not strike the light blows; that 'A short horse is soon curried,' and wait until our fires are full grown; that 'Delay makes the danger,' and then always delay. Is it not better to give more attention to this important subject than to wait until more cities—God only knows which they may be—are destroyed? Think on these things; and, thinking, act upon them. A fire is discovered; in the confusion a minute or two is lost before any one is sent to give the alarm. The average time to run to the nearest box is two minutes; to find the person who has the key, tell him where the fire is, and for him to open the box and give the alarm, two minutes more. There is no doubt that the time from when the fire is seen until the telegraph tells 300,000 people that there is a fire, averages five minutes. Next, the horses are attached to the engines in one or two minutes, when the first engine is taken to the fire in from three to five minutes, the engine attached to the hydrant, and the leading hose taken to the fire in five minutes more. Five minutes to telegraph, five to harness and get to the fire, and five more to get water upon the fire, or at least 15 minutes are lost, upon an average, from the time a fire is discovered before water is thrown upon it. Now, if the fire would

wait fifteen minutes, the only result of the delay would be that the great engines would cost a great waste and loss by water. They would always put out the fire, but the water-loss would he a serious one. But the fire is seldom so accommodating. It burns on, always doubling its proportions every minute; and often, in dangerous places, quadrupling its proportions every minute. If it has douhled each minute for the last fifteen, the result is a great loss by fire and water. If it has quadrupled, it is a total loss of the huilding on fire; and if there is added to that, crowded and dangerous huildings and a high wind, there is a dreadful conflagration. Such has heen the history of the Boston Department since the introduction of steam fire-engines. The 4th of July fire at East Boston was so small when first seen that a man took a pail, to which was attached a cord, to fill from the wharf, and with the water he would have extinguished the fire; but, the cord untying, the bucket floated away, and the loss hy fire in five hours was half a million of dollars. This is one example. Another example is the turret fire, also at East Boston, of which the president of the company making the turrets for war vessels waiting for them at the Navy-yard said to me, 'I could have covered the fire with my hat if I could have reached it, or have put it out with one of your engines in a minute.' The loss was 250,000 dols., hesides the loss of the use of the ironclads for a year. Still another was the destruction of the Winthrop House and Masonic Temple, of which the police reported that when they arrived—not when the fire was first seen—it could have heen easily put out with a few huckets of water. And who does not recollect the great fire which hegan in a hay store near the Boston and Maine depôt, and which for a time was one of the most splendid fire battles ever fought by the Boston firemen? The men worked like heroes, the splendid engines almost outdid themselves; but the fire rushed on through the hay and straw stores and the stables, then on to the great depôt on one side and the rows of wooden buildings filled with numerous families on the other, while a great cloud of smoke rolled over the city, from which dropped millions of sparks, one of which caused a fire far away off on Charles-street. Firemen fell into the flames, but were taken out without loss of life. Many thousands of dollars' worth of property were destroyed. Who, seeing that terrible hattle, could have believed that this monstrous fire when first seen was so small—only one hundle of hay, and that within a few feet of the door, out of which it could have heen pitched in a moment or the fire dashed out with a small engine in two seconds! These are a few of the many instances of the inefficiency of the present system under the most favourable circumstances, for the department of Boston is one of the hest in the world."

The general conclusion is on the necessity of immediate means, and one which the writer specially advocates is of having small hand-engines in use everywhere. We propose for the metropolis to have the power of the largest engines in readiness and use everywhere, not only for isolated houses, but for entire districts. In stating the general rule as to the results of the system in London as that of preventing the spread of fires, I stated it as stated by witnesses, and as understood by them as relating to the cases where, from the delay of the arrival of the engines, the fire had got what is termed a "fair hold." But it might be stated, as one of the consequences of the delay of relief, that the saving of loss from fire is often at the expense of so much loss by water as to make it questionable, particularly in the instance of a detached house, whether more loss would have been incurred by letting the fire have its way.

Bearing in mind the primary rule laid down by Mr. Braidwood, that relief, to be effectual for the preservation of life, must be on the spot in five minutes after the discovery of a fire; bearing in mind also the fact that, on the constant-supply system, with a general system of hydrants, the time of applying relief by the application of powerful jets of water may be reduced to about two minutes to every house near any system of pipe-water distribution, and within about that time may be brought to a suburban mansion or cottage within nearly double the area of the jurisdiction of the Metropolitan Board of Works, I present the following tabular returns showing the distances and the time at which the existing conditions keep them all away from such relief. The distances between the fire-engine stations are less than the actual distances as they have been given as the crow flies, and the time is given by an officer of longer experience in the metropolis than Captain Shaw.

This return is "seriously inaccurate," not only as to distance, but as to the time of getting the water brought to bear, which is often a quarter of an hour more. That the table is inaccurate in understating the facts—as I always endeavour to do in using statistics—is evidenced by the return in Captain Shaw's last report, He states

Distance of the Fire Stations in London from each other.	Time estimated of foot messenger running to the station.	Time estimated getting the engine to the spot and hringing water to hear.	Total time of getting water to bear on the fire from messenger starting with notice.
	Minutes.	Minutes.	Minutes.
1 of $2\frac{3}{4}$ miles	35	25	60
1 of $2\frac{1}{2}$ miles, 220 yds.	33	23	56
2 of 2 miles	22	20	42
1 of $1\frac{3}{4}$ mile, 220 yds.	20	19	39
2 of 1 mile, 660 yds...	14	17	31
1 of 1 mile, 440 yds...	12	17	29
6 of 1 mile, 220 yds...	11	16	27
8 of 1 mile	10	16	26
8 of $\frac{3}{4}$ mile, 220 yds...	9	15	24
5 of $\frac{3}{4}$ mile	8	15	23
8 of $\frac{1}{2}$ mile, 220 yds...	7	14	21
6 of $\frac{1}{2}$ mile	5	13	18
4 of 660 yds.	4	12	16
5 of 440 yds.	2	11	13
2 of 220 yds.	1	10	11

Mean distance of the whole stations...... $\frac{3}{4}$ mile, 196 yds.
Mean time of the whole 60 (including 10 suhurhan) stations .... 23 min. 54 sec.

that during the year, "The number of journeys made by the fire-engines of the 50 stations has been 6,556, and the total distance run has been 20,503 miles—that is to say, over three miles, or, taking it to be to-and-fro, of a mile and a half, or a mean of nearly double the inevitable delay of relief above represented.

But statistical means, where life is concerned, are brutalising. It is no justification of people being burnt alive in three times greater number than under a system demonstrably available, that the burnings were not in excess of the average. Captain Shaw's return states that, "During the last year the number of persons seriously endangered by fire has been 140, of whom 105 were saved and 35 lost their lives;" of whom two-thirds certainly may be declared to have been sacrificed to the system. He says as respects the men of the Brigade:—

"Our list of wounds and other injuries for 1873 is, as usual, large; there were 98 cases of burns, scalds, and other injuries, together with 228 cases of ordinary illness, making a total of 316 cases, of which many were very serious; but so long as the men continue to work with the same spirit and enterprise as hitherto no diminution of accidents can be expected."

Our answer from Mr. Bryson, the head of the fire department at Glasgow, where the system is similar to that of Manchester and of Liverpool, attended by similar results, states that "on an average engine, power is only required in three fires out of overy 100."

This may be taken as some measure of the relief which a change of system will give to the firemen from such an extent of injuries as the returns show are encountered by them in contending with the evils under the existing system in the metropolis.

We shall be prepared to demonstrate before a Committee of the Parliament that yet more effective relief may be given (within the existing charges) to the inhabitants of the metropolis, and that all further delay of proved working remedies is at the expense of great preventable loss of life as well as of property.

CHEAP ELECTRICITY.

By W. H. Walenn, F.C.S.

It is a popular belief among the unscientific that there is nothing that cannot be done by electricity. A certain class of inventors seem to have the same idea, and any difficulty that defies other means of solution is presumed to be overcome, or able to be successfully combatted, by this wonder-working power. Some endeavour to make out that the sole obstacle to perpetual motion is removed by it; others believe that its powers of reducing metals are so recondite that it only requires a slight step to adapt it to the discovery of the transmutation of metals; and

others, again, look upon electricity as the source whence the very *elixir vitæ* is to be obtained.

Among the purposes to which inventors have sought to apply electricity, such contrarieties appear as blasting rocks, capturing and killing birds; discharging fire-arms, fertilising seeds; making mirrors, metallising a human corpse; transmitting intelligence, destroying vermin. Besides these, many other remarkable applications may be cited, which, for their accomplishment, depend upon the property which electric force possesses of being somewhat readily made to excite other varieties of force, such as motive power, heat, chemical action, magnetism, and light. Motive power, by means of electro-magnetic arrangements, has been accomplished up to four horse-power. The heating power of the electric current is shown by the readiness with which platinum and iron are fused in the voltaic arc of a powerful electrical arrangement. Chemical action, excited by electric force, has been applied extensively in the arts; for instance, electrotypy, electro-plating, and electro-etching. Many more applications remain as scientific curiosities, to be soon raised to the dignity of useful and practical inventions, such as the reduction of metals from their ores, the manufacture of chemical compounds, and the production of various gaseous bodies in a direct manner. The applications of electro-magnetic power are innumerable, and range from the vast systems of telegraphy which at this moment encircle the whole of the civilised, and much of the uncivilised, portions of the earth, to registering the motions of a machine, or winding up an ordinary clock. This portion of the subject appears scarcely developed yet, and when electric power is more easily attainable, will assume giant-like proportions. Twenty or thirty years ago the electric light had only one development, namely, the convective electrical discharge between charcoal points; now it has at least two others, that arising from the ignition of rarified gas in Geissler's tubes, and the transmission of a continuous electric current through an insufficient carbon conductor enclosed in a non-active gas. The writer is informed that the latter application is likely to totally change the prospects of lighting by electricity, by enabling a number of lights to be placed in the same electric circuit.

At this place, the reader will perhaps ask, "What is electricity?" The answer to this question is not so easy to give as it might at first appear, and the writer perfectly recollects hearing a lecture, twenty-five years ago, that commenced with this query, to which the answer was, that we knew nothing about what electricity is, but could only define it as a something which produces certain definite effects. This definition is not so unsatisfactory as it seems to be, for many other well-known entities are described, and rendered intelligible and realisable by means of the evidences or manifestations of their existence; for instance, a very fair definition of mechanical force may be drawn from its power to prevent the descent of a weight, or to resist a pressure. According to this method, which appeals to the perceptive or external faculties of the mind, electricity might be described as that which produces heat, light, magnetism, and chemical action. Unfortunately for this view, electricity itself can be produced by means of either heat, magnetism, or chemical action, and perhaps by light;* it is, therefore, desirable that a method should be used to describe, connect, and classify these effects, which appeals to the deeper, more interior, and reflective faculties of the mind. This, perhaps, can be best accomplished by first of all defining the word force, and then realizing, from that definition, mechanical force, chemical force, and electrical force.

For the purposes of this essay force will be defined, as Professor Grove (now Justice Grove) defined it, in a lecture given at the London Institution, in January, 1842, namely, as a "mode of motion." This view has recently been promulgated by other philosophers (Dr. Tyndall, for instance), and it will tend to elucidate the matter if Grove's own words are reproduced here. He says*:—"Physical science treats of matter, and what I shall to-night term its *affections*, namely, attraction, motion, heat, light, electricity, magnetism, chemical affinity. When these react upon matter they constitute forces. The present tendency of theory seems to lead to the opinion that all these affections are resolvable into one, namely, motion: however, should the theories on these subjects be ultimately so effectually generalised as to become laws, they cannot avoid the necessity for retaining different names for these different affections; or, as they would then be called, different modes of motion." We shall, therefore, no longer define electricity as *something* which produces certain definite effects, but as a *force* or mode of motion which may be communicated to particles of matter capable of receiving such motion. Its waves are of such a nature that—when interrupted by a medium which opposes their progress, but which would be able to transmit the undulations entirely if it were large enough—they are converted into heat waves, accompanied by luminous vibrations. If the motion be interrupted by a decomposible fluid, the chemical affinity of the component parts of the fluid is destroyed, and they are conveyed in opposite directions. At right angles to the direction of motion of the electric force, the magnetic force always exists, and its amount and quality (boreal or austral) has direct relation respectively to the amount of the electric force, and to the direction in which it is travelling. Polarisation, or that property by which there appear to be opposite qualities in different parts of the same body, or in separate bodies—such as the opposite charges of a Leyden jar, or the contrary electrical condition of the metallic plates respectively, at the extremities of a galvanic battery—is the consequence of the electric waves occurring in definite planes. Further, it appears that electrical wave motion, confined to a given space, as in an insulated but charged conductor, for instance, tends to excite the same kind of wave motion in the opposite direction in a neighbouring conductor, and thus to produce the phenomena of electrical induction; in other words, one kind of electric polarity cannot be produced without the production also of the other kind, either in another part of the same body or in distinct bodies. Not only is electric force under specific conditions in each case convertible into heat, chemical force, or mechanical motion, but also, under specific conditions in each case, these forces are respectively convertible into electric force. If, therefore, the undulatory character of any one of these forces be conceded, it follows that electricity is a wave-propagated force, since the method of conversion of one force into another is by changing the character of the wave-motion by which it is propagated.

The classification of electricity as a force among the other forces of nature enables comparisons to be made, analogies to be drawn, and results to be anticipated, which would otherwise have been imperfectly known or wholly undiscovered. The more or less distinct perception of these relations and applications have worked in the brains of inventors, and have produced results more or less practical, the noticeable point in electrical applications, or the uses of electric force, being their diversity, their great range, and the unique character of their mode of action. The one point which has hitherto greatly restricted their general use and appreciation is that—produced from a galvanic battery—the force is dear in comparison with other forces, especially in comparison with heat, the power at present universally employed for mechanical and other work.

The next question that arises is, "Can electricity be

* See Grove's "Correlation of Physical Forces." Fourth Edition, 1862, pp. 153, 154.

* See "Correlation of Physical Forces." Preface, p. ix., *et seq.*

produced cheaply?" As remarked above, the most ordinary way of generating, inducing, or producing electric power, is by means of a galvanic battery, an arrangement which involves the destruction of metallic zinc, the employment of powerful and expensive chemicals, and a considerable amount of skilful attention and waste of material, besides two very great inconveniences, namely, the occupation of great cubical space, and the littering and spilling about of chemicals that give forth noxious fumes and promote rust and dirt. For some twenty or thirty years past, electricians have sought to supplant the galvanic battery by the magneto-electric machine, which is free from the above objections. This has been partly accomplished; but there are still some grave objections to the use of magneto-electric machines of the usual kind for the electric light, and for depositing metals, or indeed for any purpose in which an electric current of considerable capacity or quantity is required to circulate in an absolutely continuous stream for a length of time, this being just the quality of the electric power which is supplied by the galvanic battery. In ordinary magneto-electric machines, not only is the current not continuous, but it is induced in jerks or shocks, so that the term shock is a much more suitable word for the intermittent electric power produced by these machines than the term current, the shock occurring at the instant that the core of the coil giving the current undergoes the greatest change of magnetism, and resists the motion most strongly; the method of approximating the quality of this kind of current to that of the galvanic battery, is to rotate the coils so quickly that the duration of time between the intermittences is reduced to the smallest possible amount, but this necessitates the undue expenditure of mechanical power. Another, and still more serious objection to the ordinary magneto-electric machine is that the shocks are produced from the machine alternately in opposite directions; therefore, in order to derive useful work from this kind of electricity, it is necessary to reverse every alternate shock by means of a complicated and uncertain apparatus called a commutator. This reversal is never in practice so perfectly accomplished that none of the induced currents or shocks are lost or neutralised, for the electric power has to pass from revolving contact pieces to fixed metallic springs, and in so doing either leaps across the contact pieces or else burns the springs. The losses from the commutator only, may therefore be said to be:—1st. By dissipation of electric power. 2nd. By neutralisation from imperfect insulation of the contact pieces. 3rd. By the reflex or opposite extra current induced in the coils at the time of making or breaking the electrical circuit. The most serious difficulty, however, in ordinary machines, is that the heat generated by the reflex and waste currents enlarges the axis of the machine, and tends more and more powerfully to stop it as it is driven faster, so that the maximum speed with which it can be driven with economy constantly decreases during continuous use. Again, in consequence of the waste of electric power, when a quantity of electricity is required, and when therefore large and heavy coils are used, these are made larger and heavier than they otherwise would be, to make up for the waste, thereby using up still more mechanical force or engine power to drive them than if they gave forth all the currents induced in them in a useful form.

The state of electric power described in the last paragraph has caused many inventors to search for a method of inducing continuous and uninterrupted electric currents in the magneto-electric machine itself, but for many years this desideratum eluded their grasp, and its possibility has been doubted by many. This result is said to be perfectly attained by Gramme's machine. This machine does not depend upon the increase or decrease of magnetic polarity, or upon the change of magnetic polarity, to induce the electric current, as all former machines have done; it simply depends upon the fact that if one pole of a permanent magnet be moved parallel to a long, cylindrical electro-magnet, the opposite magnetic polarity induced in the core of the electro-magnet, during the travel of the permanent magnet in one direction, will induce an electric current in the conducting wire which is of constant power, continuous, and without intermission during the motion of the permanent magnet in the same direction along the electro-magnet. To enable the current to be really continuous, and not to stop when the pole of the magnet has arrived at the extremity of the electro-magnet, the core of the electro-magnet is made annular, or ring-shaped, and it is wound in a continuous coil that is composed of a series of coils having blades that proceed to an axis in the centre of the annulus. Fixed springs take off the currents from the neutral points of this travelling electro-magnet. Thus, an equable and continuous current is obtained without the necessity of a reversal of any kind.

The importance of this realisation can scarcely be over-estimated, for zinc (the destruction of which in the galvanic battery yields electric force) is 20 times the cost of coal, weight for weight, and 200 times the cost of coal for equal quantities of potential energy.* Gramme's machine depends principally upon coal, either in the form of a gas-engine or of an economical steam-engine, for its current cost; there is no heating beyond that due to the ordinary friction of bearings, and all the motive power conveyed to it is said to be utilised, because none of the induced electric currents are found to have been dissipated, neutralised, or opposed. Should the expectations held out by the new machine be realised in practice, it may not be long before the reduction of metal from their ores, the deposition of the common metals and alloys, and the obtainment at a cheap rate of chemical substances, the more recondite gases, and of artificial light itself, on a far grander scale than any that has been hitherto realised, become accomplished facts.

BRITISH JUTE TRADE.

This, comparatively speaking, modern branch of textile industry has made very rapid progress during the past five years, as will be seen by the following comparative tables, including the transactions of 1873:—

Jute, Unmanufactured.

Total Imports.

	cwts.
1869	2,467,000
1870	2,376,000
1871	3,454,000
1872	4,041,000
1873	4,643,000

Total Exports.

	cwts.
1869	413,000
1870	425,000
1871	575,000
1872	755,000
1873	789,000

The bulk of the raw jute exported is sent to France. About 20,000 cwts. are annually returned to this country in the shape of jute yarn.

The total quantity of British-made jute yarn and manufactures exported during the same period was as annexed:—

British Exports.

	yarns (lbs.)	manufactures (yds.)
1869	8,041,000	50,127,000
1870	12,669,000	57,920,000
1871	13,710,000	62,310,000
1872	12,715,000	84,452,000
1873	12,278,000	96,539,000

These amounts are exclusive of jute bags and sack (ready made), which are not separately classified in the trade returns.

* See Fleming Jenkin's "Electricity and Magnetism," p. 296.

THE CITY COMPANIES AND THEIR EARLY HISTORY.

(*Continued from p.* 128.)

Perhaps no monarch ever showed a greater anxiety that her subjects should dress plainly, or was fonder of finery herself than was Queen Elizabeth, and accordingly sumptuary regulations were carried to a ridiculous excess during her reign. This not only appears from her numerous proclamations on the subject, but from the precept which she caused to be sent to the companies. It is recorded in the books of the Ironmongers' Company that in 1579 two members of that company, and two men free of the Grocers, were chosen to attend at Bishopsgate from seven in the morning till six in the afternoon, to see that the royal orders were carried out. They were to examine the habits of all who passed through the gate. James was even more anxious than Elizabeth about dress, and in 1611 sent precepts to the wardens of the companies, enjoining them to convene and to harangue their several fraternities upon the heinous sin, viz., "the abuse growing by excesse and strange fashions of apparell used by manye apprentices, and by the inordinate pryde of mayde servantes and women servantes, in their excesse of apparell and follye in varietie of newe fashions."

Government interference with the affairs of the companies knew no limit. Elizabeth and her successors made it the business of their reigns to obtain the choice of their officers and the control of their property. An attempt was made to thrust in a court candidate for the clerkship of the Merchant Taylors; and in 1612 a letter is stated to have been read from the Lady Elizabeth, the King's daughter, recommending one John Ward to the cook's place, if it should be vacant by the death of, or resignation of, John Beumont, the present holder. In 1622 an attempt was made, and directly from the crown, to get the reversion of the clerkship of the same company. Charles principally confined himself to an interference with the companies' property and church patronage. The Merchant Taylors finally extinguished the arbitrary custom of royal interference by an order dated 12th February, 1650, declaring "that whatsoever person shall in future become a suitor for an almshouse, place, or pension, and shall procure any person to apply to the court for such, or that shall bring any nobleman's letters in the like behalf, otherwise than as certificates of good behaviour, such person in every such case shall be held to be incapable of whatever favour he may apply for." The reign of Charles and the civil wars are well known for their disastrous effects; no part of the nation felt these evils more than the livery companies. During an interval of 26 years, commencing with the troubles of that monarch in 1640 till the fire of London in 1666, which was the consummation of their miseries, the history of these societies is one of intolerable exaction, spoliation, and calamity; and to furnish tho loans arbitrarily and rapidly levied on them, the individuals of the companies had at this time not only impoverished themselves, but all the fraternities were obliged to sell or pawn their plate. The fellowship of these societies, which had formerly been highly paid for as a privilege, became a curse; men sought to detach themselves from them, and the heads of companies found it impossible to assemble a court without inflicting heavy fines on absenteeism.

Not content with exacting their money, the decorations of the halls of a religious nature which had been spared at the Reformation, came now to be looked on as superstitious. An entry in the Merchant Taylors' Court-book, dated July 3rd, 1643, states complaints to have been made, that in the company's "hangings for the hall" there are offensive and superstitious pictures. The pictures or hangings referred to represented the history of St. John the Baptist, and were eventually noticed as being defaced.

The well-known inquiry into the validity of the City charter, in 1684, the result of which rendered the king not only master of London, but of all the corporations of England, was the last public event connected with the history of the livery companies. Though ostensibly directed against the corporation of London, of which these bodies were only a branch, the mastership of the companies, there seems no doubt, was deemed a most important object of the measure. Charles II., like his father and grandfather, early evinced a desire to resume the system of interference with their government and property which we have been describing, as is to be proved by abundant entries in the different companies' books.

Previously to the charter of the City being declared forfeited, which it most arbitrarily and illegally was in the Trinity Term of the above year, several of the companies, terrified by the proceedings against London, the tendency of which were too evident to be mistaken, had surrendered their charters, but after this judgment almost all the corporations did so. The "Account of the Grocers' Company" states their wardens to have acquainted the court, on the 28th of March, 1684, that they had received his Majesty's writ in the nature of a *quo warranto*, returnable the first day of the term; and they stated further, that the same had been served on the other chief companies. The first step resolved upon was the election of a committee to conduct the proceedings on the part of the company, and the chief persons who composed it were the Lord Mayor, the Earl of Berkeley (who had served the office of master the year preceding), Sir William Hooker, Sir John Cutler, and others. A deputation, attended by the clerk, waited on Mr. Secretary Jenkins, on the 9th of April, in order to be informed what might be acceptable to his Majesty, as expected to be done by this company in obedience to the said writ, to the end the committee might without delay act as became loyal subjects and prudent members, having also regard to the trusts in them reposed? They received for answer from the Secretary that his Majesty designed not to intermeddle or take away the rights, property, or privileges of any company, nor to destroy or injure the ancient usages or franchises of their corporations, "but only a regulation of the governing part, so as his Majesty might for the future have in himself a moving power of any officer therein for mismanagement, in the same way and method that they themselves now used, and claimed to have by power derivable from the Crown," or, in other words, that they should be incapable of exercising that free control over their own affairs which all their charters, even that granted by Cromwell, had so solemnly conferred upon them. Resistance was considered fruitless, and therefore, in order to derive all possible advantage from their ready submission, the clerk was ordered to prepare an instrument of surrender, to pass the common seal, and to accompany it by a petition to his Majesty, "in order to obviate his further displeasure in prosecution of the said writ, and to obtain his grace in favour of the antient charters, rights, and privileges of this company."

In pursuance of an order of the court, the wardens "were directed to consult Mr. Holt, the counsel, respecting the same writing or instrument," and the substance of whose opinion was that the same did not amount to a surrender of their charter of incorporation, or extinguish any other franchise than that of electing their own officers or wardens, assistants, and clerks, which it vested in the Crown. All these circumstances, it is said, being debated, and the Grocers' court understanding that the other companies were forwarding the business of their surrenders, they resolved on compliance.

The like sort of proceedings took place in most of the companies. In that of the Merchant Taylors the assistants, after due consultation, subscribed the following form of surrender of their offices:—"We, the assistants of the Merchant Taylors of London, whose names are hereunto subscribed, do give up and

surrender our several and respective places as assistants or counsellors of the said company, and all our several and respective titles or interests therein, either in law or equity, unto Thomas Wardell, Esq., master; Mr. G. Torriano, Mr. Richard Taylor, Mr. Benjamin Spicer, and Mr. Richard Cawthorne, now wardens of the Merchant Taylors, of the fraternity of St. John the Baptist, in the City of London, this 11th of April, 1684, in the 36th year of our sovereign Lord Charles, &c."

The surrender of their charters was in most of the companies preceded by a petition, stating their having been chartered and incorporated by former royal grants, which conferred on them divers immunities, privileges, and franchises. That his sacred Majesty having, "in his princely wisdom," thought proper to issue a *quo warranto* against them, they had reason to fear they had highly offended him, and they therefore earnestly begged his pardon for what was passed, and "to accept their humble submission to his good-will and pleasure, and that he would be graciously pleased to continue their former charters with such regulations for their future government as he should please."

The form of the instrument of surrender of the charters seems to have been alike in all the companies. It will be found copied, as in the Merchant Taylors books. The surrender and petitions were presented to the king at Windsor, who returned a very singular answer to each. The Grocers' records thus state their interview and its results:—"The wardens reported on the 9th May (1684), that, pursuant to the order of the assembly, on the 12th of April last, they, with Sir James Edwards, Sir John Moore, and divers other members, attended his Majesty, at Windsor, on Sunday last; that his Majesty being informed that a deputation of the Grocers was in attendance, came forth and with a very kind aspect received them; where Sir James Edwards, at the request of the rest of the members, presented the petition and instrument, and declared to his Majesty, in the presence of the Lord Keeper, Lord Chief Justice, and many of the nobility, that his loyal subjects the Grocers (the company his Majesty had been graciously pleased to mark with a double stroke of his favour, in condescending so low as to become a member of their fraternity), had no sooner read the writ of *quo warranto* but they called their assistants and consulted, and soon resolved upon their duty; and, summoning their commonalty together, they had unanimously (not one dissenting member) agreed on a short humble address, which, together with the instrument under their common seal, in the name of all the Company of Grocers, they humbly presented at his Majesty's feet; and so on his knee presented them, which his Majesty most graciously received, declaring to them he was a member of their company, and that they might assure themselves of all kindness and favour he could, according to the laws, bestow upon them. And so his Majesty went to chapel, dismissing the whole assembly without hearing other persons, and committed the company's petition to the care of Sir Lionel Jenkins, with particular command to take care of his company; and that Sir Lionel Jenkins has since got the same referred, and declared himself very zealous and affectionate to serve the company to the utmost in his power; that all care and diligence has since been used to search records and make preparation, that the company may have a confirmation of their charter to the best benefit and advantage."

The Merchant Taylors' new charter was received and published on the 6th January, 1684, and, in obedience to the directions accompanying it, the new master and wardens took their several and respective oaths, that is to say, "the oaths of allegiance and supremacy, and the oath prescribed and mentioned in the Act of Parliament made for the good government and regulation of corporations in the 13th year of his now Majesty's reign, together with the several oaths of master and wardens for the due execution of their offices respectively, and also subscribed to the declaration prescribed and mentioned in the Act aforesaid, by Peter Paravicini, alderman of London, and Sir William Dodson, knight, as by his said Majesty's letter patent were directed." And the said Peter Paravicini, alderman of London, and Sir William Dodson, knight, Daniel Baker, George Wallis, &c. (naming the rest of the Merchant Taylors' court), took the oaths of allegiance and of supremacy, the oath prescribed in the aforesaid Act of Parliament, together with the oaths of the assistants for the due execution of their offices, as did the company's clerk, John Milner.

The above did not complete the measure of the company's servility. An entry in their books immediately afterwards states:—"That upon consideration of his Majesty's gracious charter, it was thought fit and unanimously voted that the whole of the court should wait upon his Majesty with an humble address in writing, to give his said Majesty thanks for his gracious charter granted to this company; and also to wait on the illustrious Prince James, Duke of York." The communication of the king's answer is thus noticed:—"This day the Right Hon. Sir George Jeffreys, knight and baronet, and Lord Chief Justice of England, did this court the great honour to declare that his Most Sacred Majesty did with pleasure accept of this court's unanimous thanks to his Sacred Majesty, for his most gracious charter given and granted to them, and would excuse the court's attendance and waiting on his said Majesty, because it would (being the first example and precedent) be a charge upon the several and respective corporations in England to do the same, or words to that effect; and therefore His Majesty would be pleased to excuse the court's attendance thereon. Whereupon, and after that the said Lord Chief Justice had been waited upon by the whole court to the hall-gate, the said court immediately sat, and considering the great and extraordinary honor his lordship had been pleased to confer on the court that day, it was thought fit, and so ordered, that a present in plate be forthwith presented to the said Lord Chief Justice from this court to the value of £100, to be raised by 50s. a-piece of every assistant of this society, and that G. Torriano, Esq., master-warden of the society, be treasurer for the same."

(*To be continued.*)

CORRESPONDENCE.

INDIAN ART.

Sir,—When speaking upon Dr. Zerffi's lecture on Indian Art on the evening of February the 6th, I made reference to certain imitations of our miserable "Kidderminster carpets" which were shown in the International Exhibition of 1862, and attributed their production to Dr. Forbes Watson's influence. I am much pleased to learn from this gentleman that he never in any way caused, nor sanctioned, their production, and that he perfectly agrees with me that we have nothing to teach the Indians in the way of art as applied to industries, but that on the contrary we may learn much from them. I thank Dr. Watson for correcting me, and beg that you allow me to state my error in your *Journal*.—I am, &c.,

C. W. Dresser.

Tower Cressy, Notting-hill, W., Feb. 25th, 1874.

POTATOES PRESERVED BY SCALDING.

Sir,—In the *Mechanics' Magazine* for 1828, is a short letter stating that potatoes had been well preserved by simply scalding them for two or three minutes, and then well drying them. They were said to keep well and store well also on shipboard.

As this plan is one that might readily be tried and has

perhaps been fully tested, it may be useful if any parties would give their experience of it.—I am, &c.,

POTATO.

SMOKY CHIMNEYS.

SIR,—You were kind enough to print a letter of mine on this subject in October last, which has brought me communications from all parts of the country. Having determined to spend some months here this winter, I brought down a small supply of the chimney tops alluded to, and a good many have been put up with invariable success. I have endeavoured to explain that the operation produced a partial vacuum in the chimney, which any one can ascertain by placing a lighted candle at the opening in a moderate breeze; it will then be blown out. I leave it to any scientific gentleman to explain the cause; I merely know the fact that the smoke which formerly came down now goes up. There is another result, not so satisfactory for me—the operation of taking out a patent and providing a supply of these articles at a distance of over 200 miles, causes a vacuum in one's bank account, and until this deficiency is supplied I shall certainly not send for any more. I find it much easier to extract smoke from a chimney than money from the pocket.—I am, &c. C. BUTLER CLEUGH.

Stanmore-house, Eastbourne, Feb. 24th, 1874.

NOTES ON BOOKS.

Report on the Vienna Exhibition.—Presented to the Chamber of Commerce by W. C. Aitken.

Artisans' Report on the Vienna Exhibition.—Manchester Society for the Promotion of Scientific Industry.

These two books are the results of the visit of a body of artisan reporters sent to last year's exhibition at Vienna by the Birmingham Chamber of Commerce and the new Society for the Promotion of Scientific Industry at Manchester. Mr. Aitken's report gives a a general sketch of the whole exhibition, and a brief notice of each of the reports contributed by the Birmingham artisans. In the other volume are published at length the various reports, nineteen by Manchester artisans, and fifteen by artisans from Birmingham.

GENERAL NOTES.

National Training School for Cookery.—A meeting of the Executive Committee of this School was held on February 21st, at the Royal Albert Hall, there being present the Hon. E. F. Leveson Gower, M.P. (chairman), Viscount Barrington, M.P., Sir Daniel Cooper, Bart., Mr. Bateman, F.R.S., Mr. Cole, and Mr. MacGregor. The Committee have appointed Lady Barker to be Lady Superintendent of the School, which is expected to commence its preliminary work of training "Instructors in Cookery" at the beginning of March. Immediately after Easter a meeting will be held in the City, under the presidency of Alderman Cotton, M.P., for the purpose of laying the scheme of the training school fully before the public, and procuring the necessary pecuniary support.

Prize for an Alcoholometer.—M. Léon Say has proposed to one of the commissions of the French Assembly that a prize of 200 francs should be offered for the discovery of a process by which it may be possible to determine immediately and practically the amount of alcohol in any mixture, no matter how composed. The commission voted unanimously in favour of the proposal, and M. Dampierre was charged to draw up a report on the subject. As is pretty generally known, Sykes' hydrometer, which is commonly used for measuring the alcoholic strength of wines, becomes unavailable for mixtures containing a large per-centage of sugar, and an instrument like that for which the above prize is offered has long been a *desideratum* in the custom-houses of this and other countries.

Vanilla.—The cultivation of vanilla is now likely to spread in Mysore, and ought to be introduced into other parts of India. The pods have brought 45s. a pound during the year, but the supply is very small. In 1868 the price was as low as 6s. per pound, when the market was glutted. The vanilla succeeds well in the Lal Bagh at Bangalore, where it is planted in a mixture of leaf-mould and sand, and trained to thin stone pillars placed three feet apart and seven feet in height, with cross pieces on the top to form a lattice work for the branches to cling to. A checkered shade is obtained from adjacent mango trees, which is essential, for if the vanilla plant be exposed to the full rays of the sun it droops and soon gets sickly. Trees with rough bark will also serve as supports for the plant, the mango being one of the best. It usually flowers the third year from planting, but does not produce fruit unless artificially fertilised. Vanilla should be packed in tins, well soldered, in quantities of about 10 lbs.—*Oriental.*

Railway Sleeping Cars on the Italian Railways.—The Alta-Italia Railway Company, by way of experiment, have recently started running a few sleeping carriages on the night express trains between Turin and Florence, and Turin and Venice. These carriages are exceedingly comfortable, and each coupè affords accommodation for three persons. An additional 15 francs is charged, in addition to the usual first-class express fare for the journey between Turin and Venice, or Turin to Florence, and *vice versa*, and proportional charges are made for the use of sleeping-cars between intermediate stations. There seems to be no doubt that the managers of this railway company mean to make it a part of their system, as they intend, as soon as they have examined the various sleeping carriages now running on other lines, to select the best to serve as a model for the others that they intend building.

The Eucalyptus.—The *Italie*, a paper published in French at Rome, gives some particulars respecting the Australian tree, the *Eucalyptus globulus*, of which so much has been said lately. Upwards of 3,000 young trees have been planted by the municipality of Rome at San Sisto Vecchia. But, unfortunately, this tree is extremely tender when young, and cannot resist a temperature lower than 27 deg. Fahr.; so notwithstanding the great care that has been taken in sheltering the young plants from wind and cold, the results have been hitherto unsatisfactory. As a proof that the *Eucalyptus* requires a climate where the temperature is never lower than freezing point, it may be mentioned that of all the trees planted by the Roman Railway Company along the line from Rome to Naples, only those plants in the neighbourhood of Naples have survived through the winter.

NOTICES.

THE LIBRARY.

The following works have been presented to the Library:—

Knapsack Manual for Sportsmen on the Field, by Edwin Ward, F.Z.S. Presented by the Author.

Statistics of the Colony of Victoria for 1872. Part 1, Blue Book; part 2, Finance; part 3, Population; part 4, Accumulation; part 5, Law, Crime, &c. Presented by the Agent-General for Victoria.

Smithsonian Institution (Washington) Miscellaneous Collections. Vol. X.

Annual Report of the Board of Regents of the Smithsonian Institution for 1871.

Memoirs of the American Academy of Arts and Sciences. Vol. IX., part II., New Series.

Sixth Annual Report of the United States Geological Survey of Territories, by F. V. Hayden.

Annual Report of the Chief Signal Officer to the Secretary of War for 1872. Presented by A. J. Myer, Chief Signal Officer, U.S.A.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

The following arrangements for Wednesday evenings up to Easter have been made :—

MARCH 4.—"On Bells, and Modern Improvements for Chiming and Carillons." By GEORGE LUND, Esq. On this evening Colonel HOGG, M.P., Chairman of the Metropolitan Board of Works, will preside.

MARCH 11.—"On the Manufacture of Cocoa." By JOHN HOLM, Esq.

MARCH 18.—"On the Channel Tunnel." By WILLIAM HAWES, Esq., F.G.S. On this evening the Duke of BUCKINGHAM AND CHANDOS will preside.

MARCH 25.—"On the London International Exhibition of 1874." By HENRY HARDY COLE, Esq., Lieut. R.E.

INDIAN SECTION.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made :—

MARCH 13.—Dr. LEITNER, Principal of the Government College of Lahore, will give an account of the Races of Dardistan (north-west of Cashmere), discovered by him. On this evening General MCMURDO, C.B., will preside.

AFRICAN SECTION.

These meetings are arranged for Tuesday evenings, at 8 o'clock, and the following arrangements for papers have been made :—

MARCH 3.—"On the General Features of West African Trade from Senegal to St. Paul de Loanda." By Consul THOMAS J. HUTCHINSON, F.R.G.S.

MARCH 17.—"Remarks on the Geographical and Physical Character of the Diamond Fields of South Africa." By the Honourable THEOPHILUS SHEPSTON, Secretary for Native Affairs in Natal. Communicated and explained by Dr. MANN.

CHEMICAL SECTION.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made :—

MARCH 6.—"On the Paraffin Industry." By FREDERICK FIELD, Esq., F.R.S. This being the opening meeting of the Section, Professor ODLING, M.A., F.R.S. (President of the Chemical Society), will preside, and will give a short address on "The Importance of Industrial Chemistry."

MARCH 20.—"On Anthracene and Alizarine." By Dr. VERSMANN.

APRIL 10.—"On some Recent Processes for the Manufacture of Soda." By C. W. VINCENT, Esq., F.C.S.

APRIL 24.—"On Pyrites, as a source of Sulphur, Copper, and Iron." By Dr. C. R. A. WRIGHT, F.C.S.

MAY 8.—"On Sugar Refining, with special reference to Finzel's Sugar Crystals." By Dr. GRIFFIN.

MAY 22.—"On the Manufacture of Chlorine." By W. WELDON, Esq., F.C.S.

CANTOR LECTURES.

The last lecture of the course on the "Chemistry of Brewing," by Dr. CHARLES GRAHAM (University College, London), will be given as follows:—

LECTURE VII.—MARCH 2ND, 1874.

The Beer of the Future.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

MON. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Dr. Graham, "On the Chemistry of Brewing." (Lecture VII.)
Farmers' Club, Salisbury-square, E.C., 5½ p.m. Dr. Voelcker, "Milk: its Supply and Adulteration."
Royal Institution, Albemarle-street, W., 2 p.m. General Monthly Meeting.
Society of Engineers, 6, Westminster-chambers, Victoria-street, S.W., 7½ p.m. Mr. S. Herbert Cox, "Recent Improvements in Tin Dressing Machinery."
Royal United Service Institution, Whitehall-yard, 8½ p.m. 1. Captain W. S. Croudace, "Croudace's Stellar Azimuth Compass and Ordnance Night Light-Vane or Collimator." 2. Mr. R. Griffiths, "Further Experiments with his Bow and Stern-Screw Propeller."
Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. D. Watney, "Timber;" and the discussion on the paper by Mr. Ralph William Clutton, entitled "The Self-sown Oak Woods of Sussex," will be resumed.
Entomological, 12, Bedford-row, W.C., 7 p.m.
Medical, 11, Chandos-street, W., 8 p.m.
Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m. Mr. W. Forsyth, "The Rules of Evidence as applicable to the Credibility of History."
London Institution, Finsbury-circus, E.C., 4 p.m.
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8 p.m. Annual Meeting.

TUES. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (African Section.) Consul Thomas J. Hutchinson, "On the General Features of West African Trade from Senegal to St. Paul de Loanda."
Royal Institution, Albemarle-street, W., 3 p.m. Professor Tyndall, "On the Physical Properties of Liquids and Gases."
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. 1. Mr. William Douglas, "The Great Basses Lighthouse, Ceylon." 2. Major James Browne, "On the Tracing and Construction of Roads in Mountainous Tropical Countries."
Pathological, 53, Berners-street, Oxford-street, W., 8 p.m.
Biblical Archæology, 9, Conduit-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m.
Anthropological Society, 37, Arundel-street, W.C., 8 p.m.

WED....**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. George Lund, "On Bells, and Modern Improvements for Chiming and Carillons."
London Institution, Finsbury-circus, E.C., 7 p.m.
Microscopical, King's College, W.C., 8 p.m. Mr. Alfred Sanders, "Contribution towards a Knowledge of *Appendicularia*."
Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.

THUR....Royal, Burlington House, W., 8½ p.m.
Antiquaries, Somerset House, W.C., 8½ p.m.
Linnæan, Burlington House, W., 8 p.m.
Chemical, Burlington House, W., 8 p.m. 1. Mr. A. F. Hargreaves, "On the Conditions of the Spontaneous Inflammability of Charcoal." 2. Dr. Gladstone and Mr. A. Tribe, "Researches on the Action of the Copper Zinc Couple on Organic Bodies." Part V., "On the Bromides of the Olefines." 3. Dr. Tommasi, "Action of Beryl Chloride on Camphor," Part II 4. Dr. Tommasi and Mr. R. Meldola, "Action of Tri-Chlor. Acetyl Chloride upon Urea." 5. Dr. Phipson, "On Emphocyanide of Ammonium and Emphocyanogen." 6. Dr. Gladstone and Mr. A. Tribe, "Researches on the Action of the Copper Zinc Couple on Organic Bodies." No. 4., "On Ethyl Bromide." 7. Mr. A. Tribe, "On the Action of Hydrogen on Finely Divided Metals." 8. Mr. Henry R. Proctor, "On a Reaction of Gallic Acid."
Royal Institution, Albemarle-street, W., 3 p.m. Professor W. C. Williamson, "On Cryptogamic Vegetation—Ferns and Mosses."
Royal Society Club, Willis's Rooms, St. James's, S.W. 6 p.m.

FRI ......**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Chemical Section). Inaugural Address by Dr. Odling. Mr. Frederick Field, F.R.S., "On the Paraffin Industry."
Royal Institution, Albemarle-street, W., 3 p.m. Sir Samuel Baker, M.A., "Suppression of the Slave Trade of the White Nile."
Geologists' Association, University College, W.C., 8 p.m.
Philological, University College, W.C., 8 p.m.
Archæological Institution, 16 New Burlington-street, W., 4 p.m.

SAT......Royal Institution, Albemarle-street, W., 3 p.m. Mr. R. Bosworth Smith, "On Mohammed and Mohammedanism."

[The Editor will be glad to receive notices of papers for insertion in the above list.]

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,111. Vol. XXII.

FRIDAY, MARCH 6, 1874.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal early in May next. This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Mons. Michel Eugéne Chevreul, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

The Council invite members of the Society to forward to the Secretary, on or before the 11th of April, the names of such men of high distinction as they may think worthy of this honour.

INTERNATIONAL EXHIBITION OF 1874.

The Council have resolved to offer the Society's Gold and Silver Medals in connection with the International Exhibition of 1874.

A gold and a silver medal is offered in each class, and these medals will be given for any object exhibited which, in the opinion of the Council, shows paramount or very great excellence, whether in respect of the final result, the machinery, method of production, or novelty.

VISIT TO THE BRIGHTON AQUARIUM.

Arrangements are now being made for a visit of the Members of the Society of Arts and their children to the Brighton Aquarium, under the guidance of Mr. Frank Buckland, M.A., Her Majesty's Inspector of Salmon Fisheries, who will then deliver his Fourth Juvenile Lecture. Friday, the 10th of April, during the Easter holidays, is selected for the visit, and a ticket will be issued for 10s. 6d., entitling the bearer to travel first-class by special train to Brighton and back, with admission to the Aquarium and luncheon. Members desirous of securing to themselves and families the privilege of obtaining these tickets, are requested to send in their names not later than Saturday, March 14th, to the Secretary of the Society of Arts, with a remittance, stating the number of tickets they will require.

ECONOMICAL USE OF COAL.

The Committee met on Tuesday, 3rd March, at ten o'clock, at the testing-houses by the Western Annexe of the International Exhibition, South Kensington. There were present—Major-Gen. F. Eardley-Wilmot, R.A., F.R.S., in the chair, General Elliott, Dr. David S. Price, Rev. A. Rigg, and Major Webber, R.E., attended by Mr. Le Neve Foster, Secretary, Mr. S. W. Davies, in charge of the testing, and Capt. Clayton, R.E. The Committee inspected the testing-houses, which have been specially erected by the Society, where the testing has already commenced. Subsequently the Committee, acting as a Committee of Selection for the International Exhibition, inspected the stoves and heating apparatus sent in for exhibition, and gave directions as to which should be retained as suitable for display.

PROCEEDINGS OF THE SOCIETY.

AFRICAN SECTION.

A meeting of this Section was held on March 3rd, Vice-Admiral Erasmus Ommanney, C.B., F.R.S., in the chair. The paper read was—

ON THE GENERAL FEATURES OF WEST AFRICAN TRADE, FROM SENEGAL TO ST. PAUL DE LOANDA.

By Thomas J. Hutchinson, F.R.G.S., F.R.S.L., M.A.I., H.B.M. Consul for Callao.

When I first contemplated a paper for the African Section of the Society of Arts, "On the General Features of West African trade from Senegal to St. Paul de Loanda," it occurred to me to divide the matter into two sections—one referring to the export slave trade, which flourished beyond the beginning of the present century, and the other to the legitimate commerce which has, during the last fifty years, made such progress in superseding it. But on second thoughts I deemed it better not to give the former so much importance, as it is now, happily, on all the coast, what it was recorded many years ago by Dr. Livingstone, referring to Angola, when he said, "the time of the slave trade may be spoken of in the past tense." I shall, therefore, only touch upon it casually, as we are passing by the *locales* where it most flourished during its existence.

The mouth of the Senegal river is in latitude 8° 30′ north, and longitude 13° 18′ west, whilst St. Paul de Loanda is situated in latitude 8° 48′ south, and longitude 13° 13′ east. So that by the sea shore the line intervening embraces a coast distance of beyond 2,400 geographical miles. This includes the whole of that deadly tract which for centuries has been recognised as the "white man's grave," and the plague spot of the world.

Of the trade at Senegal there is not much to be told. The chief articles of export from this are gum Arabic, ground nuts, (the *Arachis hypogea*), and hides; gold-dust and ivory are sometimes exported, but in small quantities. Its chief importance arises from the fact of the river here being the inlet to the principal French colony on the coast. The capital, St. Louis, situated about 20 miles up the stream, is garrisoned with a large force. Of these, however, there is but a small amount who are native Frenchmen, the majority being Negroes and Mulattos. By the treaty of our government with France, relative to West African affairs, in 1783, it was stipulated that the English gum trade should be confined to Portandik, which is about 100 miles north of the Senegal *embouchure*.

From the last-named, going southward to Goree—the next trading port, and likewise a French settlement—we have a voyage of about 80 miles. The island of Goree, standing out from the mainland of Dakur, though belonging to the British Crown from 1809 to 1816, was ceded to the French Government in the latter year by the Treaty of Paris. The trading resources of Goree are scarcely of more importance than those of Senegal, being confined to gum copal and ground nuts, both of which articles are exported principally to Rouen and Marseilles.

From Goree down to the Gambia we have a voyage of 70 miles. Near the mouth of this river, and at the right hand side as we enter, is the island of St. Mary's, on which the capital of the colony, the city of Bathurst, is built. This is the most northern of our colonial settlements on the West Coast of Africa. On the left shore, as you cross the bay, and a few miles below Bathurst, is Fort Bullom. From the latter, the beach to a distance of 20 miles up the river and a mile inland, belongs to the Colonial Government. By this is afforded a yearly revenue in the pilotage and harbour dues of ships, the greater portion of which are French vessels, as at Goree and Senegal. Up the river, at a distance of 180 miles interior from Bathurst, is a trading station on M'Carthy's Island, to which vessels sometimes ascend for cargo.

It is impossible to conceive a more unattractive-looking site for a settlement than on the flat, sandy island of St. Mary's, with its swamps all around. Writing of this place, Dr. Daniell said*:—

> "The settlements of Gambia are not so favourably situated as those of Sierra Leone, being deficient, not only in picturesque embellishments and local advantages, but also in affording a less healthy climate. Vast alluvial and densely-wooded mangrove masses extend on all sides, the heavy and monotonous scenery of which reminds the voyager of the most deadly swamps of equatorial Africa."

When I was there in 1853, I was told by Dr. Lawson, the Staff Surgeon, that in the year 1836, out of 96 Europeans (English soldiers) sent to the hospital 92 died. To talk of the amelioration of a place like this by sanatory measures is little better than sheer nonsense. Ground nuts, ivory, beeswax, and hides, are the chief articles of export hence; the three first by French vessels, and the last by North American. The Ghoora or Khola nut,† which is a bitter stomachic, forms no unimportant item of traffic (especially since the establishment of steamers) from Bathurst all along the coast to Lagos.

Regarding the trade conditions of the Gambia settlement, I find by the latest Colonial Blue Book‡ the anomalous facts, that its trade in 1871 realised in imports £102,064, while its exports were up to £153,100, and yet the revenue in that year was only £17,490, in contrast to £19,079 in 1866, or five years previous. With this the expenditure in 1866 was £17,681, whilst that in 1871 was only £16,662. So that while we have in 1871 a surplus of over £50,000 of exports over imports—a sum nearly equal to what the revenue of the whole of our West African possessions was when I was out there in 1858—the duties in these six years have decreased more than two thousand pounds.

To look at the trade of this port as it was in 1859, by a table which I procured in 1860 from the Colonial-office, it appeared that although the sum total of exports in the forementioned year was £100,364 12s. 7d. against £76,149 11s. 1d. for

* "Sketch of Medical Topography, &c." S. Highley, Fleet-street, London. Page 8.

† Ghoora or Khola nut, fruit of the Cola (*Stercalia*), "Acuminata Floræ Nigritianæ," p. 233.

‡ Papers relating to Her Majesty's Colonial Possessions, Part II., 1873 (2nd division). Presented to both Houses of Parliament by command of Her Majesty, 1873. London: printed by Clowes and Sons, Stamford-street, and Charing-cross, for Her Majesty's Stationery-office, 1873. Page 4.

imports, thus showing a profitable trade, still the benefit was not to British commerce; because in that year, and by the same table, our imports were up to £33,603 2s. 7d., and the exports to the United Kingdom were only £19,984 15s. In fact, the French and United States traders were deriving the chief profits from our establishment at Gambia, as the following statement from the Colonial Blue Book will indicate:—

Gambia, 1859.

Countries.	Imports.			Exports.		
United Kingdom.						
Great Britain	£33,603	2	7	£19,984	15	0
British Colonies.						
Sierra Leone	5,829	7	6	1,077	6	0
British West Indies ..	456	1	8	470	0	0
British North America	..		..	210	0	0
Foreign Countries.						
France	8,398	7	1	52,366	6	3
Canary Islands	277	3	0	..		..
Cape Verde Islands ..	222	14	0	739	3	0
Goree and Senegal....	5,023	8	5	2,167	6	0
Leeward Coast	7,717	10	9	7,421	1	10
Windward Coast	119	14	0	154	5	0
Foreign West Indies..	100	0	0	..		..
United States	14,402	2	1	25,774	9	6
Total..........	£76,149	11	1	£110,364	12	7

During the seventeenth century the Gambia was the chief route by which attempts were made for explorations into Central Africa. Thompson went up in 1618 as far as Tenda, where he was murdered. Jobson ascended the river in 1620, and his narrative appears somewhat of the Munchausen type in regard to the numerous herds of wild animals, such as lions, elephants, river-horses, and crocodiles, with which he described the river as abounding. To him succeeded Vermuyden, in 1665. Then, in 1791, Major Houghton tried to reach the Niger by overland journey from the Gambia, but was murdered by some Moors near Tisheet, who, whilst pretending to show him the way to Timbuctoo, robbed him of his clothing, and left him to perish under a tree. I mention these facts because they refer to explorers who were the pioneers of our trade relations with Western Africa. Mungo Park sailed from England in 1793 to explore Central Africa by the Gambia, and to search for the Niger. In a subsequent voyage he perished near Bousa, on the bank of that hitherto mysterious stream.

Between Bathurst and Sierra Leone, a distance of 390 miles, we pass the principal river mouths, where the slave-trade exports of the Northern Coast was carried on for two to three centuries, not only by Portuguese and Spaniards, but, I regret to say, by Englishmen too. The convenience of these sites for the nefarious traffic was rendered palpable by the fact that, at the mouths of the different rivers, Cazamanza, Cacheo, Rio Nunez, Mellacoree, and several others, are the islands of Bijooga, of de Los, Matacong, and soforth. These served as stations for slave barracoons, where the human cargo could be kept till it was convenient to take it on board. From the River Nunez was brought more than three hundred years ago—*Anno Domini* 1562—a shipment of slaves by Captain Hawkins, the first Englishman who was known to be in the trade. These he bartered at Hispaniola for hides, sugar, and other produce of that island. The traffic which Captain Hawkins initiated was soon legalised in England, and continued thus for nearly two centuries, whilst he (its founder) was knighted by Queen Elizabeth. So that it is no great fancy to imagine the West African of the present day may thank his stars for living in the reign of Queen Victoria, instead of Queen Elizabeth.

Matters of trade being the subject of this paper, it must be cause of regret that our first connection with West Africa was that of the abominable form of it just alluded to. I cannot pass by the position where we are now without giving an abstract of it, particularly as here were its head-quarters for a considerable period. True, Captain Hawkins had been preceded by Alonzo Gonzalvez, a Portuguese, who began so early as the year 1434. The chronicles tell us that, through the money made in the slave trade, was effected the first settlement of the Portuguese at Sierra Leone in 1480. These people went further down the coast, and the existing fort at Elmina, long held by the Dutch, and so well known in connection with our Ashantee war, was built by them in 1481. But in the reigns of King Charles I., as well as King James I., companies were formed in England, and with royal privileges conceded to them, to carry on the slave trade. One was got up by Sir Robert Rich, in 1618, with a charter from King James I., to establish a regular slave-trading company to Africa, but it did not prosper. Another was formed in 1631 with privileges from King Charles I., but the opposition, or rather competition of private adventurers, made this unsuccessful likewise. Jamaica was first founded as a colony by England in 1645, and seventeen years afterwards, in 1662, a slave-trading company was formed in this country, at the head of which was the then Duke of York. One of the obligations of this company was to supply Jamaica annually with 3,000 slaves from the West Coast of Africa.

The export trade of Sierra Leone, which is now the head-quarters of our West African dependencies, consists of teak-wood, palm oil,* coffee, gum copal, red pepper, arrowroot, and ginger. In 1851 there were 500 tons of ginger exported, and in 1852 a spasmodic attempt at cotton cultivation resulted in 8,000 to 9,000 lbs. of the fibre being being sent to England by the African Improvement Society. It gets ivory and gold from the interior.

The original settlement of the English here was made in 1787 by a colony of 400 Negroes, sailors and soldiers, discharged after the American war, and sixty white men. It was in 1809 that it was ceded to the Crown from the African Company who had managed it to that period, but it was not recog-

* Of this Mr. Pope Hennessy tells us there was exported, in 1871, oil to the value of £400,000. But I am at a loss to know if it be from Sierra Leone, or if the aggregate of the colonies is meant.

nised as an accredited British colony till 1822. How it has progressed in a commercial point of view during the last half century may, to a certain extent, be judged from what we read in the *Times* of a fortnight ago (February 12th) from its special correspondent at Freetown, in the following words:—

"The fiscal charges introduced during Mr. Pope Hennessy's administration have wholly failed to produce the expected results, *owing to the war*. The Customs duties—the sheet-anchor of the revenue—produced last year £9,000 less than they were estimated to do. The entire deficiency in the actual revenue from that estimated was, during the past year (1873), not less than £11,000."

I have quoted this, and put a few of the words in italics, because these figures puzzle me. For I am doubtful of there ever having been a trade between Sierra Leone and the Gold Coast to that extent as to account for such a miscalculation and deficiency.

Of the value of imports and exports at all our West African colonies in 1871, I find this statement in the Blue Book already referred to:—

Imports and Exports.

The following table is a summary of the trade returns in the four Blue Books for 1871. It shows, at a glance, the value of the commerce of the British Settlements:—

	Imports.	Exports.	Vessels Entered.	Vessels Cleared.	Tonnage Entered.	Tonnage Cleared.
	£	£				
Sierra Leone.....	305,849	467,755	411	409	110,646	110,919
Gold Coast	250,671	295,207	343	315	131,553	119,494
Gambia	102,064	153,100	229	211	51,853	47,997
Lagos	391,653	589,802	278	275	125,776	125,168
Totals	1,050,237	1,505,864	1,271	1,210	419,828	403,578

Recapitulation.

	£
Imports	1,050,237
Exports	1,505,864
Total commercial movement ..	£2,556,101

Thus, over 1,200 vessels cleared and entered with cargoes exceeding two millions and a half in value.

In the same year, the total revenue upon this traffic was £172,197, and the whole expenditure £167,497. Through the countries interior to Sierra Leone, an important feature of the native home trade is of manufactured saddles and bridles from leather tanned by themselves, and coloured with native dyes. The Mandingos that I saw at Sierra Leone, who are Mohammedans, and who have the finest physique as well as the most dignified bearing of any men on the coast, are particularly expert in this leather manufacture.

The foregoing tables of traffic might perhaps be better explained if they were published as those of 1858; because, although in both cases exports exceed imports thus at Sierra Leone—

	Imports.		Exports.
1858........	£133,485 6 5	......	£225,349 6 4
1871........	305,849 0 0	......	467,755 0 0

yet we find the same results as in Gambia from the table already quoted, namely, that the profit of trade is in the pockets of French and United States' merchants. Thus—

Sierra Leone, 1858.

Countries.	Imports.	Exports.
United Kingdom.		
Great Britain	£108,007 8 7	£86,532 5 6
British Colonies.		
Bathurst, Gambia....	720 10 7	3,204 18 11
Foreign Countries.		
France	1,456 6 1	25,271 16 11
Madeira	11 13 10	.. ..
Teneriffe	87 5 6	.. ..
Goree	3,460 4 11	34,795 10 11
Leeward Coasts......	1,178 5 9	28,531 16 7
United States	18,563 11 2	47,013 0 6
Total	£133,485 6 5	£225,349 9 4

It is a matter which cannot be passed over without reflection, in a commercial point of view, what is suggested by these figures—that imports from the United Kingdom into Sierra Leone, amounted to beyond £100,000, whilst the exports to meet these were only little over £80,000. From France, the imports to Sierra Leone of £1,456 6s. 1d. were met by £25,000 and odd value of exports, whilst the United States for £18,563 11s. 2d., got a return of £47,013. So that we are keeping up colonies in Western Africa, by which the French and North Americans realise profit. In fact, writing the same year of the Sierra Leone commerce in his pamphlet on the Niger trade, Mr. Jameson observed that:—"It was not more than the value of produce passing through the hands of any second or third rate commercial house engaged in trade with China or North America." To the best of my recollection, this was in connexion with the statement of that colony having cost Her Majesty's government over ten millions of money—in civil administration—in naval expenses, in prize money for captured slaves, in missionary efforts, in salaries to the executive of the Mixed Commission Court. I may add that these items were independent of the thousands of valuable lives that found a last resting-place in the white man's grave.

From Freetown, the capital of this colony, south by the Banana and Sherbro islands, and along what is called the Grain Coast to Cape Palmas. In this part of the voyage we pass by the Republic of Liberia, founded by the American Colonisation Society, where coffee cultivation has been tried, but, I believe, with poor success. All along here the traffic is what may be called a cruising trade. At Cape Palmas we are in the centre of the Krumans country, whereat every vessel trading out here must call to have on board some of these men, who are the bone and sinew of West African Negroes, and whose aid in working ships or helping on shore is indispensable. Between Cape Palmas and the Assini River we find what is called the Ivory Coast. It is indeed to the windward of the Gold Coast. My friend and colleague, Captain

Burton,*—than whom no man knows the West Coast better,—writing of this point says that some Frenchmen, who occupied certain settlements at Assini, Grand Bassam, and other parts of the Western Gold Coast, extending from the Assini river nearly to the Liberian frontier, found it prudent after the Franco-Prussian war to lease their stations to an English mercantile firm. In a short time after, the latter had forty vessels plying upon the Assini and Tando streams, as well as the lagoons between them. From Cape Apollonia down to the Volta, a distance of 262 miles, we are amongst the old forts that constitute the foreground of the Gold Coast, and the sea boundaries of the countries where the war is with the Ashantees.

Upon this "little war" I must ask you to let me have my little say, as it is to no small extent connected with our trade operations of the coast, if not indeed, directly proceeding from them. On the last of the African section meeting, and in the discussion succeeding the able paper of Mr. Saunders, a gentleman observed on the necessity of her Majesty's Government protecting British traders on the Leeward coast, or, in fact, through the neutral territory of the palm oil rivers, by not allowing middlemen to swallow up the profits of the exports from the interior countries; in fact, to put down or do away with the country brokers, who levied their tariff on the oil as it came from the interior to the coast. I hope I am right. Why, this was the very principle that caused the war. The Ashantees did not care to have the cowardly Fantees (our allies on the Gold Coast, who, it may be remembered, would neither fight nor act as porters) to be brokers between them and the traders from abroad. Since 1800, Captain Burton tells us the Ashantees wanted "to make a beach or establish a port," and this they had, to a certain extent, so long as the Dutch held Elmina, which was handed over to Mr. Pope Hennessy for our Government in 1872. In a pamphlet recently published I read—"The King of Ashantee declares war that he may re-take the port of Elmina [though, by the way, it never was his to claim any such right], at which place, I ought to have said, he bought his guns, powder, rum, and Manchester goods before the transfer, free of duty." Why the Ashantees should be prevented coming directly to the coast with their gold and ivory, is a matter that might be inquired into before we advocate free-trade amongst the semi-civilised tribes of the palm oil rivers. Writing from Government-house, Cape Coast, to Mr. Pope Hennessy, under date of 9th September, 1872, Mr. Acting-Administrator C. S. Salmon observed :—

"The acquisition of the windward coast will have a considerable effect upon the trade of the settlement generally; the old feuds which caused such disturbances, and which so completely cut off rich provinces from access to the trading centres, will die out. The anticipation of the transfer had, in the latter part of the year 1871, a rather depressing action on trade, because people were in a state of expectancy, many not anticipating the very peaceful manner in which it was effected. It takes very little in this settlement to disturb the native trade and the flow of produce. It would be impossible to estimate what proportions the trade would assume were the interior tribes to have access to the coast, and the jealousies that bar intercourse between people speaking the same language broken down."

I hope none of my auditors think I would advocate the cause of the Ashantees. But I must advocate the cause of truth and right, as of firmness and justice, in regard to the trade of our merchants on the West Coast of Africa. If the advice and proposals of Captain Burton had been taken, I believe this war might have been avoided, and Mr. Salmon's predictions verified in "the enormous trade certain to ensue were the interior tribes to be admitted to the coast." Captain Burton's suggestions were as follow, and may be seen in "Ocean Highwys" for last month (February), page 452 :—

"Recalled from Damascus, I proposed to Mr. Swanzy, Mr. Reddle, and other influential West African merchants, to organise a mission to Ashanti; and it is still my belief that, with due prudence, such as requiring hostages, with the expenditure of £2,000 to £3,000 upon presents, and with the willingness to grant the great desideratum, this ugly affair might have been settled."

One word more about this war, and only in a trade point of view. Without any concession to the Ashantees or remitting one jot of their punishment, and if we are to keep up our settlements on the West Coast, I say it advisedly, that all the indemnity which you can get from King Coffee, and all the treaties you can make with him—though they should fill a volume of "Hansard"—will not be of the slightest use in keeping off war hereafter, unless you allow the Ashantees to trade with the coast. Place their trading under whatever law you like—if you choose "under the stern discipline of unceasing despotic rule"—but let them understand that admirable idea of Sir Bartle Frere's, "who is to be the master, and whose ideas are to be in the ascendant." Captain Burton further says :—

"The Fantis and coast-tribes were originally as murderous and bloodthirsty as their northern neighbours, and if they have changed for the better, the improvement is wholly due to the presence and the pressure, physical as well as moral, of Europeans. Even Whydah is not bloodstained like Agbome, because it was occupied by a few white and brown slavers. Why then should not the Ashantis have the opportunity of amendment offered to them? Ten years' experience of Africa teaches me that they would be as easily reformed as the maritime peoples; and it is evident to me that the sentimentalist, if he added common sense to the higher quality, should be the first to advocate the trial."

I consider it my duty to endorse every word of this, and I do so from the results of my practical knowledge of ten years' residence on the coast. About the trade at Cape Coast, which is the headquarters of the Gold Coast, I was permitted to take the following table at the Colonial-office, Downing-street, in 1858 :—

Gold Coast.—1858.

Countries.	Imports.	Exports.
United Kingdom....	£76,835 17 9	£118,553 6 5
United States	31,722 12 0	20,421 5 6½
British Colonies	.. ..	.. ..
Foreign Countries—		
France	6,012 11 3	11,103 7 6
Holland	4,857 6 8	4,057 16 6
Portugal	1,435 11 2	.. ..
Other Countries	2,193 0 0	.. ..
Totals	£122,456 18 10	£154,135 15 11½

Surplus of exports over imports......£31,678 17s. 1½d.

* Vide "Ocean Highways" for February, 1874. No. 11, vol. i., page 452.

In what I have already quoted from the Blue Book of 1873, it may be seen the trade of the Gold Coast was in 1871, as regards surplus of exports, little more than £12,000 over what it was 15 years ago, whilst the expenditure of 1871 was £485 over the revenue.

Passing the Gold Coast, we go on to Whydah, Porto Novo, Badagry, Jella Coffee, to Lagos. This district constitutes the Slave Coast. It was at Badagry that the brothers Lander—natives of Truro in Cornwall — went, twenty years after Mungo Park's time, and having gone across the country to Boussa, where the latter was killed, came out by the Nun mouth of the Niger, in November, 1830. The surging roll of Lagos bar upsets a large proportion of canoes attempting to cross it, and the harbour is so full of sharks that no one has ever escaped alive after such a catastrophe. In the slave trade times, it was calculated that only one out of six canoes escaped; and this was considered sufficient remuneration for and profit on the inhuman traffic.

The town of Lagos, our latest annexation in the Gulf of Guinea, is situated in latitude 6 deg. 28 min. north, and longitude 15 deg. 52 min. west, at the mouth of the river Ossa, which runs from Badagry into Lake Cradoo. It is at this port that the palm oil district proper commences. Before the civil war of 1850, the market of Ejenrin, near Ekpe, used to furnish the traders of this port with 60,000 to 70,000 gallons of palm oil per week. In the markets interior here, the cowrie (shell of the *cyprea moneta*) is the chief currency.* During 1856 and thereabouts, a considerable effort was made by some Manchester gentleman to get cotton cultivated in Abbeokuta, and exported thence *via* Lagos. But the obstacles to shipping cotton in Lagos must be ever added to the difficulty of getting cotton to ship. East of Lagos the French made a settlement about fifteen years ago, in a place called Palma, from the fact that the palm nuts fell from the trees on the ground in such abundance as to pave the ground all about. But they were allowed to rot.

The trade of Lagos, however, shows from 1866 to 1871 a more gradual increase than any other of our possessions on the West Coast. From the Blue Book already quoted, I see that its exports as well as imports in 1871 exceeded those of Sierra Leone. The aggregate tonnage likewise surpassed that of the last-named port. In fact, during 1871 the exports from Lagos exceeded half a million pounds sterling, whereof £23,733 was to Porto Novo, only twenty miles away to the westward. This I suspect to have been chiefly the value of cowries, which are brought to Lagos from Zanzibar and Mozambique, in Eastern Africa, principally in Hamburg vessels. Of the colony, the real revenue in 1871 was accredited at 42,740 15s. 3d., whilst the actual expenditure for same period is put down at £45,611 14s. 4d. On the 22nd of June, 1872, the Blue Book tells us the liabilities of the settlement at Lagos, over and above its revenue, amounted to £13,810 17s. 6d.

The Bight of Benin, as it existed in my time out there (1850 to 1860), included the coast and rivers from Cape St. Paul's to Cape Formosa, a distance of 380 miles, and the head-quarters of the Consular department (where, *en parenthese*, I may add three died in eighteen months) were at Lagos. In 1856, as I learned from Consul Campbell, there was exported palm oil from all the ports in this district, together with a small portion of ivory and cotton, to the amount of £858,280. This only included the quantity of ivory on which duty was paid; and in those days smuggling of that article was carried on to a prodigious extent. The trade at all the stations, except Benin, at the time of which I write, was carried on under English, American, Hamburgh, French, Sardinian, Dutch, and Portuguese flags. At Benin it was solely English. Within the Bight of Benin were comprised the ports of Whydah, Porto Novo, Badagry, Lagos, Benin, and several outlets of the Niger to the west of Cape Formosa.

But the main entrance to the Niger is the river Nun, by which, as I have already mentioned, the Brothers Lander came down in 1830, and whereby I ascended in 1854 and 1855 as far as Hamarua on the Tshadda, or Binue, in lat. 9° 16 N., long. 10° 50 E., a river voyage, by course of stream, of more than 735 miles. Through the interior countries we found several varieties of traffic. The native produce obtainable up the Niger consists of palm oil, shea butter, ivory (in abundance when we get up a few hundred miles), red pepper, camwood, and indigo. It is a considerable distance from the coast where we arrive amongst the Mohammedans. But we find them on the river banks at Kororoofa and Hamarua, very different in their physique and courteous bearing from the native pagans of the coast. At their towns we saw used as currency not only cowrie shells and cloth, but glass beads of a double pyriform shape, that are brought over the continent from Mecca. At Rogan Koto, where the river Tshadda is called Lihu, they have a money of a spear-like shape, which is of thin iron, the handle being about four inches long, and the base of the triangle a similar length across. This, no doubt, is the same kind of thing as that mentioned by Sir Samuel Baker at the Royal Geographical Society, on the 8th of December last, with reference to the man who, in the Valley of the Nile, offered to sell his son for half a dozen of them. That these are of general use in the countries around Sokoto, is evident from the fact that they are styled *Ikika* in the Doma and Tuka languages, *Ibia* in the Mitshi, and *Agelemma* in the Houssa. The medals of which I speak, however, cannot be so valuable as those recorded by Sir Samuel Baker, as 36 of these constitute the market price for a slave. This money is mentioned by previous writers, as Barbot, in his "Description of the Coasts of South Guinea;" Ogilby, in his work entitled "Africa;" and "Doctor Baikie's

* Captain F. R. Burton, in the last number of "Ocean Highways" (February, 1874), speaks of this "having been" the currency of the Gold Coast. I believe it still exists interior to Lagos and up the Niger district. He describes it as the barbarous eowrie, of which Leo Africanus speaks at Tinbuktu (Timbuctoo) "in rebus minutioribus cochleis quibusdam utuntur quæ huc ex Persarum regione eonvehi solent" (*i.e.*, from India). They are now beeoming obsolete upon the West African shores, though still highly prized in the interior. In 1862 the following table was, and perhaps still is, useful:—

40 shells equal 1 string.
5 strings equal 1 tokoo (the seed of Abrus Precatorius).
10 strings equal 6d. (the day labourer's hire in 1862, now inereased to 1s. 3d.)
50 strings (2,000 cowries equal 1 head) equal 2s. 6d., or the loeal half-crown. (The people will take silver money, but they object to it if at all worn).

The ackie is at present equal to 1 dollar; in Bowdich's time, 5s. His *Gold Table* (p. 330) gives:—

8 tokoos or carats equal 1 ackie.
16 ackies equal 1 newemeën (or ounee) equal £4 (in 1819-20).
36 " " 1 benda.
40 " " 1 periguin equal £10 (p. 283

Narrative of his Exploring Voyage of 1854." Salt is much prized as an article of traffic up the Niger; so likewise is Trona, or coarse saltpetre; whilst amongst the Mohammedans, the articles most esteemed are beads, and white cloth wherewith to form turbans.

Mr. Pope Hennessy, late Administrator-in-Chief, in his report about Sierra Leone, published with the Blue Book of last year, observes*

"In Kambia itself I saw, for the first time in Africa, some attempts at manufactures. From the cotton shrub that grows near every house the women pluck the raw material, from which they spin a coarse strong thread. This is transferred to a native loom, made of hard wood, and of leather prepared by themselves. In the verandahs of the houses, the country cloths, from which they make tobes and other articles of wearing apparel, may be seen in process of manufacture, within a few feet of the plant, still laden with the opening seeds, from which the material of the thread is plucked whenever it is required."

But, strange to say, we saw exactly the same manufacture as this nearly 20 years ago up the Niger, and amongst tribes who had never seen white people previous to the visit of the steamship *Pleiad*. When I returned from Hamarua in 1855, I brought with me specimens of native manufacture in the shape of cloth tobes (garments), given to us by the Sultan, and basket-work of most tasteful design and execution. In fact, trade and manufactures are indigenous to Central Africa.

From Cape Formosa, southwards, we pass several other outlets of the Niger not necessary to be enumerated, as my paper is not a geographical one. Indeed, all the rivers from Lagos to Bonny, a distance of 280 miles, may be considered as, if not coming from, at least communicating with, that stream interiorly. The palm oil trading rivers in this part of the Gulf of Guinea, which is called the Bight of Biafra, are the Brass or Bento, the New Kalabar, the Bonny, Old Kalabar, and Kameroons, with which may be included the Bimbia mainland and the island of Fernando Po. This island is now producing cocoa, of which Mr. Irvine, of Liverpool, tells me he has recently had a shipment of 10 tons. Palm kernels, as well as ground nuts, are likewise forming exports from it.

From Bonny, in the flourishing days of slave trade, they used to export twenty thousand slaves per year. Fairs for the sale of the human stock were held every five or six weeks, as horse and pig fairs are in Great Britain. This continued until the abolition of the slave trade by Act of Parliament in 1819, and the consequent opening up of the palm oil traffic in 1821. Previous to the commencement of this latter, it is said 190 cargoes, or ship-loads, of slaves had been carried off from Bonny during a period of fifteen months. I believe the Liverpool slave trade was chiefly in connection with the Bight of Biafra, and more particularly with Bonny. Although this was begun, as I have already mentioned, by the Portuguese so early as A.D. 1434, and Captain Hawkins's first venture was in 1562, I find by "Gore's Directory" that the first vessel from Liverpool to Africa was only of 30 tons burden, and that she sailed from that port in 1709. The African trade thence, however, quickly increased, as in 1732 fifteen vessels started out. In 1752 there belonged to Liverpool 83 vessels in the same trade, and in 1756 sixty vessels left that port for Africa. How many of these were engaged in slave traffic I cannot ascertain, but I find in the same record that, in 1766, "the *Vine*, Captain Simmons, returned from a voyage to Bonny, on the coast of Africa, and Dominica, in the West Indies, with 400 slaves, in seven months and ten days." In 1767 there is an advertisement:—"To be sold by the candle (no doubt before the days of gas), the 23rd of August, the hull of the *Snow Molly*. N.B.—Three young men, slaves, to be sold at the same time." And with this were "one negro and two boys advertised for sale at Mr. Robinson's offices, December 1st." In 1769, ninety-six vessels sailed to Africa from Liverpool, of the burden of 9,825 tons.

* Papers as before quoted, page 10.

The barter and traffic system in the palm oil district from Lagos through the Benin and Biafra down to Batanga, a distance of 480 miles, differs chiefly in the nomenclature of currency. The materials used for barter consist of salt, powder, rum, tobacco, iron ware, crockery ware, brass rods, Manchester calicoes, and other things. The barter account has different titles. At Benin, Brass, New Kalabar, and Bonny, each article represents so many "bars;" at Old Kalabar the thing sold is set down at such a number of "coppers" to buy an equivalent in "coppers" or "bars" of palm oil or ivory. In Kameroons they are described as "bars," "coppers," "crews," "big tings," or "little tings." At all these rivers the foreign trader has to pay comey (a corruption, I believe, for customs) duty before being permitted to begin traffic. In the rivers Benin and Brass, it is computed by the value in goods for purchase of two palm oil puncheons to each mast which a vessel carries. At Bonny and New Kalabar the comey is five "bars" per registered ton of the ship; whilst at Old Calabar the comey is twenty "coppers" per registered ton. In Kameroons it is at the rate of ten "crews" for every hundred tons of the ship's register. The value in English goods of a "bar" is 6d. to 1s., of a "copper" the same, of a "crew" about half-a-crown, of a "little ting" a shilling, and of a "big ting" about a pound.

No more cogent illustration of the success of legitimate traffic to supersede the foreign slave export need be adduced, than a record of the fact that, during the year 1856, 2,280 tons of palm oil were exported from Brass River, and I should suppose it is going on the same, if not increasing since that time. My reason for particularising this river is, that the chiefs of the place have never received a farthing from her Majesty's Government for indemnity, on account of loss by slave trade, as the chiefs of all the other rivers did. They picked up knowledge of the legal traffic from their neighbours of New Kalabar and Bonny. When I mention, too, that in 1836, less than forty years ago, the total amount of palm oil imported into England from all Western Africa was 13,850 tons, whilst in twenty years after, or in 1856, that amount was exceeded by 3,000 tons from the river Bonny alone, it may be seen what germs for illimitable traffic still wait development out there.

From the Secretary of the African Association at Liverpool (Mr. J. B. Cooper), I find the returns from West Coast, for palm oil alone, into Liverpool, constitute the following amounts in tonnage and worth during the respective years:—

	Tons.	Value in Sterling Money.
		£ s. d.
1871......	45,245	1,560,952 10 0
1872......	41,500	1,431,750 0 0
1873......	44,827	1,546,531 10 0

"This," Mr. Cooper adds, "is independent of palm oil to London and Bristol, as well as of ivory, palm nuts, ground nuts, palm kernels, coffee, and other items elsewhere."

A few more statistics, and I shall conclude. I have already mentioned, on the night of this section being inaugurated, that during the five years of my Consulship in the Bight of Biafra, exports of palm oil therefrom ranged from 25,000 to 30,000 tons per year, which, at the price then generally ruling in Liverpool of £48 per ton, exceeded a million and a quarter of money. In the list of 99 ships entered out from Liverpool to Western Africa from the 24th of September, 1854, to the same day, 1855, the tonnage amounted to 43,346 tons. During the same date were imported into Liverpool 50,672 casks of palm oil of various sizes, nearly one half of which, 23,830, was brought from Bonny, and 2,850 from New Kalabar. When it is added that in December 1855 there were upwards of 40 vessels, comprising a tonnage of 10,000 tons, engaged in the African trade from the port of Bristol, it may be guessed how legitimate commerce was progressing. This trade prospered under the administration of a man-of-war, with a Consul on board, to teach the people who were to be masters there, and whose ideas were to be the dominant ones. But it is the man-of-war, with her 24-pounders on board, that constitutes the primary moral power to enforce protection to our trade in Western Africa.

From Cape St. John down to St. Paul de Loanda, a voyage of 720 miles, the chief trade is at the French colony of Gaboon, and the Portuguese settlements of Loango, Ambriz and others. At the latter place, the principle trade is ivory. Mr. James Irvine, of Liverpool, writes to me:—

"Coffee is increasing from St. Paul de Loando and province of Angola generally, at quite a wonderful rate. A few years ago if a shipment of ten tons came home it was thought an extraordinary thing. Then it brought about 30s. a cwt., and was difficult of sale. Now not a steamer arrives from St. Paul and Ambriz which does not fetch it, so that between September and May we have nearly 200 tons. It is now worth 110s. a cwt. It is grown from Mocha seed, and is used largely for adulterating the real Mocha."

In this course, too, we pass by the river Congo, through which went up last year what has proved a fruitless search for the great friend of Africa, and the most persevering geographical explorer that has ever trod her soil—I need scarcely mention the great Livingstone. In the history of the future, a glance at the map of that continent—of whose hitherto secret mysteries he has unrolled so much—may generate the same idea as we see written in front of St. Paul's, *Si monumentum quæris! circumspice?* One of the most glorious traits in the principles of Livingstone was the faith and fidelity with which he stuck to the success of the liberated Africans. In a letter which he wrote to the *Times* on his visit to England in 1855 or 1856—I forget which—he said:—

"The idea that the Africans could not produce cotton enough on their own soil I very much suspect is a Yankee notion too. Look at the insignificant island of the Mauritius, 35 miles by 25 broad, a great piece of volcanic rock, with so little soil that the boulders which covered it must be placed in rows, as dry stone dykes, in order to get space for the sugar cane. The holes are made for the cane between the rows, and a little guano added, for without that there would be no sugar; and when that part is exhausted the dykes must be all removed on to the intervening spaces. The labour must be all brought by colonial money from India, and then English enterprise produces sugar equal in amount to one-fourth of the entire consumption of Great Britain. The population of this wonderful little island, 200,000, is entirely free; the labourers, happy and free from the influence of caste, feel more friendly to Christianity and civilisation, and often return home to spend their after-life in ease and quiet. Indeed, it is free labour which here, as in Angola, produces the large supply of the articles we need. The latter country contains a population of 600,000 souls, and only from 5 to 7 per cent. as slaves."

Angola, of which St. Paul de Loanda is the capital, stands in latitude 8′ 48″ S., and longitude 13′ 13″ E.

But we have starting up as the great problem against doing for Africa what is done at the Mauritius, the fact, recorded by McQueen, that of the 150 millions of population which the great continent holds, three-fourths are slaves, whilst the others constitute the governing power. This latter is generally nothing more than a truculent despotism founded on grossest superstition. Such a state of things being the growth of centuries, cannot be eradicated in a day. The people of Africa are slow in their habits of thinking, as well as of acting. But the introduction of trade, and with it the natural sequences of civilisation, I believe will not only convince the African owner of slaves of how much more profitably he can make use of his serfs in labour, than in selling them; and the slaves themselves will be able to work out their own freedom, as is being done to-day in the palm-oil rivers. Thus a spirit of commerce may be introduced, that will teach the untutored African there is a reality in our professions of kindness towards him, and whilst at the same time developing peace, comfort, happiness, and prosperity to the great continent, it must add very materially to the commercial wealth of Great Britain. I believe it to be likewise the most effectual means to stamp out the human sacrifices and cannibalism which still, I regret to add, are clung to by some tribes of the West Coast of Africa.

DISCUSSION.

Mr. Swanzy said it was stated in the paper there were 40 steamers on the Grand Bassam Lake, but the fact was there were only four. Those who knew Africa, knew that Grand Bassam and Assini were up to 1870 entirely in the hands of the French, but in that year they were occupied by the English; he himself paid a rent of 400 francs a year to the French. The lagoons in Africa were all composed of fresh and salt water mixed, but such was not the case at Grand Bassam, the water there being entirely fresh. His firm carried on trade there with people who went entirely naked, but he hoped they would soon induce them to wear clothing. The Ashantees had always, within present memory, had access to the coast, although they had to travel through two hostile tribes to get there. The people of Elmina had always been friendly to England, and the road had always been ostensibly open, although from time to time it had been obstructed

to some extent by the Assini people; still the Ashantees had always had free access to the coast. A great deal had been said about the trade in the interior of Africa; he had read every work on the subject, it being his duty as a merchant to do so, and from his experience he thought there was not a vast amount of trade or a vast amount of produce to be found in Africa. The very pith and marrow of the trade consisted in palm oil, but the tree producing the oil only grew within a short distance of the sea. There were forests in the interior, at a distance of from 200 to 400 miles, but he thought they would not receive a very large amount of produce from that source. As far as the gold trade with Ashantee was concerned, that was a comparatively small and unimportant business, he having two-thirds of the trade in his own hands, and it had never reached £60,000 a year. He had done everything he could to increase that trade but without success, although the palm oil trade had increased very considerably all along the Gold Coast. Mr. Hutchinson had spoken of the attempt to cultivate cotton on the West Coast of Africa, but though everyone knew that cotton was indigenous to that part, there were great difficulties in cultivating it, owing to the scarcity of labour. In 1850, a number of gentlemen connected with the African trade, including merchants in London, Liverpool, and Manchester, subscribed a certain sum of money and sent out a gentleman from the southern states of America, who planted 25,000 cotton trees, but they only received six bags of cotton, although the cotton existed to an enormous amount, in consequence of the want of labour to properly attend to it. It was only where the population was dense that a supply of labour could be expected. In 1847, his brother planted coffee trees on the Gold Coast, but he did it with the assistance of labour which was considered to be too near an approach to slave labour, and so it was stopped. It was called pawn labour, which meant that when a man wanted a wife or any other luxury he pawned himself for ten dollars, or some such sum, and worked till he paid it back. This kind of labour was tried, but it was considered to be too much like slavery, and so the whole thing was stopped, and since then no coffee had been produced, although that grown there was very valuable. Such was the character of the natives of Africa. With regard to the increase in the quantity of palm oil exported from the different parts of the coast, he held in his hand a paper showing that in 1790 about 130 tons of oil were imported into this country; the amount went on gradually increasing till 1860, when it reached 40,000 tons, and at the present time the amount imported was 50,000 tons a year. He believed the only way to increase that to any extent would be by opening up new places. The natives of Africa did not look for luxuries; their wants were few, and when supplied they did not care to work. He did not think there was much increase in the quantity of palm oil exported from the various mouths of the River Niger. Africa produced all the necessaries of life, sugar, coffee, and almost every tropical product that could be mentioned; and there was a large uncultivated country which would produce anything, but it wanted population, and without that nothing could be done. The present population did not seem inclined to develope its resources; but he believed the day would come when Africa would be as densely populated as India, and produce the valuable necessaries of life which were now received from other places. In any endeavours to develop its resources Government assistance would be required, but in neither of the instances he had referred to was that afforded.

Mr. Trelawny Saunders said if Mr. Swanzy had not advocated both sides of the question, he should have felt greatly discouraged by what had been said; but while he told them of the difficulties arising from the want of labour, he had also spoken of certain experiments which had proved successful. He had shown them that under one combination, until interference came, there was neither want of labour or employment; so that he hoped the meeting would not go away with the impression that there was any indisposition on the part of the natives to work. What was wanted in order to develop the glorious results pointed out by Mr. Swanzy was a proper organisation, for hitherto they had been unfortunate in applying the organisation calculated to develop them. He hoped one of the results of these African discussions would be to induce African merchants and others to form a combination to prosecute the matter, and he had no doubt they would succeed in bringing about before long the great results which Mr. Swanzy anticipated. They had seen great results in the course of a hundred years in Africa since the slave trade was first abolished and an exploration of the interior made. They had come to know something of the country, they had had the ground cleared for operating upon, and since that time they had had the advantage of railways and telegraphs, and he doubted not that with such appliances they would see in another ten or twenty years some of the results which Mr. Swanzy, with a prophetic eye, had spoken of. But they had not yet been able to get out of the rut of established experience, and the conditions which had grown up from the slave trade. Mr. Swanzy had tried to persuade them that while he perceived the grand results to accrue from the cultivation of sugar, coffee, and so on, yet on the other hand there was nothing to be hoped for from Africa but palm oil. Those two conclusions were inconsistent with one another; and while he admitted they had nothing to expect but palm oil under the present system of organisation and restriction of European exertion, he thought they wanted an extension into the heart of the interior, and that the merchant should follow the explorer. They must not fail to bear in mind either the grandeur or the precise conditions of the task before them. Mr. Swanzy was no doubt aware of the printed book of Anderson's, and also acquainted with a recent publication by Mr. Skearchley, who showed that the Mohammedans found it worth their while to come down from the interior to Coomassie to trade. If it was worth their while, it was surely worth the while of Europeans to have an agency at Coomassie, and even to go as far as Timbuctoo overland. The result would be the removal of the evils which had caused the present Ashantee war, evils which every one deprecated, viz., the closing of the roads by every little chief on the wayside. That could only be done by the establishment upon the coast of a moveable and adapted force, which should make these petty chiefs know that Englishmen would have their own way for their own good and the good of the people. When they were told by Mr. Swanzy that they could produce large crops, when they had those conditions before them upon such a suitable climate and soil, he thought there ought to be no longer a word said against the extension of the operations of the Society of Arts into Timbuctoo, or anywhere else in Africa.

Mr. Hamilton could not agree with all that had been said by Mr. Swanzy; and to him it was a matter of great regret that merchants who had long been in the habit of dealing with Africa should have confined their operations to the coast. Mr. Swanzy had said that there was no hope of doing anything within 80 miles of the coast, but he begged to differ in that most decidedly, because a trade had already sprung up with the interior, up the River Niger, which had already produced extraordinary results. At one time he was engaged in endeavouring to establish a trade on that river, but the opposition he received was not only from the Government, but from the merchants trading on the coast, who no doubt had been doing uncommonly well, and therefore wanted to leave well alone. But a very great change was coming over the ordinary trade of Africa, inasmuch as it was not long ago that it was necessary for a merchant who traded there to employ a fleet of ships to carry on the trade, because a ship that took out a cargo had to unload and

wait till it was converted into palm oil, which required a large capital; but now they had steamers running every week to the coast of Africa, so that young men could go and establish themselves there, and send home once a week the oil which they collected, instead of keeping a ship waiting for a cargo, thus effecting a great saving. That change was as yet only in its infancy, but very great results would flow from it, and large merchants would find it necessary to employ their capital to push into the interior. There were four or five companies trading on the River Niger, and Captain Croft, who read a paper a short time ago before the Geographical Society, had made no less than six ascents up the river, and had sent home a considerable quantity of ivory. The traders who went up the River Niger brought back palm oil, ivory, and native cloth, which was more durable than that made in Manchester, and was in great demand on the coast. But when Mr. Swanzy said there was nothing but palm oil to be got there, he did not agree with him. Indigo had been produced for some time there, and he thought as the trade was extended up the River Niger that would become a great trade. He quite agreed that there would not be a great supply of cotton from the interior of Africa, because it would require too much European superintendence; but that there would be a trade, increasing year by year up the River Niger, he thought no one could doubt. The inhabitants of the interior were very civilised people and could be trusted, as was proved by the fact that merchants sent their goods up the River Niger, and they remained in the hands of the blacks in the dry season, during which time the cargoes were exchanged, and this was done without any plundering. The great thing to be done was to get the coast clear of the comparatively degraded race who resided there, as the further they went inland the better the class of people; and it was only necessary to reach them to establish an exceedingly profitable trade.

Mr. P. L. Simmonds, who stated that he had been connected through some members of his family with African commerce, regretted that Mr. Hutchinson had not given later statistics with regard to the trade with Africa; these he knew were accessible, because he had recently had before him the whole details with respect to ivory, which formed an important and growing element in the West African trade. It might be supposed that the supply of such an article would decrease, but this was not the case; and as England formed the *entrepôt* to supply the whole of Europe, it was an important branch of commerce. He quite concurred in Mr. Hamilton's view that much was to be looked for from the Niger in the shape of native produce, leather, coffee, native cloths, and a variety of other articles being obtained in that region; indeed, generally speaking, there was much to be obtained from the interior of Africa which could not be expected from the coast, for there the country to a certain extent was becoming exhausted. No doubt the palm oil trade was very important and profitable, but there were many other articles to be obtained from Africa, for example, coffee, of which the supply was getting quite inadequate, and prices were rising accordingly. He had seen excellent coffee from Liberia and other parts of Africa. It was no doubt true that it was very difficult to obtain continuous labour in Africa, because at present the wants of the natives were slight; it was just the same in the West Indies, where he happened to be at the time of the emancipation; the Negroes when freed could not be induced to do more than sufficed to supply their very limited wants. The climate was fitted to produce all tropical articles, and he had even seen very good specimens of cotton from Abeokuta, and probably, if there were a scarcity and higher prices, a considerable supply could be obtained. Of late years there had been much greater diffusion of knowledge with reference to Africa owing to the efforts of recent explorers, and the great difficulty now seemed to be the means of communication with the interior. Still he believed these were only temporary obstacles which would by-and-bye be removed. Trade had been very much progressing during the last eight or ten years, especially in minor articles, such as dyewoods, minerals, &c., as to which he should have liked farther particulars to have been given.

Mr. Swanzy said everybody seemed to agree with him as to the difficulty of getting labour. All the other articles which had been enumerated amounted to a mere bagatelle compared to the staples of palm oil, ground nuts, ivory, and kernels, which was a new trade. There was no considerable export from the West Coast of any article which required either the outlay of capital or continuous labour for its production. He quite agreed that the Niger offered great facilities for commerce, but did not see any probability of English traders going to Timbuctoo. Looking at the difficulty which Sir Garnet Wolseley had found in getting labourers to carry a few packs into the interior, he did not think there was much hope of regular communication, at any rate for many years to come. This was simply speaking from experience, for Africa had been known for the last 300 years, and yet there had been no communication by land with the interior. The great difficulty was to pass the unhealthy and inhospitable border land of about 150 miles, and he thought they would have to leave the Africans to be their own carriers. With regard to the charge of want of energy which he understood had been brought against African merchants, he must repudiate it most strongly. He was always endeavouring to find something which would meet the taste of these benighted Africans and so induce them to trade, and at the present moment one of the *Times*' special correspondents was a gentleman whom he had sent out there at his own expense for the purpose of exploration, for there were many parts, as for instance between Cape Palma and Cape Three Points, where the country was perfectly unknown even five miles from the coast.

Mr. Rogerson thought the trade between the Gambia and the United Kingdom did not stand quite so badly as it appeared from the figures quoted in the paper, a great part of the returns from there being made, not directly to England, but to French ports, the money flowing back through British merchants in the shape of French bills or other remittances. There appeared an immense falling off in the trade from Sierra Leone to the Gold Coast, but that arose simply from the arbitrary and unwarranted rise of duties at the latter place preventing the export from Sierra Leone of tobacco and spirits, which had been sent there to a great extent as an *entrepôt* for the whole West Coast. He had no doubt, however, that this was only a temporary stoppage of trade. It was quite true that Europeans had not gained much access to the interior. He had endeavoured to tap it from the coast, but with no great success, beyond discovering some minerals which were of very little use, because from the prevailing winds it was impossible during a great part of the year for ships to lie off there. The position held in Western Africa with regard to Great Britain must depend on the security given to the trading interest, and this he believed would best be secured by the establishment of a small squadron to act as a kind of naval police. Vessels were often lost from getting on shore, which might be got off were it not for the piratical attacks of the natives. This would apply not only to the Gold Coast proper, but to the whole West Coast. There was an immense export from the Congo of coffee, kernels, ground nuts, palm oil, pepper, ivory, and so on, because the Portuguese, weak as they were, yet insisted on keeping order, and knew how to make themselves respected. He did not think a regular seat of Government could ever be established at Sierra Leone or on the Gold Coast, but there might be a few floating representatives of English

power, which, as in the case of the French off the coast of Morocco, would have a most beneficial effect on the natives.

Mr. Consul Petherick had listened with pleasure to some remarks showing the necessity of penetrating into the interior, and was surprised to find West Coast traders avowing their ignorance of the people and the country inland, except for a few miles, after 300 years of intercourse. His own efforts in this direction were quite independent, and he did not rely on either gun-boats or any force whatever beyond what he took with him, yet he had penetrated nearly a thousand miles into the heart of Africa. After spending some five or six years in the gum-arabic trade, after the monopoly was given up by Mohammed Ali Pasha, finding he had so many competitors that it was hardly worth continuing, he had a boat upon the White Nile, following the course pursued by two earlier European merchants, who, taking a cargo of 30 or 40 tons of merchandise up the Nile, reremained until they had bartered them away to the natives, when they returned with what they had obtained in exchange. Their trade was of course very insignificant, because in that region, as on the opposite side of the Continent, every tribe was at enmity with all its neighbours, and no man dared cross the territory of a stranger with inpunity. He was the first European who ever set foot in the interior of Africa from the White Nile, which he did in 1853, and with only forty men he faced every tribe whose land he crossed, returning each year with a rich booty. He did not do, however, as the merchants on the West Coast did—supply the natives with arms and ammunition to be turned against himself. On one occasion, with only thirteen men, seven of whom were on their backs with fever, he kept 6,000 natives at bay, and stood a siege for several weeks. Not only so, but he went out sporting every day, simply because he could kill big game at a distance of 50 or 100 yards, whereas it took perhaps 40 to 50 Negroes to kill an elephant or buffalo within a few yards. They therefore stood in awe of his rifles, and took care to keep at a respectful distance. Hundreds of Mohammedan traders followed in his footsteps, until the country became quite overrun with them, and he had no doubt that perhaps with larger numbers, the same thing might be done from the west coast, as he had done from the Nile. As they had already heard, Mohammedan traders came down from Timbuctoo to Coomassie, and they had no force to defend them, and pilgrims went from Senegal to Mecca every year. Hitherto, however, British merchants had relied on the natives bringing down food to fill their ships, instead of going inland to search for them. He had no doubt that with energy and determination to overcome every obstacle, caravans could be established in one part of Africa as well as in another. With regard to the slave trade, it had only arisen from the contact of Africans with white men, who formerly encouraged it, though they were now doing their best to stop it. Nothing of the kind was known in the interior, though domestic slavery existed. In their numerous wars, the conquering party put to death the warriors and old men, but took the children as slaves, bringing them up in their own families, where they were treated much better than the conquerors' own children. The only thing in the shape of a trade in slaves was on occasions of famine, or scarcity, when it was not uncommon for those who were in want to sell their children as slaves for a basket of grain; he knew of no actual slave-trading there.

Mr. Hutchinson, in replying, said he had not come with any idea of presenting a complete and perfect paper, but only to break the ice and prepare the way for others. It was 13 years since he left the coast of Africa, and the statistics of trade he had referred to had been supplied to him from the Colonial-office as the most recent Blue Books, and he was therefore not responsible for them. He was up the the River Niger in 1854, as far as Amaroan, and did not think there was any danger in getting to the interior by that means. He went 730 miles up the river, 150 miles further than the expedition in 1840 went, and he brought back to Liverpool 54 Africans and 12 Europeans, without the loss of a single life, thus showing that the interior of Africa, up the River Niger, was very healthy. The trade up the river consisted to a great extent of palm oil, but chiefly of ivory; and he thought that the River Niger would be the great canal to connect the East Coast with the West Coast. He had no doubt that the Ashantees were always allowed to come down to the coast, but they had to pay a tax for passing through other tribes, and that was a thing which merchants ought to try and abolish. It might be done, as was suggested, by a fleet of steamers carrying an efficient naval police force. He hoped Mr. Simmonds would prepare a paper on the subject, and give the meeting more information than it was possible for him to do.

Votes of thanks to Mr. Hutchinson for his valuable paper, and to the Chairman for presiding, having been carried, the meeting separated.

THIRTEENTH ORDINARY MEETING.

Wednesday, March 4th, 1874; Colonel J. MACNAGHTEN HOGG, M.P., Chairman of the Metropolitan Board of Works, in the chair.

The following candidates were proposed for election as members of the Society:—

De Luc, Charles Lombard, Forest-hill, S.E.
De Salles, I., 6, Great Winchester-street-buildings, E.C.
Honey, A. J., the Distillery, 25, Holborn, E.C.
Matthiessen, Henry, Raymond-buildings, Gray's-inn, W.C.
McDonnell, Alexander, St. John's, Island-bridge, Dublin.
Moll, E. A., Beech Tree-bank, Rectory-lane, Prestwich, Manchester.
Spartali, Démétrius M., the Shrubbery, Clapham-common, S.W.
Stacey, Samuel Lloyd, 300, High Holborn, W.C.
Whitehouse, E. O. Wildman, Roslyn Hill-house, Hampstead, N.W.

The following candidates were balloted for and duly elected members of the Society:—

Addis, William, Leicester-street, Leicester-square, W.C.
Allott, Alfred, Young Men's Christian Association, Sheffield.
Bowing, John, 4, Unity-place, Woolwich, S.E.
Hickson, John Godfrey, Education Department, Whitehall, S.W.
Judd, James, Phœnix Printing Works, St. Andrew's-hill, Doctors'-commons, E.C.
Prim, J., 7, Bedford-street, Bedford-square, W.C.
Waring, William, 39, Princes-gardens, S.W.
Warren, Captain Charles, R.E., Shoeburyness.
Williams, Richard Harris, C.E., Cuddra-house, St. Austell, Cornwall.
Wood, C. Malcolm, F.R.G.S., 14, Waterloo-place, S.W.
Woodall, Corbett, Engineer's-office, Phœnix Gas Light Company, Bankside, S.E.
Youle, Frederick, 4, Montague-street, Russell-square, W.C.

The Paper read was:—

ON BELLS, AND MODERN IMPROVEMENTS FOR CHIMING AND CARILLONS.

By George Lund.

I feel that some words of apology are due from me for presuming to read a paper before so learned a

society as this; but upon the scientific part of the question, I most candidly admit that I am not equal to entering at present, being quite content to quote the opinions of others, far more competent than I to express an opinion; but I venture to think that, upon the practical part of the bell question, and the mechanical means used for producing the best musical effects upon them, I may be heard with pleasure and interest by my audience generally; and to some of my hearers who, like myself, are enthusiastic in such matters, I may be able to impart some information which may prove of value in furthering the common object we have in view, the revival of the love of bell music, which, until within the last few years, has fallen considerably in public estimation, on account of the rude and unsatisfactory machinery used in its production. I propose to divide the subject of this paper into three heads, giving, firstly, some information about what came under my notice while making a hurried tour through Belgium, the home of chimes; then, secondly, touching briefly upon bells, their manufacture and uses in our own country, to come, thirdly, to the more immediate subject of this paper—hemispherical bells, and modern improvements in the machinery of chimes and carillons. The first town of importance on the route, viâ Dover, Calais, and Cologne, is Ghent, where there are 44 bells, a tune being played every quarter of an hour, once an hour being not enough to satisfy the insatiable desire of the Belgians for bell music. My impression on first hearing them was, that they were played by some means loud and soft, but I soon decided that that could not be without a system of dampers being used, and that I knew had not, and has not yet been successfully, if at all, applied to bells. It is a subject to which I intend to give attention as soon as possible, and I hope any difficulties, should damping be found to be useful, may be overcome. I must say I do not believe it to be a Herculean task. We have already sketched out a very simple method of damping by apparatus attached to the hammer, which could be easily altered to be worked by a pedal or by an extra key, so that a bell could be allowed to sound out for any length of time or damped instantly; and I have no doubt that most intricate and difficult effects of melodies, with running accompaniments in the base, could be played in this way with perfect distinctness, the great fault with all the Belgian music being its indistinctness.

The machinery used in Ghent is on the same principle as in all the other towns, and is the same as has been used in England till within the last few years. A large barrel of either iron or brass, with pins in it of large size to catch upon the ends of the levers, to which are attached the hammers which strike the bells, to raise them, and let them fall again immediately on the bell, is driven by a smaller drum and wheel, round which is wound the flax or iron wire rope, to which is attached the weight, which is the motive power (as shown in diagram). At Ghent, the music drum is made of brass with square holes punched into it, and in these holes iron lifting-pins are placed. The surface of the barrel being divided by the square holes into intervals for crotchets, quavers, and semiquavers, it is a matter of no very great difficulty to arrange the tunes, and when it is desired to remove them for a change of tune it is easy to knock them out from the inside, and to put them in such other holes as the nature of the notes to be produced may require. The ropes here are of flax; the driving weight is 300 lbs., and is wound up twice a day. There are as many as four hammers to some of the bells, and none have less than three. The brass drum is about six feet in diameter, and when in motion reminds one very much of a water-wheel, so ponderous does all the machinery look. It was constructed by Charles Nolet, a native of the town, and I have no doubt his fellow townsmen are very proud of his memory, for he must have been long since dead. The next place, *en route*, is Bruges, where the machinery is on a much larger scale than even at Ghent, the barrel being eight feet in diameter, 48 bells, and as many as six hammers to some of the bells—190 in all. The machinery was constructed by Antomusde de Hondt, of Bruges, as far back as 1748, and of late years iron wire has been substituted for flax rope. The weight has to be wound up every two hours, a man living in the tower for that purpose. The clock here is worthy of passing notice, being of a very large size to carry the hands for the dials, which are 19 feet in diameter. It has a gridiron pendulum, which is supposed to compensate for changes of temperature, but this it certainly does not do to any satisfactory extent. It strikes the hours at the hour and half-hour, on a different bell at the half-hour to distinguish them, and a tune is played at each quarter. As at Ghent, there are small clappers fixed inside the bells, by which they are played upon by hand. The performance is done in this way. The man who is about to distinguish himself, regularly prepares as for a pugilistic encounter. He takes off his coat, waistcoat, and hat, puts his long hair learnedly off his forehead and behind his ears—at least the man I saw did—looks intently for a few moments into the corner of the room, puts on a regular pair of boxing-gloves in the greatest possible hurry, evidently for fear that the brilliant melody should escape him, sits himself down in front of long rows of pegs and pedals, and bangs away at them as hard as ever he can go, first up, then down, now in the middle, now both ends at once—and I believe the whole lot would have gone down at once if he could have managed it—legs and arms all going in a perfect frenzy, but there being many more pegs than arms and legs, he could not manage more than a certain number at a time. How thankful the Antwerpers ought to be. Now for the result produced—a great deal of clatter and fatigue, but very little music. Noise and jingle, most lovely to those who like it; but I am one of those unappreciative sort of people who do not think that music consists in a thundering noise and clatter. Dr. Gatty, in his "History of the Bell" says, upon this subject:—"The Carilloneur uses both hands and feet in executing the sprightly airs which charm the inhabitants of the cities of the Low Countries. The pedals communicate with the larger bells for the base; and the keys upon which the treble notes depend are struck by the hand edgeways, the little finger of the player being defended by a thick leathern stall. It requires considerable strength, as well as celerity and skill in the player, for unless a violent blow be

given to the key, only a weak sound would be produced;" and Dr. Burney (in his "Present State of Music in Germany, 1772") says:—"The want of something to stop the vibration of each bell at the pleasure of the player, like the valves of an organ, is an intolerable defect to a cultivated ear, for by the notes of one passage perpetually running into another, everything is so inarticulate and confused, as to occasion a very disagreeable jargon." He also says:—"The carillons are said to be originally of Alost, in this country (that is, Germany), and are still here and in Holland in their greatest perfection."

The next town I visited where there are chimes was Antwerp, where there are 48 bells. The bells are swung as well as chimed on by the machinery, which was made by Von Hoof in 1786. The weight is wound up twice a day. These people seem very fond of winding up weights, nothing less than twice a day suits them, and in one instance named, every two hours. The next and last in my route was Namur, where there are 54 bells. The machinery was made by Nolet, of Ghent; of the date I have no note, but I should say it was decidedly more recent than the machine by the same maker at his native town, the whole arrangement of the bells and hammers and machinery being much more perfect and mechanical. The music was taken in excellent time; there was a distinct melody running all through, with a most judiciously arranged accompaniment in the base.

There is at Louvain, a large bell foundry where I believe nearly, if not all, the Belgian bells have been cast. Van Acholdt is the proprietor. At the time I visited him he had nothing particular in hand, but a few years ago he sent a large peal of forty-two bells to this country for Boston, in Lincolnshire, which are considered to be very good. The process of manufacture of English bells which I am now about to describe, will apply equally to the German bells, and I need only mention here that many people consider them superior in tone to ours. I believe that a great deal of this apparent superiority is due to the number they use. Take them singly, and undoubtedly they are thin in quality of tone.

There is a most excellent work about bells, edited by the Rev. H. T. Ellacombe, and called the "Bells of the Church," a supplement to the "Church Bells of Devon," and I was so much struck with the easily-understood description he gives there of bell founding, that I think I cannot do better than give it in his own words. He says:—"It will be interesting to the general reader if I describe the modern process of bell casting. This I am the better enabled to do by taking the establishment at Whitechapel, the oldest in London or in England." Before describing the process of casting a bell, it may be well to state that bell-metal consists of an amalgum of copper and tin, in proportion of about three parts of copper to one of tin. There are of course various trade secrets as to the exact proportions of the different metals necessary to constitute a first-rate alloy. Mr. Denison in his book says that, after many experiments, he has come to the conclusion that the proper composition for bells is thirteen of copper to four of tin.

There is no great mystery after all in the bell founders' art, but extreme care is necessary, in order to produce a good toned bell, that all the preliminary operations should be conducted with the greatest exactness. Passing through various yards at the Whitechapel Foundry—in which are stored quantities of old timber, old bell-metal, and a multitude of odds and ends, in the shape of cannon and great masses of old copper destined one day for the furnace—we arrive at the moulding-room. In describing the casting of a bell it will be necessary to observe that it is nothing more than a layer of metal which has been run into the space between the mould and its outer covering and allowed to cool. Figure 2 will explain this very readily. Here we have a section of a bell as it lies in the pit during the process of casting. The various parts of a bell may be described as the body, or barrel; the clapper, or striker, hanging on the inside; and the ear, or cannon, on its top or crown, by which it is hung in its chosen position in the tower. If my hearers will keep the diagram (No 2) in their mind's eye, they will have no difficulty in understanding all I have to say on the subject.

The following description applies to all bells, large and small, the various modifications in the shape, &c., not interfering with the principle on which it is manufactured. The first principle to be observed, is the construction of the shape or form of the future bell, so as to ensure that due harmony in all the parts which shall give to it the proper degree of tone and vibration. Various theories have obtained in different countries, and among the different founders of our own country, as to the best proportions for bells; but the following scale has been proposed and generally followed at this foundry as coming nearest to perfection. Taking the thickness of the sound-bow or brim—that is, the part where the clapper strikes—a bell should measure in diameter at the mouth, fifteen brims; in height to the shoulder, twelve brims; and in width at the shoulder, seven and a-half brims, or half the width of the mouth. These proportions, however, are very variable, and depend greatly on the taste, experience, and skill of the founder, an approximation merely being arrived at in these figures. Mr. Denison says, "The most essential point of all to be attended to in ordering bells is to require absolutely, and in spite of all protestation of the founders, that none of them when finished are to be thinner in the sound-bow, or thickest part, than one-thirteenth of the diameter." I know that some good old bells are a little thinner, but I never saw a new one that was less, and had at the same time anything of the soft and sweet tone which church bells ought to have. I can only account for the old ones bearing to be thinner, though by no means so thin as many modern ones, by the well-known greater softness and toughness of the copper of old times, when they smelted less metal out of the ore. The small bells of a peal are always rightly made thicker in proportion than the large ones, and will run up one-eleventh of the diameter, the large ones being one-thirteenth. I would here observe that Mr. Denison goes most minutely into the why and the wherefore of the proportions of metal and the shape of bells; but I have selected Mr. Ellacombe's description of bell founding, because I have thought it would be more generally understood. To the searcher after

information both books are invaluable, one treating exhaustively on the constructive part, and only slightly on what I may call the archæological part of the question; and the other exhaustively on the archæological, and only slightly on the constructive. I believe that Mr. Denison is at issue with some of the bell founders about the proportions and shapes; but that his theory is a right one seems entirely borne out by the fact that many most excellent peals of bells have been constructed under his instructions, and that he is consulted in almost every matter of importance. The size and proportions, then, of the future bells being ascertained, the making of the mould is proceeded with. The outer form of the core, by which the inner shape of the bell is determined, is made by means of a crook, which is made to revolve on the clay, &c., of which the mould is composed. This crook is a kind of double compass, the outer leg of which is in two parts, formed of wood and metal. The inner part (of metal) is cut or curved to the shape of the outside of the core, or inside of the intended bell; and the outer part (of wood) to the form the outside of the bell is to be made. This crook and compass is made to move on a pivot affixed to a beam above, and its lower end is driven into the ground. In the case of very large bells the mould is perfected in the pit in which they are to be cast. The crook is driven by the hand of the moulder, and the moulds being composed of plastic clay, &c., the form of the inner side of the bell is defined by a few revolutions of this simple machine. Thus is formed the core, or inner mould. The cope, or outer mould, is formed in much the same way, except that its inner surface is smoothed to form the outer side of the bell. The core is first roughly built up of brickwork, with a hollow in the centre. It is then plastered over with soft clay, &c., and moulded as described, by the action of the crook, and is afterwards dried by means of a fire in the hollow mentioned. When baked sufficiently hard, it is covered all over with a size of tan and grease. Over this size a coating of hay bands and loam is laid, the exact thickness the bell is intended to be made; on this thickness the outer leg of the crook—the inner leg which formed the core having been removed—is made to rotate, and so forms the shape of the inside of the cope or outer mould. This thickening being thoroughly dried, upon it is formed the cope, or outer mould, upon the outer surface of which are formed ledges, by means of which, when dry, it is raised, and the thickening destroyed. Both are then retouched, any device or inscription being impressed upon the inside of the cope; it is re-lowered, and the hollow space between the cope and core is, of course, the exact shape the bell is to be. The head and staple to hold the clapper being now fitted above all, the mould may be said to be complete. A sufficient number of moulds being now formed for the number of bells to be cast, the pit is filled in with earth, firmly rammed down to prevent the copes rising when the metal is run in. The furnaces are now lighted, the metals in their proper proportion are melted—some times as much as twenty tons at a time—and from time to time tested, till found to be of the right temperature, when the furnace doors are opened, and the molten metal directed through properly constructed channels to each mould in succession, till the whole number of bells is cast. Sufficient time is allowed for cooling. The earth is dug away from around the moulds, which are then destroyed, the bells being taken to the tuning room, where they are tried for note; and when tuning is necessary, which is almost always the case, the bell is securely fixed into a wooden frame by means of wedges, underneath a steam cutter, which cuts as much as may be required, either from the inside of the bell in the region of the sound-bow to deepen the note, or from the edge of the lip to sharpen it.

The earliest notice of a belfry and peal of bells is contained in the following passage:—Egelric, Abbot of Croyland (who died 984) in the time of Edgar, caused a peal of bells to be made for his Abbey, to each of which he gave names, which it is needless to give here; and the celebrated "Benedictional of St. Ethelwold," in the library of the Duke of Devonshire, furnishes us with an earlier instance of a belfry with four bells, namely, about the year 980. From that time to the present bells of all sizes, shapes, and weights have been cast, and I think that a few moments may not be unpleasantly spent in enumerating some of the most famous. The largest bell in England is, as you are doubtless aware, "Big Ben," the clock bell at Westminster; it may not be equally well-known that it derives its name from the fact that Sir Benjamin Hall was then Chief Commissioner of Her Majesty's Office of Works when the bell was first cast and his name inscribed on it, it was named after him Ben, and from its size was naturally called big; hence the name, "Big Ben." It bears this inscription; "This bell, weighing 13 tons, 10 cwt., 3 qrs., 15 lbs., was cast by George Mears, of Whitechapel, for the clock of the Houses of Parliament, under the direction of Edward Beckett Denison, Esq., Q.C., in the 21st year of the reign of Queen Victoria, and in the year of our Lord, 1858." It was contracted for that the bell should bear the blow of an 8 cwt. hammer, but after the clock had struck on it for a few months cracks showed themselves, and upon examination it was found that the metal was porous and the casting defective. The striking was then removed to the fourth quarter bell, upon which the hours were struck for two or three years; but, after many complaints of the confusion, the striking on the big bell was resumed (November, 1863) with a lighter hammer, the bell being turned a quarter round by the button or mushroom head by which it is hung. The four quarter bells were cast by Messrs. Warner without any known defect, and are remarkably good. I may here give you some information which may be new to you, and at the same time bear testimony to the remarkable time-keeping of the clock. We receive from the Royal Observatory at Greenwich by electric current a time signal every hour—and I show upon the table the instrument we use for registering it—having found it extremely inconvenient to be on the lookout exactly at the hour, failing which the signal was lost. It is the invention of a brother of mine, improved by myself only to this extent, that instead of using an ink chronograph watch we use a stop chronograph; and for the information of those who do not know the difference between the two, I would say that in one the seconds-hand is double, and that when the signal comes

it draws the upper hand through the reservoir of ink in the end of the lower hand, and so marks the error of the watch on its dial or face, and that the hand is constantly moving. In our chronograph the hand can be started from zero and allowed to travel as long as desired, can be stopped, and again be brought to zero for another start, each being done by pressure. Having placed the hand at rest we put the watch into the instrument and leave it. At the next hour the signal is sent from the Royal Observatory, and the hand of the watch is started absolutely to Greenwich meantime. We can then at our leisure compare our regulators. The wire through which our signals come is used by the Westminster clock once each day, to transmit a register of its time to the Astronomer Royal at Greenwich, and to Mr. Dent, in the Strand. When we want to compare "Big Ben" we only replace our watch, and let the clock signal (being the second pressure) stop the hand. Whenever it stops to the right or left of zero, so is it fast or slow of time. If it stops at zero it is of course correct time. It is very rarely indeed that we find it many seconds out. The next largest bell in England is "Peter of York," diameter 8ft. 4in., height 7ft. 7in., weight 12 tons 10 cwt.; the note is F sharp. The next great bell is the "Mighty Tom" of Oxford, 7ft. 12in. in diameter and weighing 7 tons 12 cwt. The note is generally considered to be A, but being faulty in some parts, the tones vary, and some say it gives out five notes. Rather a cheap way that of getting the effect of a peal of five bells. Three unsuccessful attempts were made to cast it in 1681; twice it wanted metal enough to make out the canons, and the third time it burst the mould and ran into the ground. It was at last, can I say successfully cast, with its five notes, by a London bell founder named Christopher Hodson. In 1682 it was moved from the Church to the Gate House, and on the 29th of May, 1684, it first rang out between eight and nine at night, from which time to this a servant tolls it every night at nine, as a signal to all scholars to repair to their respective colleges and halls.

There is a great bell at Lincoln Cathedral weighing 5 tons 8 cwt.; note A. This, and the two quarter bells, were cast from the old 1610 bell, and six other bells from the rood tower, called the Lady bells, by Mears, of London, in 1834. St. Paul's Cathedral has a large hour and two smaller quarter bells, none of them anything to boast of, in the south tower. There is however, in the north tower, a bell which bears the inscription:—"Made by Philip Wightman, 1700." The diameter is only 49½ inches, and the thickness 3¼ inches, yet the tone is most deep and sonorous, and I think, for its size, one of the most pleasing to the ear I ever heard. Having had occasion to try it several times, the impression remaining of it is a most pleasing one, which I cannot say of the three other bells; the quarter bells are specially poor and lacking in quality of tone. There are also large bells at Leeds Town-Hall, St. Dunstan's Canterbury, and at Glasgow. One of the latest additions to the large bells in England is at Worcester Cathedral for the new clock to strike on, and for occasional tolling. It is hung on the balance-beam principle. The gudgeons or pivots on which the bell moves are wedge-shaped, and roll on hand brasses very slightly hollowed; the friction is thereby so little that the bell can be tolled by one man with one hand, although it weighs four tons and a-half, a lever being attached to the stock instead of a wheel, which is necessary under some circumstances. It was so tolled for service for the first time by Mr. Denison and the Rev. H. T. Ellacombe, on Sunday, the 17th January, 1869, in the company of the Rev. R. Cattley and others, and it is owing to the last-named gentleman's indefatigible efforts that the peal has since been made up to thirteen bells, and machinery provided to play tunes upon them.

I may here be permitted to publicly thank him for his extreme courtesy to me on the occasion of a visit which I lately made to Worcester. Anything more perfect in the way of general arrangement of bell framing to support and carry the bells, of fittings in the bell-ringers' floor, and evidence of heart and soul enthusiasm of the master mind in the work from floor to roof of the tower, is not to be found. This is no fulsome flattery, but a statement of plain truth, as any person going there can see for themselves. The bells, made by Messrs. Taylor, of Loughborough, are undoubtedly very fine, and the clock, made by Messrs. Joyce, of Whitchurch, is a specimen of English work of the highest order. The chiming machinery for the tunes was made by Messrs. Gillett and Bland, of Croydon.

In Mr. Ellacombe's book much more and most interesting information will be found about big bells in this and other countries, large peals, &c., and recommending it to your notice, I pass on to "The various uses to which bells have been put." The two most important of these, and the only two which I shall speak of, are change ringing by ringers swinging the bells, and chiming tunes by machinery. Seventy or one hundred years ago ringing was a much more popular and fashionable pastime than it is now. The exact date is uncertain when the art of ringing a number of variations on bells was first practised, but probably about the commencement of the 17th century. Long before that date no doubt bells had been rung, but only in rounds, that is, in the same rotation each time. The earliest known record of a ringing Society is to be found in a manuscript in the library of All Souls College, Oxford, entitled, "Orders conceyved and agreed upon by the company exercising the arte of ringing, knowne and called by the name of the Schollers of Chepezyde, in London, begun and so continued from the second day of February, anno 1603." This society appears to have existed down to 1634. Three years afterwards another society was formed, called the College Youths, records of which exist down to 1755. There is at the present time a Society of the same name, which claims relationship, rightly or wrongly it is not necessary here to inquire, with this ancient and aristocratic Society. I do not suppose that much harm will be done either one way or the other; it is enough for my purpose to say that other societies have been formed, too numerous to mention, that some have flourished more or less—the majority I imagine less—some have died natural and some unnatural deaths, but still the College Youths, in name at least, exist. The aristocratic element of the Society has now, however, given way to respectable tradesmen, clerks in various capacities,

and skilled artisans (I quote Mr. Ellacombe's words)' with a very fair sprinkling of clergymen, barristers, and gentlemen of no occupation (but bell-ringing, I suppose). They, however, gave most practical proof of the good ringing qualities they possessed in 1862, by ringing on the 27th April in that year a true and complete peal of cinques on Stedman's principle, consisting of 8,580 changes, in a most masterly style, in six hours and forty-one minutes, on the noble bells of St. Michael's, Cornhill, being the greatest number of changes ever rung in that method on twelve bells. The number of changes which can be rung upon a given number of bells is something extraordinary, and should any of my hearers care to inquire into the mysteries of the art, I would recommend them to get a book called "An Intoduction to the Early Stages of the Art of Church or Hand-bell Ringing, for the use of Beginners" by Charles A. W. Troyte. He there gives as the number which can be rung on eight bells at 40,320, time required to ring, one day four hours.

On	9 bells,	362,880	Time	10 days 12 hours.
„	10 „	3,628,800	„	105 days
„	11 „	39,916,800	„	3 years 60 days.
„	12 „	479,001,600	„	37 years 355 days.

It is truly a most mysterious art. I have tried to master its intricacies so as to be able to write the changes for our chiming barrels, but at present have made very little progress. The book being only an introduction and for the instruction of beginners, what is to follow after must be wonderful indeed. I will read you just one chapter as a specimen. In chapter 4, Mr. Troyte says, "Having in the last chapter I hope explained the working of the Grandsire method, I now call the learner's attention to the most beautiful of all five bell methods. It is beautiful in its work and beautiful in its music, and once learnt, I think not much harder than the Grandsire method. It was invented by a Mr. Fabian Stedman, about the year 1640, and has since then become most justly popular among ringers. The great beauty of it no doubt consists in the two facts, that bells come to lead at back stroke as well as at hand stroke, and that double dodging is always going on behind. The foundation of the principle is that three bells should go through the three bell changes as given in chapter 2, while the other bells dodge behind at the completion of each six changes, one bell coming down from behind to take its part in the dodging. But it is not possible to ring it by this plan, therefore it is necessary to give certain further instructions, and before I do so, I wish to call the learner's attention to the fact that the treble is no longer the easiest bell to ring, but does exactly the same work as the other bells; this forms one of the great difficulties of the method." Then come the rules for Stedman's principle. The work of each bell is described as divided into three parts, viz., the quick work, the dodging, and the slow work, each being minutely described. He then goes on to say, "In short, and for the sake of making it easy for learning by heart, in coming from behind make 3rd's place, lead a whole pull, strike one blow in 2nd's place, lead another whole pull, make 3rd's place, lead one blow, make 3rd's again, lead another blow, make 3rd's again, lead a whole pull, one blow in 2nd's, and another whole pull, make 3rd's, and up (or out)." After describing more dodging in and out, half turns and whole turns, odd, even, slow, and quick sixes, he says, "I have now, I hope, expl.ined the following terms, and shall use them hereafter without further explanation:—

Quick work.	First and last whole turns.
Slow work.	First and last half turns.
The dodging.	Gong in quick.
Odd sixes.	Going out quick.
Even sixes.	Going in slow.
Slow sixes.	Going out slow.
Quick sixes.	

It is necessary that these terms should be thoroughly understood before the learner attempts to go further." I do not think any of us do thoroughly understand—I can answer for myself—and we will therefore take such sound advice and dismiss the subject, and pass on to another use to which church bells have been put, viz., for the playing of tunes upon them by machinery. These machines have been most aptly described as "rather rough, the barrel-end has a rope coiled round it, and it drives two or three wheels, ending in a fly, to regulate the velocity." This meagre description exactly conveying the impression of their meagre effects. There are many of them spread all over the country in various stages of decay. I will only mention three which have come under my own immediate notice. The first was, until the restorations were commenced, in full force on eight bells at St. Alban's Abbey. One tune after another had gone to rest, till at last "The Curly-headed Plough Boy" alone remained to tell his tale of past glories. He at last has been put in a corner, where some friends of mine, who live close to the abbey, fervently hope he will remain for all time. At Southwell, where there is a Minster second only to Lincoln Cathedral in interest as a specimen of early Norman architecture, there are chimes. Here the only remaining tune is "God Save the Queen," The last I came across accidentally at Kettering. There I could make nothing of the tune at all, and ceased to be surprised at it when told by an old inhabitant that I was no exception to the rule. He was the only person who knew that it was made up of the "Old Hundredth" and "Caller Herring," that they were the two last surviving tunes 20 odd years ago, that they had not been played for about that time till a few years since when the machinery was then put in order, and he supposed that in the interval they had got so inextricably mixed up together, that separated they could not be. He thought it would have been better to have left them alone. We did not disagree upon the point. No doubt there are many machines constructed upon the old principle which continue to play the music as well as ever they did, proper care and attention having been always bestowed upon them; but bad is the best. If any one should wish to hear a melancholy exhibition of what such machines of comparative modern construction can do, let him go and hear the Royal Exchange chimes play at 9 a.m. and 6 p.m. Can nothing be done to remove the reproach that the wealthiest city in the world, at its Royal Exchange, presents such a contemptible specimen of discord!

We now come to the more immediate subject of this paper, hemispherical bells, and modern improvements in the machinery for carillons and chimes, and I would wish it to be distinctly understood, that I do not for one moment desire to be understood to say that this shape of bell will supersede to any great extent the church bell shape, or that the power of the tone of one is to be compared to the power of tone of the other. In the hemispherical shape, a $4\frac{1}{2}$ cwt. bell will produce the same note as 25 cwt. in the church bell shape, and it is quite obvious that $4\frac{1}{2}$ cwt. cannot produce the same volume of sound as 25 cwt. Moreover, these bells cannot be swung. But what I do say is, and my firm have proved it in practice, that hemispherical bells can be used most advantageously in places and spaces of peals of eight and more, with all the machinery necessary to produce the required effects of change ringing, quarter striking, and tune playing, where the other shape could not have been used, first, for want of space, and, secondly, in many instances a most serious consideration, on account of the cost.

That they and our machinery will prove useful in providing for a want which has been greatly felt of late years, viz., the supply of bells and filling the place of ringers in neighbourhoods where they are not to be found, I have no doubt whatever; and I am also of opinion that a very large field for their use exists in towers and turrets attached to country mansions. Their sweetness of tone is eminently suited for this purpose, as all the charming effects of bell music may be obtained from them without the tinkling sheep-bell sound of light peals, or the impossible expense and overpowering sound at short distances of peals of the ordinary shape, sufficiently heavy and deep in tone to give good effects.

It is not proposed to enter in this paper into the question whether or not hemispherical bells are constructed upon scientific principles. I cannot really tell you upon what principle they are constructed. I have never put the question to the founders of them, for the (to me) satisfactory reason that I do not believe they would tell me if I did. At present I have quite enough to do to make use of them when made. All I propose to do is to give some information respecting accomplished facts with regard to them and the chiming machinery which we have made and are making, under the patent of Mr. Imhof, taken out on the 29th September, 1866—information which we have ventured to think may prove to be interesting to our fellow-members in this Society. From time to time we have applied them in isolated cases to clocks with invariable success, but it was not till 1870 that we had an opportunity of ordering a peal of 16 for a tower at Colonel Tomline's, Orwell-park, a few miles from Ipswich. Messrs. Mears and Stainbank, who have given great attention to the founding of hemispherical bells, cast them for us with the most perfect success. The smallest in the peal is 1ft. 4in. in diameter, and weighs 3qrs. 13lbs., from which they run down to the lowest in the peal, 3ft. $\frac{1}{8}$in. in diameter, which weighs 6cwt. 19lbs. The hour bell is 3ft. $6\frac{1}{2}$in. in diameter, and weighs 9cwt. 2 qrs. 5lbs. The peal is in the key of E flat, with two half notes, the key which we consider best adapted for bell music, and was the first of that number and size ever cast. The whole weight is about two and a-half tons, and the bells are arranged in two tiers of wooden bell-frame, the cranks leading to the machinery being placed in the centre of the two, and leading right and left. The whole is contained in a space 7ft. 9in. by about 11ft. high, tier above tier, each bell in its own compartment, so as not to interfere with or stifle the sound of its next door neighbour. When the bells arrived at the foot of the tower, it was unanimously considered by the builders' employés engaged on the estate that the tower would not hold them, but to the intense astonishment of every one, the bell-frame and the bells were all fixed in their places in less than a week, with two feet out of the nine unoccupied. Our first object in undertaking work of this kind is to see the place the bells are to go in, and then to obtain from the architect of the building tracings of the bell-chamber. We then design and carefully draw to scale the bell-frame and bells knowing approximately their dimensions, so that they are as good as placed, for all practical purposes of construction, in the tower before they are actually cast, and we are then able to state with the greatest accuracy what sized bells can be used. The facility with which these bells can be fixed in their places is one of their numerous recommendations. A hole is drilled through the crown $1\frac{1}{8}$ of an inch diameter, and through this and the cross-beam of the bell-frame which is to carry it is passed a bolt, secured by a nut and washers, and in this way each is fastened to its own beam, upon which are fixed the hammers and counter springs to prevent chattering in the blow, so that falling as it does from the centre of the bell, the full force of the blow of the hammer falls upon the bell. The machine which we manufactured and applied to these bells, chimes the Cambridge quarters the same as the Westminster clock, and plays one of seven tunes twice over or not at will, each third hour with one weight and one train of wheels, but does not strike the hours. A clock being already there, it was thought desirable to alter that for the purpose. It may be here observed that we are making, by gracious command of Her Majesty the Queen, a machine for St. Mark's, Victoria-park, which does all three with one weight and one train of wheels, a description of which I shall give later on. The patent, under which these machines are manufactured, is the sole invention of Mr. Imhof, and consists in the discharge of the hammer upon the bell by means of a pin in a wooden barrel, and the provision of a cam action to again raise it to the catch from which it was discharged; thus doing away with the difficulty which is experienced in preventing the wear of the pin in the barrel, and the end of the lever in the old principle, where the hammer is raised by the pin in the barrel acting upon the end of the lever to which the hammer is attached, and so lifting it and allowing it to again fall upon the bell, and strike the blow; thus from the very first, two defects from wear arise—the pin and lever both wear, and the time of the music and draught of the hammer are consequently affected. Mr. Imhof's plan is now universally acknowledged to be the only one suitable for the purpose of chiming machines, and has been applied

by Messrs. Gillett and Bland, of Croydon (the only persons besides my own firm who have a right to use it), to several large machines, notably at Worcester, Rochdale, and Bradford. No doubt many improvements have been made since Mr. Imhof designed the first machine, and I am sure that he most readily admits it, but at the same time the fact should not be lost sight of that to him alone is due the credit of inventing the separating of the discharge of the hammer from the lifting pin, and it is this which constitutes the mainspring of all the improvements which have been from time to time introduced. Messrs. Gillett and Bland (like my own firm) find it advantageous, I believe, to apply Mr. Imhof's system in combination with additions and modifications planned especially by themselves. I shall abstain from attempting the exposition of their methods in the hope that we may, at some future time, hear this much better done in a paper by one of themselves, which would not fail to be an interesting and valuable contribution towards the elucidation of my subject. I shall now proceed to give a description of the machine at Ipswich, and as I propose to show you the principal improvements which we have made from stage to stage of our progress, I must preface my remarks upon this part of my subject by referring to the first machine we made, which we do not now use. Its great defect—and one which invariably proves fatal to accurate time-keeping in any self-acting instrument which has rough work to do — is that the barrel is made to revolve by means of an outside driving-wheel fixed on to the main shaft of the weight-drum, and geared into a wheel of a similar number of teeth, and upon the shaft of which was fixed what is called the carrying arm, which carries round the musical barrel one revolution of the drum, this being equal to one of the barrel. Let the pivots of these two shafts fit the holes in which they work, and let the depths of the wheels be pitched as accurately as possible, and the working of the teeth one into the other be quite perfect tooth and space, and yet in a very short time wear will begin to show itself, the wheels will begin to rock, and the machine for time-keeping purposes becomes no better than one constructed upon the old principle. A barrel which can be set back by any unusual pressure cannot keep good time, for it not only retards the note which it is discharging, but with the spring it gets with the set back, it shoots forward to the next pin, and discharges it as much too soon as the last one was too late. This will be evident to the most casual observer. This machine is constructed to strke the hours and quarters, and to play a tune twice over every third hour with one weight and one train of wheels. There are three key-frames constructed in the same way as the key-frame of a self-acting organ, the key discharging the hammer on the bell instead of opening the valve as in an organ, as shown in diagram No. 5. Two are for the music, and one small one for the quarters, placed for convenience and saving of room in the centre of the two. They are all connected together, and are so arranged, that when the two are down, playing the music, the quarter frame is lifted, and the pins in the barrel cannot touch the quarter keys, and *vice-versa*, the quarter frame being down, the music-frames are up; the striking of the hours is also ingeniously arranged for, but to this I shall refer later on. As previously stated, we have abandoned the driving of the musical barrels by outside wheels, and now always drive them direct from the shaft, upon which the weight-drum works, and to which is fixed the main wheel of the machine, by making it project sufficiently through the bracket in which it works, to allow of the carrying-arm being fastened to it. The carrying-arm is, as its name implies, that part of the machine which gives motion to, or carries round, the musical barrel, the main shaft passing into the centre of the barrel, and the carrying-pin also entering it as near to the outer circumference as possible, both being accurately fitted, and the action of the barrel being only backwards and forwards. Not being circular, the wear, even in the course of years, is very trifling, and can be rectified at any time by simply putting a new back brass to the barrel. This was the first great improvement. Our next endeavour was to avoid, in the striking of the quarters, so much loss of fall of weight, one turn of the barrel, equal to a fall of 2ft., being used for the striking of the quarters in one hour alone, in the first machine. We therefore separated the quarter barrel from the musical barrel, making the quarter barrel revolve only twice for the quarters of three hours, thus saving one turn, equal to two feet of fall, every three hours, equal to a saving of sixteen feet in the twenty-four hours, an enormous saving in such matters. In this machine, as in the first, the catches are released by a key in a key-frame, and a difficulty presented itself. How could we get over the pins discharging the hammers for the music at the same time as the quarters, without lifting the key-frame, which is very heavy and cumbersome to deal with? We soon decided that a simple plan was to keep the musical barrel still, till required to play the tune, by holding it free of the carrying pin in the carrying-arm, and successfully accomplished it in this way. Instead of having a spring to bear on the end of the pivot of the barrel, we substituted a weight working over a pulley, and attached to a lever, by which it can be lifted or allowed to fall according to whether the barrel is required to revolve or not. We put a spring at the other end of the barrel, where the main-shaft enters, so that when the weight is lifted this spring pumps the barrel away from the carrier, and it is held in the proper position for the pin to pick it up again the next third hour by a piece of steel in its outer edge entering a notched piece of iron. The weight when raised is held by a catch, which is withdrawn just before the last quarter change at the hour is being struck, by a pin in the quarter barrel. It then falls, and brings the musical barrel to bear against the end of the carrier pin till it reaches the notch cut in the brass rim, arrived there the machine stops, the barrel is drawn by the weight to the proper depth, according to the tune to be played, and it only awaits release from the clock at the last blow of the hour to start and play a tune through twice. This having been done, the weight is again raised by a small roller in the main wheel of the machine, and the barrel remains at rest for three hours more. There are seven tunes played, a different one at each third hour or not at will; and here again the small barrel plays a

simple, yet most important part. The tunes are changed by shifting a seven-star snail, as in an ordinary musical box. This snail is shifted by a double action lever. A small roller is fitted to the carrying-arm, which at each revolution comes in contact with the "V" shaped end of the lever, presses it down, and so doing, raises the other end of the lever, which in its turn shifts the snail. To prevent this being done the first time round, a short spring lever is made to hold the pushing end of the snail-shifting lever away, and it is only when it is required to change the tune that a pin in the quarter barrel withdraws the spring lever and allows the lever to work. The shifting lever end is made with a joint, so that by simply withdrawing it from contact with the snail the tune is not changed, although the spring lever may be withdrawn by the pin in the barrel. The quarter barrel thus performs four distinct functions. It strikes the quarters, stops the machine when required by a simple action—which I have thought it needless to explain—causes the music to be played at the proper times, and changes the tune or not, as desired; thus making it an automatic machine, it only being necessary that a small weight should be lifted by the clock and allowed to fall at each quarter of an hour, by which the machinery is started for the quarters, and a similar weight each third hour for the music. In the one case, the weight is raised by four pins in a gun metal wheel fixed to the minute square of the clock, and in the other, from the locking plate which regulates the striking of the hours. The improvements sought for in the construction of our next machine were these—to do away with the key-frame which we thought unnecessary, both on account of the expensiveness of its manufacture, and the drag we found it was upon the machinery. The discharge was not as easy as we could have wished it to be (although the machine still works admirably), and other minor details, such as to reduce the weight of the cam, to do away with the hammers having to drag the weight of the levers after them, and so reducing their force of blows; and in other respects to give the machinery more life, or more properly speaking, velocity, which performs a most important part in this machinery, the two main considerations being an easy and quick discharge, the most rapid lift attainable, so as to have as few hammers as possible on the lift at one time. The machine I am now about briefly to describe, has been made for, and is now in course of erection at, High Beech Church, Epping Forest, to the order of T. C. Baring, Esq. There are thirteen hemispherical bells in a tower nine feet square, and the machinery is placed in a room below. In a space of only nine feet square it would have been quite impossible to have got church bells of any size or of a sufficient number, and ringers could not have been found to use them. Hemispherical bells here exactly supply the want, and in making the machinery we desired that it should be no mere approach to the speed of changes as rung by ringers, but the exact speed should be given.

Ringers ring 28 changes per minute, which is 224 blows in the same time, each change being 8 blows on 8 bells, and in order that not more than one hammer should be on the lift at once it was necessary to have a cam of that lifting power. The main wheel makes a revolution once a minute, consequently the discharging barrel which it drives from its shaft, as before described, makes a revolution in the same time; and to produce the needful correspondence between our wheels and pinions, and to give the proper interval between each pair of changes, exactly the same as ringers do, it was necessary to make our cam revolve 60 times to its once, and having four lifters, four times sixty (240) blows can be lifted per minute, more really than is required. I may here say that before making this machine we made a smaller one, which we here exhibit, and which we have had in use for some time. The heaviest hammers to be lifted are about 20 lbs., for which the machinery need not be large. For larger machines we have plans of a more powerful description, which we do not propose here to explain, suffice it to say that, be the weights what they may, we are prepared to deal satisfactorily with them. Having disposed of the number of hammers to be lifted, our next object was to do away with the unwieldy key-frame, and make a key and catch-all in one, which should be quite easy of discharge and yet have holding power to its extreme point of discharge. This was not arrived at without much thought, one amongst many difficulties being to put them in such a position that the wooden barrel could be removed without disturbing them. This has been quite satisfactorily done, a catch has been constructed with all the requisite qualities in itself, and has been put in such a position that the barrel can be removed in a moment. We also here introduced a great improvement in the spring which draws in the pusher, by which the lever, to which is attached the bell hammer, is raised again to the catch which holds it. When the catch is discharged and the lever falls, it is of course necessary that the lever should not be again raised until the blow is struck upon the bell; and in order to do this, what we call a pusher, or cat's-paw, is attached to the lever, working freely on it, which is drawn into contact with the cam at the last moment in this way. It is, of course, a well-known mechanical law that there is much less action at the centre upon which anything works than at its extreme end. We therefore place a spring on an iron bar, which does three things. While the lever and hammer are held up, it keeps the pusher against its banking pin; as the lever falls it keeps it pressed away from the cam till the last moment, when its bent end comes in contact with a corresponding projecting part at the centre of the pusher and so draws it in contact with the cam, the next coming lifter of which lifts it to the catch, firmly held by which, all the weight of the hammer being gone from it, it flirts the pusher away to the banking pin till again discharged, when the process is repeated. Originally three separate actions were provided for this purpose. We consider these two improvements to be of the most important character, both as regards cost and efficiency. Other improvements were made, but not of sufficient importance to be referred to. It has two barrels, one of which has 296 changes on eight bells pricked on it, which will be used from 10.30 till 10.45, at which time that barrel will be taken out and one with 110 changes on 10 bells, three bell chimes and tolling, used at the discretion of the

verger. A barrel can also be applied by which the hours and quarters can be struck the same as at Westminster; or, still further, a 7-tune barrel could be made, by which a different tune could be played through twice, at each hour, or the same at will, if the quarter-hour striking were found wearisome. To remove the barrel, all that is necessary is to move the spring which presses on the end pivot on one side, draw the barrel a little to the left, and out it comes free of everything. There is also a key-board attached, by which Mrs. Baring can play on the bells as easily as she can play on a piano. This machine, therefore, is applicable for four purposes, chiming for the services of the church at any time, the striking part of a Cambridge quarter-clock, the playing of seven different tunes automatically, or a musical instrument to be played by hand. Some of my fellow craftsmen here this evening may perhaps be sceptical, and say that I have as strong an imagination as the man who used to warm his hands by holding them round a candle-flame, but I can assure them it is quite true, and that I may perhaps have some further astonishments in store.

All our machinery is so constructed that any one part can be taken out for repair without disturbing any other, and even to every lever, and every catch up to any number. The advantage of this plan was fully demonstrated in this way. After the machinery had been fixed at Ipswich some short time, I had left it at nine o'clock on the Saturday evening, after it had chimed the quarters and played its tune twice over, and upon my return, at nine o'clock on Sunday morning—of course you understand that I was only there to see all was right—to my great dismay I found that the heavy rain of the night before had run through an unstopped hole in the lead floor of the bell-chamber above, and that the machinery was most carefully watered all over. Of course by Monday red rust was everywhere where I had not been able to wipe it off the day before. A workman and myself began at seven o'clock on Monday morning. It only missed striking the quarters for two hours; it played as usual each third hour, and was as free from water and rust as ever it was by six o'clock the same evening, much of the steel work having been re-polished. Had it been needful to take all the machine to pieces at once, three days at least of silence would have been necessary.

It now only remains to explain the arrangements we have made in the larger of the two machines before you for the several actions it has to perform. It will chime the Cambridge quarters, and strike the hours (the same as the Westminster clock), and will play one of seven tunes every third hour, to be changed or not at will, as described in the others, with only one weight and one train of wheels. Clock-makers have always, hitherto, used three weights and three trains of wheels for the same purpose. It will also be used for chiming for the services of the church of St. Mark, Victoria-park. As you see, there are two wooden barrels; one, the shorter, chimes the quarters and strikes the hours, and the longer will play the tunes or changes. The smaller barrel makes fifteen revolutions in twelve hours by means of a fifteen-step snail, which is shifted one step forward by a carrying-arm and double-action lever, once each turn, the same as used for altering the tunes, and before described. The quarters are also struck from it by means of keys and levers, connected with the four proper notes on the music side of the machine. By it are also struck the hours by a key and lever action, drawing in the hour-hammer lever in contact with the pins in the back of the main wheel of the machine, and holding it there sufficiently long for one or more blows to be struck on the bell, according to the hour. Immediately the last blow is struck, the spring, against which it was drawn, throws the lever out of the way of the pins, and at each third hour a weight is dropped, and the musical barrel pushed in, it having stood still during the striking of the hours and quarters, as already described in the Ipswich machine. We have, however, greatly improved and strengthened the catch which holds up the lever to which the weight is attached, and have made the lever to fall free of the lifting pins in the face of the main wheel, so that by removing the jointed end of the snail shifting lever, and moving forward the small-barrel snail to a step in which there are no pins, as occurs in that part of it which comes into action each third hour, changes or music can be played for any desired length of time, without the weight being raised, and the barrel being pushed out of action, after the second time round, as it would be in the ordinary way. In the Ipswich machine the shorter wooden barrel is a three hour locking plate for hours and music only; in this it becomes a twelve hour rapidly revolving locking plate, for hours, quarters, and music, than which there is no simpler or safer mode of stopping in clock work or any self-acting machinery. A slow one is, however, very little use. In the intervals defined by this locking plate pins will be put which will either act upon the four quarter keys, the hour lever key, or the key which discharges the weight for the playing of the music, and causes it to be raised again when it should cease, one key serving both purposes, according to whether quarters or hours are to be struck or music played.

Messrs. Charles Frodsham and Co., Her Majesty's clock makers, are making the time-piece which will show the time on the three dials, and start the machinery every quarter of an hour. We are also engaged upon the manufacture of a smaller machine for ten small hemispherical bells, the stable turret into which they will go being only 4ft. 6in. square by 8ft. high, which, with change of barrel, will either strike the hours and quarters, or play one of seven tunes twice over every hour, or as often as desired; a key-board for playing by hand will also be added. We are also planning a Cambridge quarter clock, which will only require one weight instead of the two ordinarily used, for a larger tower, hemispherical bells again carrying off the palm. The advantages which we claim for our method of carrying out this patent are:—Extreme simplicity of all the parts of action; lightness of all the several parts, yet perfect strength and durability; high finish and accuracy (and upon this point we are most particular, as, failing this, in self-acting musical instruments all else is labour in vain); absolute steadiness and ease of discharge, by which perfection is obtained in the music or changes, or whatever work the

machinery is called upon to perform; rapidity of lift, by which multiplicity of hammers is avoided and weight saved; ease with which repair can be done to any one given part without disturbing the machine as a whole; and last, but not least, cheapness, not the cheapness which is obtained by inferiority of workmanship, but cheapness which is obtained by simplicity of action—not using three actions where one will do because our ancestors did it that way three hundred years ago, and therefore it must be right, and, consequently, saving material and labour which make the cost.

DISCUSSION.

After a few words from **Mr. Botly**,

Mr. Ward said he doubted of the good effect of perpetually recurring chimes in a city, where they were disturbing rather than pleasant.

Mr. Hale then made a few observations.

Mr. John Lund remarked that, although he had but very few remarks to make, standing as he did in the relation of a brother to the reader of the paper, he could not help bearing his testimony to the patience and skill his brother had shown during the whole of the long and weary time he had spent over this machine. It had given him many sleepless nights and many a long day of anxious care to produce the machine that stood before them, He could testify to the simplicity of the machine, and to the remarkable results he was able to produce from it. As to the recording instrument at Greenwich, whatever might be the accumulated errors of the instrument, it could never interfere with the little black spot which recorded what the error was. He felt there was only one more great step to perfect the machine, and that was the application of electricity to the discharge, which would leave the machine nothing else to do but the lifting, the discharge always being given by electricity. The machine might be reduced very largely indeed then, and put up in one corner of the room, where the bells themselves were played.

Mr. Ellis A. Davidson asked the opinion of the writer of the paper as to the effect of an inscription on the bells. It would be clear that the horizontal section of the bell would be a circle at the plain parts, but materially altered at the part where the inscription was. He desired to know whether a hemispherical bell, in its pure and simple form, would give a sound more power than it would if it were embossed at unequal parts by unequal projections. If the name of Lund, for instance, were put on the bell in a three-inch letter, and a quarter-inch high, then if he took a horizontal section, that section would not be a perfect circle as at other parts. Would that interfere with the sound?

Mr. Lund replied that he really did not pretend to understand the scientific part of the question. He, however, knew that the name of the founders was generally inscribed all round the bell, and the note was produced quite perfectly.

The Chairman said it became his duty to ask those present to join him in a vote of thanks to Mr. Lund for the very interesting paper he had read. He thought it would be apparent to all that it had been a labour of love to him, and that he had brought to the subject a great amount of patient labour, attention, and scientific skill. As to the last paragraph, they must have all felt the soothing influence produced by a chime of bells, and many were the sweet recollections the village bells recalled to most of us. He agreed with the speaker who remarked that some bells in London were felt to be a nuisance, but even in London many people liked to hear a chime of bells. As to young beginners, he thought they would be deterred from commencing the study of change-ringing by the description of Mr. Lund. He would say, even if he had an inclination at his time of life to commence a new study, what had been stated was more than sufficient to deter him, and he would rather prefer commencing the study of Hebrew or Sanscrit. He asked them to join with him in sincerely thanking Mr. Lund for his paper, and in congratulating him, after the years of labour he had bestowed, on the satisfactory results he had produced. He could only express a hope that those labours and the intelligence he had shown might not cease, but that they might be dovoted to some other work in the same branch, which might tend to be useful to both science and art.

Mr. Lund in reply said:—I rise to thank you, ladies and gentlemen, for the kind way in which you received my paper. I can assure you it has been a very great pleasure to me to come here and read it.

The vote of thanks was then passed.

CANTOR LECTURES.

The sixth lecture of the second course of Cantor Lectures for the session, "On the Chemistry of Brewing," by Dr. Charles Graham (University College, London), was delivered on Monday evening, February 23rd, 1874, as follows:—

Lecture VI.

At our last meeting I called your attention to the subject of cooling, and pointed out to you that there was a precipitation which occurred during that process, due to two causes. In the first place, it was due to the action of cold itself, and secondly, to oxidation. I attach some importance to this matter, because we shall see it has some bearing upon the slow fermentation process. I then pointed out to you that in the old system of cooling the temperatures between 75° and 120° were especially dangerous, because the conditions were favourable to the production of lactic acid, and I showed you how this lactic acid might be formed from sugar without the intervention of any living organism. Fortunately, most of these dangers are removed by those admirable instruments called refrigerators. I then referred to the subject of fermentation, and I shall briefly recapitulate what I then brought forward before your notice. I showed you that the theory that was formerly most general, and still has very many advocates, viz., that of physico-chemical action, was advocated by Liebig, and supported by other eminent chemists. That theory asserts that, where you have got one molecule in a state of unstable equilibrium, it imparts that disturbance of equilibrium to an adjacent molecule, and so Liebig accounted for the decomposition of sugar by the oxidation of albuminous matter. Hence, therefore, according to that school, vital organisms are not necessary for the purpose. The other theory started by Schwann in 1836, asserted distinctly that fermentation is a phenomenon of life. Although sugar may be converted from starch by means of albuminous matter or of dilute sulphuric acid, and although acetic acid may be formed from alcohol by means of oxygen and platinum black, and although lactic acid may be oonverted by a simple inversion of the sugar, yet as regards the question of the formation of alcohol from sugar, hitherto at least we have found no chemical or physical means by which that decomposition can be produced. And Pasteur, I think, has shown, at any rate so far as organisms are concerned in these different actions, that he is correct. I then went on to point out to you that the fermentations were minute organisms, and drew your attention to the cellular forms, which I spoke of under the term of *torula*, and I also drew your attention to the *bacteria*. Now, we do not know the exact function of each of these minute organisms, but so far as the beer *torula* is con

cerned we know its functions tolerably well, and so do we as regards the chemical functions of some of these *bacteria*. This drew us naturally to the consideration of the especial importance that ought to be given by every practical brewer to the use of a very important instrument for the purpose of distinguishing the *torula*, which he requires, from these minute organisms—these *bacteria* —some looking like straight tubes, others like figures of 8, and others like long or short chaplets or rosaries. I asked Mr. Crouch, 66, Barbican, who has made various instruments for Dr. Carpenter, Professor Foster, and other eminent microscopists, to supply us with some microscopes for the purpose of examining the different samples of yeast that were supplied by different brewers, but, unfortunately, he was so much afraid of using powers too high, that he did not avail himself of the full means at his command, and not only so, but he had also binocular instruments which are ill adapted for high powers. I have here to-night an instrument which I have asked him to make for my own investigation with reference to these lectures, and I shall be very happy indeed, if any of you contemplate purchasing an instrument for this purpose, to point out its particular advantages. You will find that the magnifying power which I now have on, which is a $\frac{1}{8}$th with deep eye piecing, gives a vastly greater increase than any instrument you saw at our last meeting. I suggested to you then a process by which you might in a rough way determine within some twelve hours the respective energies of various samples of yeast. Now, upon the purity of yeast depends of course the goodness of your beer. The yeast is employed in the English fermentation process as a filter. You remember when you cool the worts now by means of these artificial refrigerators, there is no longer that partial deposition of tannate of albumen and albuminous matters which used to occur in old times with the open coolers. The whole of these foreign matters are placed in the fermenting tun, and you trust entirely to the activity of the yeast to get rid of these impurities. In so doing you render your yeast more and more impure, so that it is necessary to reject the first portion of the yeast crop. You should ferment at a low temperature at any rate for a part of your yeast crop, and you should keep the yeast, as I pointed out, perfectly free from acidity, that is from acid ale, and it should be washed, pressed, and kept cool. I then went on to consider the nature of the chemical changes that take place owing to the action of these minute organisms, and I showed you that in addition to carbonic acid and alcohol there was also succinic acid, discovered by Schmidt, glycerine, discovered by Pasteur, and that aldehyde and acetic acid, which had been for a long time suspected by many German chemists and brewers, has been proved to exist by the valuable researches of Mr. Brown. He has proved that, in addition to aldehyde and acetic acid, which are always formed in small quantities, there are also the two gases, hydrogen and nitrogen. Finally, when all these changes have been produced, the cell dies, and its albuminous matter and cellulose matter tend of course to render the gyle impure.

Now, as regards the phenomena, observed in looking at a fermenting tun, after the addition of the yeast, in a few hours you notice the scum rise. The next stage would be the production of a large and vigorous crop of yeast, yellow and brown. This is mainly due to the decomposition that has occurred of the peculiar glucose compound with the resin of the hop. As the glucose is broken up and forms alcohol and carbonic acid, so the resinous matter which was previously associated with the sugar is now liberated. After a time the fermentation, still going on vigorously, is attended of course with an attenuation of the wort. No very accurate or delicate experiments have yet been undertaken in order to prove distinctly the relation that exists between the amount of chemical work done and the increment of the cells, but this I hope beforo long will be cleared up. This amount of attenuation in our own country proceeds to the extent of about two-thirds of the original gravity of the wort; in some cases it is even carried down to three-fourths. The Germans do not carry it so low. The amount of work done depends of course to some extent upon the amount of yeast produced, and the amount of yeast production varies with a number of points or factors of the fermentation itself. In the first place, upon the temperature; for the higher the temperature within a given range, the more active of course is the production of these cells; it depends also upon the amount of hops used, the less hop the more vigorous the cell growth and chemical decomposition. It depends also upon the amount of glutinous matter found in a soluble condition in the wort. It also depends upon the amount of kiln drying to which the malt has been originally submitted, and lastly, it depends on the actual reproductive energy of the yeast cell itself.

Now instead of seeing a vigorous yeast crop going on steadily, we occasionally observe that the fermentation flags; and various plans are adopted to overcome this difficulty of the fermentation standing still. One of the simplest plans is to add more yeast, but probably enough yeast may have already been added. The other plan which is very much used is to add some ground malt. Now in adding this, we supply a large quantity of soluble albuminous matter, and the probabilities are that the action of the ground malt is of this kind, not that it supplies sugar, because there is enough there, but that it supplies the yeast with a quantity of readily assimilable albuminous matter. Occasionally, those who use ground malt also add salt at the same time, but as salt is considered to be rather adverse to fermentation, and though I know it is very often done, I myself do not understand the rationale of the process.

Finally, this stage being over, the yeast of course would subside, and were not precautions taken it would sink into the wort, and in so doing would produce what is called "yeast-bite," which is due to the action of the alcohol formed, not upon the living, but upon the dead cells, and upon the resinous matter separated out in the decomposition of that glucosate which I have spoken of.

The stage that we now come to is the process of cleansing, but before speaking of that it will be perhaps well if I allude to the fact that fermentation goes on sometimes so vigorously, that the temperature which is produced by the decomposition of the sugar is too high. The increase of heat if unchecked would be too great. That is reduced by the use of very simple appliances, cold water is run through pipes, and in that way the temperature is kept down; and not only by that means, but by the removal of some of the active yeast itself; in other words by the very process which tends to cleanse the ale. I will briefly refer to some of the variations which occur in the English process, and then I will take up the Bavarian system.

First of all, as regards the London method of fermentation, or I should say methods, because there is no one method employed in London. The fermentation as a rule is started at a temperature ranging between 60° 62°, or even up to 68°, and as a rule it is carried on in fermenting tuns. Some of these are open, and some are closed, and this question of having open or closed tuns has not only a connection with the old question whether it is better to keep the tun closed in order to prevent radiation or not, but now in the days of the germ theory it has an additional interest. I think perhaps on the whole, where you are working in a room not too liable to action of the outside changes of temperature, the open tun is quite as good as the closed one, because the tun is really closed with carbonic acid, and whether you use an open tun or a closed tun you must in either case be equally careful that there must be a covering of carbonic acid to prevent the action of the air on the products formed. The tuns are usually made of wood, and that as you know is a very

pervious material, and there are considerable difficulties in keeping the wood free from impurities that gradually soak into it. On a previous occasion, I suggested that you should saturate the pores of the wood with paraffin wax, but I have not heard whether any one has tried that for fermenting tuns, though I know some have done so for their barrels. Another material has been introduced lately to some extent, and that is slate, and it is a very excellent material, the only drawback being that for large vessels the weight is enormous, and you require very strong iron work to support it. Stone has also been used, though not, that I am aware of, in London. Perhaps there is no material that would be equal to glass, in every point of view, provided we could find out some mode by which we could put a thin layer of glass upon a wooden tun; but I have no doubt the ingenuity of some one will be able, before very long, to give us glass fermenting tuns, because such would be less liable to impurity than any other material that I know of.

As regards the tuns used at present, I cannot recommend you a better material for cleansing them, whether they be of wood, uncovered, or protected in any way, than a mixture of chloride of lime and burnt lime. You may use it very safely, for no one has yet taken out a patent for it, and if, after it has burnt up and destroyed the impurities, you wash the vessel thoroughly, you will find no better material.

As the fermentation goes on, there are a number of different modifications employed. In some cases, the fermentation is allowed to go on in the tun itself for a period of six or seven days with occasional periodical skimming, and after the fermentation is perfect and complete there, it is run from the fermenting tun into the barrel, where the after process goes on. Another method is, not to carry on the fermentation so long in the original fermenting tun, but merely to skim it a few times, and then to run it off into a cleansing square. This plan is liable to great danger. If you carry on the skimming process too far, you run your gyle into the cleansing square in a sort of dead condition, and it takes some time before it is covered with a layer of carbonic acid; and it is necessary that it should be so covered in order to prevent injury to the alcohol that has already been formed. But not only so; the process is a dangerous one in the South of England on account of the high temperature that we usually have, and it ought not to be adopted when we cannot secure a low temperature. Another and a much more general method is to use pontoons, or cleansing rounds as they are called, such as may be seen at Messrs. Truman and Hanbury's, where there is a very long room filled with these cleansing rounds, all made of slate. Formerly these used to be, and they are to a great extent yet, made of wood, and the operation of cleansing the beer from the yeast goes on in these rounds or pontoons. By dividing the wort into a number of small portions, of course you will have lowered the temperature, and not only that, but you enable the portion you put into each of these cleansing rounds, which only amounts to a few barrels, to throw off a greater amount of the yeast that is still in the gyle. The process is finished by the ales being finally put in the barrels. After a day or two the ale may be consumed.

Now as regards one or two points connected with the London system, it seems to me that as a rule the temperature of pitching the fermentation, and the temperature to which the fermentation is carried, is very high. A high fermentation cannot but favour those little organisms, the *bacteria*, and so it comes to pass that the yeast becomes more and more impure, and the ales or porters fermented at such a high temperature must be less adapted for store purposes. I have under this microscope a sample of yeast that was taken from a fermentation near London, where the temperature at cleansing was 87°. Now, not only do you injure the yeast, but at the same time you set up the very conditions necessary for the formation of lactic acid and of acetic acid. I pointed out to you, last Monday, that Mr. Brown proved that a reduction of pressure was attended by an increase of hydrogen, aldehyde, and acetic acid. Now an increase of temperature is very much the same in its chemical effects as a reduction of pressure.

I will pass on now to another process of carrying on the fermentation, namely, the Burton process. They set their fermentations at a temperature of 57° to 58°, and in no case is it allowed to go higher than about 70° to 72°. It is kept down below that point, and when the fermentation has been carried on sufficiently far, so that attenuation is low enough, it is run into a number of small barrels very much resembling in principle the rounds I spoke of just now, only they are suspended on their axes, and they are all united together, hence the term "union" has been given to that particular method of cleansing in barrels. They each hold about three or four ordinary barrels, and they are filled all at one time by means of pipes. The process goes on in the same way as in the other method; the yeast is driven out, and in being driven out it is sent up a long pipe, which is bent round, and the yeast is passed into a long trough, called the yeast trough. From the form of these rounded pipes the term "swan neck" has been given to them; they are some three feet long. Hence the fermentation is carried on under a little additional pressure, and to that extent the fermentation probably must be better, since we have seen from Mr. Brown's experiments that pressure has a great influence on fermentation. The amount of beer that has been carried away is kept up of course by a constant supply; there is a small reservoir at the end of the room, and this keeps the beer in the whole of these unions at the same level. After the action is completed, the ale is then run into the smaller barrels and placed in the cellar, where the after process of slow fermentation goes on. The advantages of this Burton process are that you are working with a smaller quantity. You are working under a slight additional pressure, and at a low temperature; and whatever our personal opinions may be as regards mild ale, bitter ale, old ale, or new ale, still I think we must all agree that as regards the particular production manfactured at Burton, it is, from its power to withstand climate, one of the best ales we produce, and certainly for an alcoholic beer (for it is highly alcoholic), I myself do not know its superior anywhere. But the objections are that you have a great amount of apparatus, a great number of pipes, a large quantity of plant, and by this system of cleansing in a number of little vessels you naturally have a greater amount of waste. The least waste of all perhaps occurs in the system where you ferment and cleanse by skimming only, and then run the beer straight into the small barrels. The more you subdivide it, and especially in the particular way in which it is carried on at Burton, the greater amount of waste you have, but the product is very excellent.

Another system, which may be called the Scottish system, is as follows:—The temperature of setting the fermentation in the olden times used to be 55°, sometimes even lower, but the influence of competition and the necessities of the trade have gradually driven the brewers one or two degrees higher, and the temperature at which they pitch now is about 58°, and they also endeavour not to allow the fermentation at any time to get higher than 72°. It is carried on for a few days in large fermenting tuns or squares, and is afterwards let down into cleansing squares. In these, which are underneath, the temperature is low, and of late years, in order to keep it low even in the summer time, attemperators are placed in these shallow settling squares. But the Edinburgh or Scottish brewer takes care that his yeast, or rather that the gyle shall not be dead when he runs it down there, that it shall be active, so that in a very short time the gyle is covered with a layer of carbonic acid. The temperature best adapted for that process is about 55°. Here we have

very much the same kind of conditions which one finds in the Bavarian system. The process goes on slowly; there is a gradual oxidation of the albuminous matter, and this is brought about not by the oxygen of the air, but by the decomposition of the water itself. The water is decomposed, and the oxygen goes in the main to oxidise the albuminous matter, whilst the hydrogen is liberated as such, or tends to form other products. The Scottish method of a very low pitching heat, and this method of cleansing in the open, as I may call it, at a low temperature, is remarkably successful in producing ales that will stand climate well. The plan is excessively simple. There is no large quantity of pipes and tubes, and at the same time there is very little waste. The amount of acidity produced is very slight indeed, for the temperature is too low to form lactic acid, and acetic acid cannot be formed under these particular conditions.

In the north of England a very interesting method is employed, called the stone square system, by which we have in the same apparatus the fermenting arrangement and also a cleansing arrangement; of course so have you in the ordinary square when you employ a parachute skimmer. The Yorkshire stone squares are made of stone, as the name indicates, very strong, thick, and heavy. Inside there is another smaller square, which has at the top a small man-hole, so large that a man may readily enough get down and cleanse the interior of the chamber. There is here on this diagram a small valve, and after the stone square is filled, or nearly filled, the fermenting goes on in the usual way, and the yeast is driven up through this man-hole on to the top. There the yeast, along with some of the gyle, flows over and lies on the top. At first, from time to time the valve is opened, so as to allow it to run back again into the main fermenting chamber, and from time to time they are in the habit of putting a pump down the man-hole, so as to "rouse" the fermentation. They pump up the gyle and yeast to the top, and in that way they bring it in contact with the air; for they hold that the contact with the air stimulates the proper growth of the cell, and doubtless it may stimulate the oxidation of the albuminous matter. After the fermenting process is sufficiently carried on, it is finally left to rest here, and then the solid yeast is driven up over the man-hole and rests on the top, from whence it is readily enough removed, and finally, when the process is completed, the ale is run off from the bottom into barrels. In this form of apparatus a large quantity of yeast naturally gets shot in under this flat top, and towards the end, when the yeast becomes denser and more viscous, it of course tends to settle down and to produce yeast bite. It occurs to me that this very admirable system might be improved by simply giving a slight inclination to the upper surface. In addition to that, if a large stone weight, nearly the size of the man-hole but not quite so large, was allowed to press down at the end of the process, you could in that way force the liquid up and keep the fermenting chamber full, and in that way you could perfectly well cleanse the beer in much the same way as the Burton brewers do by means of their reservoir. The method is a very good one, but I think it must be very expensive, although at the same time, as stone is used, it is less pervious to impurity and more readily kept clean than wood.

Abroad, the fermentation of beer is carried out in the main upon what is called the "bottom fermentation" principle. The tuns in the Bavarian system are all placed underground, in order that the temperature may be kept equal, and in addition to that, they are surrounded with large quantities of ice. I have seen a large fermenting cellar in which there was at least from 8,000 to 10,000 tons of ice placed around it. The object of this is to keep the temperature low, and it is always kept as low as 40° Fah. They are also particularly careful in their attention to the purity of air, and the air is removed from time to time with a view to remove the small spores that are given off from the yeast *torulæ*. They are no less careful to keep the walls thoroughly clean. The temperature at which they set their fermentation varies slightly, but not more than 2°. The lowest is about 42°, and perhaps the highest 44° or 45° Fah. The ales that are intended for quick consumption are sometimes pitched at about 48°. Now the "bottom" yeast which Bavarians employ, is very much the same as the English "top" yeast; there is no essential difference, the yeast-cell, perphaps, is slightly smaller, and as a rule is ovoid. The amount that they add depends on a number of circumstances, because their yeast also varies in power. It varies because it may have been left to the action of the air, and consequently, therefore, oxidation may have set up. The only effectual remedy for that is to throw it away. The second cause of injury is sometimes overwashing, but that is readily enough cured by supplying the yeast with some strong wort, because, although the parent cells may be weak, yet the offspring are active and vigorous, and then the supernatant gyle is used to ferment with. Occasionally the yeast may be rather inactive from overhopping, and the plan they adopt then is to ferment with unhopped wort. The amount that they add varies from seven or about eight litres to twelve for every 4,000 litres of wort that they use. They apply the yeast, generally speaking, in the same manner that we do, simply mixing it with a little of the wort and then supplying that to the remainder. Another plan is to take a portion of the wort, add the yeast to it so as to start fermentation, and after that has gone on about twelve hours, they then add that to the remaining wort. The object of doing so is that they may use as little yeast as possible. The phenomena we would observe in a Bavarian fermenting tun—and their tuns are very much the same as those at Burton, simply a deep tun or barrel—are these, after some twelve hours one would notice the formation of a little carbonic acid. Of course that which is formed at first is absorbed, and as the temperature is very low, much more is absorbed than with us. In some 24 to 30 hours a scum is formed, and then 12 or 15 hours later, there is thrown up to the surface a light yellow or brown yeast, containing the resinous matter of the hops, together with many of the dead cells. This is very carefully removed for the purpose mainly of keeping the yeast pure. After this the fermentation goes on much more slowly and regularly, and the carbonic acid is given off in very minute bubbles, hence therefore the cells do not rise to the surface, but sink to the bottom. The process goes on for some 10, 12, 14, or 16 days, and in some rare cases of very strong ale, at a very low temperature, I have known it as long as three weeks. But as a rule, it lasts some 12 days, and the attenuation at the end of that time is carried to about the extent of one-half the original gravity. Therefore they do not attenuate in their first process so low as we do. Having completed the action in their fermenting tun, the gyle is run into a large store barrel, and here the sugar and dextrine of the wort are gradually used up by the yeast cells and converted into carbonic acid. I say, *and* dextrine, because the sugar of course breaks up readily enough into carbonic acid and alcohol, but dextrine is a much more inert body, and if you were to attempt to ferment your dextrine without the addition of sugar, the probabilities are that you would fail, even supposing that you supplied it with proper albuminous food. Dextrine, however, although very inert and excessively obstinate to yield itself to the alcoholic decomposition, yet in the presence of grape sugar does so break up, slowly it is true, but still it gradually breaks up and supplies alcohol and carbonic acid. One of the most remarkable points that you would observe in going into the cellar of the Bavarian brewer, would be to see that on each large barrel or fermenting tun—they are not very large—you would notice a manometer, or pressure gauge. The barometer is also found in each brewery, and of course the thermometer, and the brewer every day as he passes along notices, not merely the atmospheric pressure, but also the internal pressure in the store vats,

because by so doing he is enabled to decide whether the slow decomposition of the sugar, and the consequent introduction of alcohol, is going on steadily. As he passes down he looks at each small gauge, and notices by the scale the amount of internal pressure, which should always be equal to some few inches of water; and if by chance he notices that the pressure of the internal carbonic acid is much less than it ought to be, he then feeds the yeast in such a barrel with sugar. Thus in the Bavarian system, where they keep ales for weeks and months, there is a gradual process of feeding going on. Of course, the time comes when the original sugar in the wort is used up, and if you were not to attend to the production of more carbonic acid, the oxygen of the air would naturally get in by the bung-hole, and the result would be the oxidation of the alcohol. The German brewer carefully avoids that by a slow system of feeding, little by little, and in that way he insures that there shall always be a pressure inside greater than the atmospheric pressure. While he notices the indication of the manometer, he bears in mind the atmospheric pressure outside, because it may occasionally happen that the barometer has fallen or risen some two or three inches, and of course therefore he guides his process, not only by looking at the barrel manometer, but also at the external atmospheric pressure.

The main points, perhaps, to notice about the Bavarian method are the following. The great Liebig explained the peculiar Bavarian fermentation by supposing that there was an oxidation owing to the external air going on; and he said the difference between top fermentation and bottom fermentation was, that in the former there was a putrefactive change going on, and a disturbance of equilibrium producing the English form of fermentation with the usual products, whereas in the Bavarian system there was a slow oxidation and precipitation of the albuminous matter going on, and hence therefore a decomposition of the sugar in the liquid. He assumed that because the fermenting tuns were open, just as they are in the Burton process, that the oxygen of the air was the agent by which this albuminous matter was oxidised and therefore precipitated. The explanation is exceedingly interesting and valuable, but unfortunately it is based on a false assumption. There are, perhaps, no brewers in the world more careful to avoid exposure to the action of the air than the Bavarian brewers. I have pointed out to you that in their store vats they allow a space of about a hand-breadth between the surface of the liquid and the bung itself, with a manometer indicating the difference between the internal and external pressure. And they are equally careful in the original fermenting process to have a layer or covering of carbonic acid over the fermenting wort. But Baron Liebig was undoubtedly right, there is an oxidation going on. Where does the oxygen come from? Undoubtedly from the water. Water is decomposed owing to these organisms, and the oxygen of the water goes to oxidise these albuminous matters, and at that low temperature does not oxidise as it does, in our ordinary English fermentation, any of the alcohol; consequently, in the Bavarian system, they have less aldehyde formed, and less acetic acid, and working as they do at a low temperature, they have a small quantity of lactic acid; and not only that, but so long as these beer *torulæ* are working, there is a guarantee that at that low temperature the acetic acid ferment, the *Micodermi aceti*, shall not be able to thrive, and also that the lactic acid ferments shall not thrive, because the conditions are unfavourable for their rapid growth. If you for a moment consider the views of Mr. Darwin as to the origin of species, and apply them to brewing purposes, you will see that here we have not those conditions which are favourable to the production and increase of the lactic ferment, or the acetic ferment; in other words, we have a low temperature. Now, a low temperature is very favourable to the production of these *torulæ*, and so long as those are growing fast and multiplying, even if the others come into the field, they are gradually driven out, because the climatic conditions are unfavourable to their rapid development. Hence, therefore, in the Bavarian system, they thoroughly and economically decompose their sugar, and by this low temperature the major portion of the oxygen derived from the decomposition of the water goes to oxidise the glutinous matter of the wort. They are especially careful to keep down the temperature much in the same way as the English brewer. They use a very simple plan, for they either throw large lumps of ice into the fermenting tuns, or since that as a general rule is not available, because it turns into water and makes the beer weaker, they use a small floating vessel which is nearly filled with ice, and placed in the middle of the fermenting tun, which keeps down the temperature below 48° Fah. The beer of Bavaria produced in this way contains very often only as much as one and a-half or two per cent. of alcohol. It has a full-mouthed round flavour; the amount of hop they use is very slight, but yet it has a delicate aroma. In Norway they ferment in very much the same way as the Bavarians, the only difference being that the Norwegian ale is rather stronger, indeed very much the same as the Bock and Salvator beer of Munich. The Norwegian ale, however, has not for Englishmen that unpleasant flavour which the Bavarian ale has, and which is not in any way to be attributed to fermenting at low temperature, but is produced entirely by the very free use of pitch or resinous matters to protect the wood of the fermenting tun. The result is, that as alcohol is formed it dissolves some of the resinous matters, and hence, therefore, the peculiar flavour which German beer usually has. Under this system what I think stands out very clear is, first of all this use of a very low temperature, a temperature obtained by working underground in a large chamber kept cool by ice; and hence, therefore, they obtain less waste in the alcohol formed, less aldehyde, and less acetic acid. The second point is, their very careful attention to secure a slow fermentation process in the store vats, the management of the manometer, and the slow process of feeding the yeast.

As regards fermentation generally, including the Bavarian as well as our own, I think one may say that the salient features from a chemical point of view are, first of all, that the decomposition depends upon two factors, namely, temperature and pressure, and as they vary so do the products vary. High temperature—the barometerical pressure being the same—produces a rapid decomposition of the sugar in the wort, more hydrogen is evolved, more aldehyde is formed, and more acetic acid, at the same time less nitrogen is evolved, and on account of the favourable thermal conditions, there is also more lactic acid. Low temperature on the other hand, if the barometric pressure be the same, produces a slower action, but there is less hydrogen, and more nitrogen, and there is a more complete oxidation of the albuminous matter. Now, this is a very important point, because on the perfect separation of the glutinous matter depends the future store-keeping qualities of the ales. High barometeric pressure may be considered very much the same in its effects as low temperature, and of course *vice versâ*; but the range of variation of the barometer is never greater than some three inches, and consequently this is by no means so important a factor as the question of temperature. I think, therefore, you will theoretically agree with me that for store ales, fermentation ought to be carried on at a temperature intermediate, at any rate between the Bavarian and the very high temperature that some of us use; and above all, that your secondary fermentations should be carried out underground, under conditions of low and equable temperature, which ought not to be allowed to exceed 55° Fahr.

I will pass on now to the cellar, where the English secondary process goes on much in the same manner as in the Bavarian cellar, but with this difference, that

the case of English ale, if as weak in original gravity as Bavarian ale, vastly more care is required, because it has more glutinous matter to be got rid of, the Bavarian having got rid of the greater portion in the original fermentation. Still you may do the same in your store vats or barrels, and in order to do that you must have a low temperature, and if necessary—and only when necessary—a slow process of feeding. You should also adopt the Bavarian plan of noticing carefully the internal pressure in your store vat. It is very common to try and guard against acidity by using bi-sulphite of lime, or other such materials, but you must bear in mind that these produce by oxidation sulphuric acid, and although it does to some extent, and for a time, prevent oxidation of the alcohol, it is a very much better plan to insure by constant feeding that there shall be work for these ferments to do, so that you shall always obtain carbonic acid, and that the pressure inside shall be greater than the pressure outside. That of course you can only decide by carefully watching the pressure-gauge. Possibly there may not be many here who are in the habit of storing ales for the purpose of producing what are called hard ales, but I know among the readers of the Society's *Journal*, and of the two important brewers' journals, there are some who are obliged by the nature of their trade to produce these kind of ales, and therefore I will devote a few minutes to the consideration of the proper storing of the ales in the cellar. It is a very common plan to use hops in these large store vats, and the hops are very often steamed, and allowed almost to ferment in an open trough. After that action has set up, they then add them to the store vat. This cannot but be a bad method, and it would be vastly better to digest the hops under pressure, and without exposing them to the air to allow them to cool down, and then add them to the store vat. Another very curious plan which I have seen many times, is not to cleanse out the store vats, but to add new beer to the old lees. You will find at the bottom of such store vats large quantities of old decomposing hops, and old acid beer, and the result is, they do succeed in producing the hard article which they desire. But occasionally, another peculiar fermentation sets up—the mucilaginous fermentation—and it is due to very minute filaments, and by a peculiar interlacing of these filaments the beer becomes ropey. This, of course, becomes a very serious matter, and probably one of the best cures for this is to kill them by means of a little oil of mustard. These ferments are produced by this bad system of supplying new beer to old, and using dirty vats with the lees in them. The chemical changes which go on in a large store vat are much the same as go on in the wine vat or barrel. There is a slow oozing in of oxygen and a slow oozing out through the pervious wood of the beer itself. While this is going on there are a number of ethers formed, and these ethers tend to produce a fine aroma or flavour which old ales have or should have. But the amount of evaporation that goes on especially in a dry cellar is very great, and not only so, but if in order to produce this hardening process they do not take care to gradually feed the beer, by this German method of slow feeding with glucose or with sugar, a time arrives when a large quantity of it goes into the acid fermentation, lactic acid is formed, and what is worse, acetic acid in considerable quantity. Bottlers, I understand, are not able to make use of this feeding process because it is illegal for them to feed their beer by means of sugar. Still I think they may very readily get over that difficulty by asking the brewers who supply them with beer from time to time to supply them with a barrel or so of a special saccharine liquid which might be called beer, and I presume the law does not forbid them to add one beer to another. If you take an ordinary malt infusion, and boil it up thoroughly, and then charge it with a large quantity of grape sugar, you may make it very poor in albumen, because the object is by this slow oxidation process to imitate the Bavarian's internal decomposition of water, and to get rid of the albumen, and consequently to supply a wort containing a large quantity of sugar. By this process, you get a wort that contains a small quantity of malt and a large quantity of the sugar, and you may also add a little bi-sulphite with it, and in that way I think you may readily enough get over the difficulty of the excise laws, because of course the product will have paid the malt duty. The bottlers for South America, India, Australia, and other parts, have a number of difficulties which those who are merely interested in a running trade have not to encounter. In the first place, if they bottle the ale too soon these little yeast organisms will consume the sugar that is in the beer, and the probabilities are that not a single bottle will arrive at Shanghai or Calcutta in a proper state. Those which have not burst are too much charged with gas. If, on the other hand, he keeps it a much longer time, he then incurs the opposite danger; it may be so dead that there will be no fermentation afterwards, and the consequence will be that the bottles as they arrive out are found to contain but a dead liquid, not beer, because beer must be effervescing. The difficulties at present attending the bottling trade are really very great. It requires excessive care, and they are undoubtedly hampered by our excise laws. But I think I shall be able next week to point out a method which, if taken up and worked out, will perhaps ultimately get rid of many of these difficulties. There is one more point as regards bottlers especially. They should not merely content themselves with the use of the saccharometer, but should also from time to time test the actual sugar in the wort by means of the copper solution; and they should also bear in mind that acetic acid is heavier than water, and therefore, if it is gradually being formed, it will render the determinations of the saccharometer useless. Fehling's method, however, I have always found perfectly trustworthy.

With reference to the chemicals employed in brewing, I have not said much about them, because, with the exception of chloride of lime and bi-sulphite and quicklime, the less perhaps you have to do with them the better. You all know what the antacids are, simple quicklime, or some such material mixed either with neutral sulphite of lime or acid sulphite of lime. Of course quicklime is cheap enough, but it would be very much better not to produce those hard sour ales. The solution that I pointed out to you before of iodine is one that you ought to use continually in your mashing process. It has been brought to my notice that the reaction with iodine is not a trustworthy one in the presence of albuminous matter. That is not correct, iodine when used properly will always show you the presence of soluble starch, even in the presence of the soluble albuminous matter of the malt. White of egg is not exactly the same thing as the soluble albuminous matter of malt. But in order to use this with accuracy you must only drop into your test tube containing your mash one drop of the solution, and at that moment you must notice whether there is any blue tinge formed. Upon shaking you will find, no doubt, that the blue is destroyed, and you get the red again, or the yellow, but upon the addition of another drop you again find the blue tinge. If you experiment in that way, I think you will find no difficulty in detecting starch in your worts. The isinglass which you employ is, as you know, treated with sour beer or tartaric acid, or acetic acid. It is well to mix this very valuable filtering material with a little sulphite of lime, and especially if you are compelled to use sour beer, which contains the germs of future destruction. For store purposes, on the other hand, an injurious solvent ought not to be used.

At our next meeting I propose to bring before your notice several modifications in some of the brewing processes, and at the same time to lay before you the necessity of some important conditions needful for future progress.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

The Sub-Committee for Civil and Mechanical Engineering met last Monday. There were present—Sir John Coode, in the chair, Mr. R. Moreland, Col. C. Pasley, R.E., and Mr. E. Woods. The Committee approved of several fresh applications, and adjourned until the 16th inst.

The fourth meeting of the Committee for Scientific Inventions and New Discoveries was held at the Royal Albert Hall, on Tuesday last, Mr. J. Ramsbottom in the chair. There were also present—Mr. F. A. Abel, F.R.S., Captain Hans Busk, Major W. Crossman, Sir Eustace Piers, Bart., Dr. David S. Price, and Mr. T. Sopwith. Capt. E. G. Clayton, R.E., attended. The Committee considered the applications that had been received, and directed that letters should be written to a number of the applicants, stating that the objects they propose to exhibit are inadmissible. The Committee adjourned until the 17th inst.

The *Architect* has the following on the Belgian pictures for the Exhibition:—"The Belgian jury for the International Exhibition this year have examined and selected a portion of the paintings to be contributed, and although the works in question do not include those coming from Antwerp, yet the Belgian school even in them is well represented. Amongst historical pictures are works by M. Em. Wontners, the painter of the admired picture of 'Marie of Burgundy before the Echevins of Ghent;' he also sends a study of the nude. M. Soubre, of Leige, contributes two historical subjects —'A Noble Family Before the Council of Blood,' and 'Catherine of Aragon and Cardinal Wolsey;' this artist also sends a *genre* subject, 'The Departure of the Falconers.' M. de Schampheleer contributes two of his fine landscapes, both in the Netherlands; one presenting a spring morning, the other a waterside scene, with gay pleasure-boats. M. Coosemans sends one or more of his rich forest scenes. MM. Hipp, Boulinger, and de Baerdemaecker also contribute forest scenery. Mdlle. Baernaert sends some of her beautifully-coloured views. MM. Keelhoff and Roffiaen have several works in the collection; the former, amongst others, a large mountain view: the latter, a calm lake nestling amongst the hills. The Count de Bylandt also sends landscapes. M. R. de Buel contributes a fine cattle piece, the animals being driven home across a verdant meadow. M. Gabriel, another well known landscape painter, is amongst the contributors; and M. Montigny sends two works, 'the Door of the Château,' and 'A Winter Morning.' Flower painting has for its contributors Mlle. Rosa Venneman, M. Van den Bossche, and M. Robbe. In the class of *genre* we have a remarkable work which attracted much attention at the last Antwerp exhibition, 'The Triteur,' by M. Marckelbach; three fine works by M. Th. Gérard, 'Prosperity,' 'The Artist,' and 'Good Morning;' costume pieces of the time of Louis XV., by M. Serrure; an interior, in the Renaissance style, by M. Lagye; 'La Correction,' by M. C. Cap, a scene in the boudoir of a rich amateur, which had a great success at the Vienna Exhibition; one of M. J. D. Stevens's charming cabinet works. 'The Bird's Nest,' by M. Verdegen; 'The Italian Window,' and 'The Bracelet,' by M. Eng. Smits, two very graceful works; three productions remarkable for vigour and colour, by M. Cluysenaar; two works by M. D. de Noter; a figure of a young woman, by M. Fl. Willems, and a girl eating water melon by M. Goupil; three remarkable works by M. Hermans—'The Slave,' 'The Visit to the Hospital,' and 'Dejeuner in Lent;' a fishing piece, by M. Eng. de Block. The life-sized studies are comparatively numerous, including 'A Young Italian Mother with Infant,' by M. A. Robert; 'The Foster Sister,' by M. Zambrechts; a striking contrast of a town young lady and a country girl; and 'A Man and Woman of Bohemia,' by M. Van Keirsbilk. M. Fred. Tschaggeny contributes two fine works—'The Young Widow with Two Children in Mourning,' painted on a white ground; and 'The Young Mother giving her Little One a First Lesson.' Amongst animal pictures are one by M. Charles Tschaggeny, 'Horses Halting'; two bold works by M. E. de Pratere, 'Dog in Leash,' and 'The Water Trough'; others by Mdlle. Henriette Dormer, M. Robbe, M. Van Cleemputte, and the late M. L. Van Kuyck. Marine paintings are contributed by M. F. Musin, M. Francia, and M. de Burbure. We regret not to find M. Clay amongst the number. The Belgian artists are famous for their architectural and picturesque town views; here we have views of 'Heidelberg,' and of the 'Abbaye de Villiers,' by M. Stroobant; three Dutch views, by M. Carabin; and views in Hal and Enghien, by M. Walcklers. We also miss the learned professor of Brussels, M. Bossuet, but, as already stated, this is only a first instalment.

EXHIBITIONS.

International Exhibition at Paris.—It seems that the International Exhibition to be held in Paris in 1875 will be a private undertaking, as the Government, though supporting the scheme, is unable to grant any subsidy for the purpose of carrying it out. Rumours that the proposed Exhibition has been abandoned are declared to be unfounded.

Vienna Exhibition.—An institution destined to survive the Vienna Exhibition, and at the same time to serve as a memorial of that event, is the Austrian Athenæum, an establishment founded in the interest and for the instruction of mechanics and working men, and constructed after the plan of the *Conservatoire des Arts et Métiers* in Paris. Large numbers of articles left by exhibitors at the Exposition have been transported thither, together with a quantity of models and other instructive apparatus, and a library of 3,412 volumes.

MANUFACTURE OF BEER THAT WILL KEEP.

M. Pasteur has made an examination of the causes which promote the deterioration of beer, and finds that this change results from the development of microscopic organisms, which may be termed "ferments of beer-sickness" *(ferments de maladie)*. The germs of these organisms come from the air, &c. To make beer keep indefinitely, all that is required is to prevent them from coming in contact with the liquid. This is accomplished by using a peculiar yeast, freed from all kinds of foreign germs.

The process whereby this pure yeast is obtained in the first instance is not stated; having been once obtained, it can be multiplied to any extent by fermentation.

The wort is cooled in the fermenting vat either by the air or by a current of water. If the entrance of air is to be avoided, a current of carbonic acid gas is let in by one vertical tube, another removing the excess. Under these circumstances the wort will remain unchanged for an indefinitely long period. By the addition of a little pure yeast, fermentation is set up; but care must be taken that the yeast is excessively pure, as the germs of sickness develope much more readily in an

atmosphere deprived of oxygen than in the air, the true yeast being oppositely affected by the air.

The fermenting vat employed when the entrance of air is avoided is made of tin plate, covered by a water-lute, so that communication can only be made between the interior and exterior by means of the pipes whereby the carbonic acid enters and leaves the tube. The operation may be conducted at a temperature of 20° to 25°c. —*Comptes Rendus*, lxxvii. 1140.

SUPPLEMENTARY CONVENTION TO THE FRENCH TREATY OF 1873.

A law giving effect to the recently concluded convention between France and England has just been promulgated in France. It will be remembered that Article III. of the Treaty of July, 1873, provided that a supplementary convention should be drawn up by the two contracting parties, with the object of revising certain provisions of the Treaty of 1860 and of its supplementary conventions. The following is an abstract of the articles of the new convention which affect British trade:—

Art. 1. Should one of the contracting parties establish an excise duty, or internal tax, upon any product of the soil or national industry, an equivalent compensatory duty shall be levied upon similar products imported from the territory of the other power, provided that the same compensatory duty be also levied upon similar products on their importation from all other countries. In the case of a reduction or suppression of an excise duty, or internal tax, a corresponding reduction or suppression of the compensatory duty on imported articles shall take place.

Art. 2. Goods passing through either of the contracting states in transit to the other, shall be exempt from transit duty.

Art. 3. Firearms, anchors, chain cables, and other articles upon which a control can be exercised, shall pay a duty for marking and guarantee.

Art. 4. In case of disagreement between importers and the French Custom-house authorities as to the denomination, origin, or class to which imported goods belong, the question shall be submitted to the Committee of Legal Expertise, attached to the Ministry of Commerce, established by law of 27th July, 1822.

The importer as well as the Custom-house authorities shall each be allowed to select an expert from the list of merchants and manufacturers annually prepared by the President of the Paris Chamber of Commerce, and transmitted by him to the Minister of Commerce. After hearing the evidence of the two experts, the above-mentioned Committee of Legal Expertise shall, if the two experts are agreed upon the subject, register the decision as final. If, on the contrary, the two experts differ, the decision of the case shall be left to the Committee of Legal Expertise.

Art. 5. National treatment as regards trade-marks, models, and designs.

Art. 6. Patterns and samples will be admitted into France duty-free under the following conditions:—

(*a*) The importer will either deposit at the Custom-house the amount of import duty to which each sample is liable, or give security for the same.

(*b*) In order to establish the identity of the goods, each sample will, as far as possible, be marked with a stamp or seal.

(*c*) The importer will be furnished, free of charge, with a certificate of the description of the samples, and of the amount of duty deposited. Samples may be re-exported either from the port of entry or from any other port, when the duty deposited will be refunded. But should such re-exportation not take place, or should the samples not be placed in bond within twelve months, the deposits will be forfeited, or proceedings taken against securities.

The above Convention will remain in force until the 30th June, 1877.

THE CITY COMPANIES AND THEIR EARLY HISTORY.

(*Concluded from p.* 310.)

Charles's new charters to the companies, granted after the *quo warranto*, commence with a recital of the instrument of surrender of the wardens and assistants, and proceed to state that his Majesty is graciously pleased to grant them another charter under such restrictions as he shall think fit. He incorporates them by their ancient name, to have perpetual succession, and to have power, yearly, to choose wardens, with the proviso that they must hold communion with the Church of England, that they shall have received the Holy Sacrament according to the form prescribed by the church within six months before, and that after their election they shall, before they act, take the several oaths and subscribe the declaration appointed by Act of Parliament. The wardens and clerks' names are, by a special clause, to be first presented to the king, and if approved under the sign manual or privy signet, they may proceed to take the oaths; if, on the contrary, they are rejected, the courts of assistants are to elect others, and so on from time to time, until his Majesty is satisfied; any election made contrary to this clause to be null and void. The king reserves to himself the power of removing, by an order of Privy Council, any warden, assistant, or clerk. The said wardens and commonalty are to be subject to the Lord Mayor and aldermen, (who are themselves to be appointed by the Crown), and who were to approve of all persons admitted to the clothing or livery. Some apparent privileges are added in return for this sacrifice, but all liberty of will and actions is effectually destroyed; the companies are allowed only to exist during the royal pleasure, "and, as if in bitter irony of the rest, the several instruments close with a confirmation of all charters, grants, usages, and privileges, in and by all things, so that the companies shall not be touched or molested by the king, his heirs or successors, or any of their ministers, for or by reason of any abuse or misusage for the past."

James the Second's first act, on his succeeding his brother, February 6th, 1685, was an attempt to influence the companies' selection of votes. He directed the Lord Mayor to issue precepts requiring them to return "such loyal and worthy members as might be judged worthy and fit to be, by the Lord Mayor and court of aldermen, approved of as liverymen, to elect members to serve for the City of London at the approaching Parliament." What rendered this more glaring was, that most of the independent aldermen had been previously put out of their places, and compliant tools appointed by the Crown in their room. The Merchant Taylors, as if in approval of these measures, are stated in their books to have made application, near this time, to the Lord Mayor to put up the king's statue in the Royal Exchange.

The news of the coming of the Prince of Orange in 1688, forced from James II. an Act of restitution, or rather a hasty order in council, preparatory to the passing of such an Act, by which all restrictions consequent upon the judgment on the *quo warranto* was repealed. On the 7th of October, a special court of lord mayor and aldermen was held, pursuant to the grants for restoring the City charter (and which preceded this emancipation of the companies), when an order was made for restoring the liverymen of the several companies of the City to the state they had been in before such judgment, and which orders the master wardens and assistants of the several incorporations were to put in execution, as were their several clerks to enter the same in their respective books. The abdication of James confirmed this emancipation. The security of the City of London, and its immunities and privileges being considered on this joyful event essential to the national welfare, the statute 2 William and Mary passed, which not only reversed the *quo warranto* against the City, but enacted as to

associate bodies generally, "That all and every of the several companies and corporations of the said city (London) shall henceforth stand and be incorporated in such manners and names and in such sort and manner as they respectively were at the time of the said judgment given, and every one of them are hereby restored to all and every the lands, tenements, and hereditaments, rights, titles, estates, liberties, powers, privileges, precedencies, and immunities which they lawfully had and enjoyed at the time of the giving of the said judgment. And that as well all surrenders, charters, letters patent, and grants for new incorporating any of the said companies, or touching or concerning any of their liberties, privileges, or franchises, made or granted by the said late King James, or by the said King Charles II., since the giving of the said judgment shall be void, and are hereby declared null and void to all intents and purposes whatsoever." Tranquility and confidence having been restored after the accession of William and Mary, and the privileges and rights of corporate bodies firmly established by Parliament, the affairs of the livery companies began to improve. During the interval between that period and the present time various minor events and changes have occurred in their separate histories and government, but nothing sufficiently affecting the whole to demand the continuation of this essay. It shall therefore here conclude with a few words relative to what are called the companies' Irish estates.

IRISH ESTATES.

In the reign of Elizabeth, a rebellion having broken out in the province of Ulster, in the north of Ireland, that province became vested in the Crown by forfeiture; and in order to resettle the same, and to establish a colony of Protestants there, particularly in the county of Derry, James I., in 1609, made proposals to the Mayor and commonalty of London of such forfeited lands, upon condition of their new planting and peopling the same.

The proceedings for the purchase commenced by the mayor's sending precepts to the companies, dated July 1st, 1609, which were accompanied by a copy of certain "Motives and Reasons," to induce the citizens of London "to undertake in a plantation in the north parts of Ireland," together with a printed book, containing a collection of such orders and conditions as were to be observed by the undertakers, upon the distribution and plantation of the escheated lands in Ulster, lately received by his lordship (the mayor) from the Lords of his Majesty's Most Honourable Privy Council, and to the said precept annexed.

The "Motives and Reasons" are long, but very curious. The spots pointed out as fittest for the city of London to plant are stated to be "the late desolated cittie of the Derrie," situated on the river of Lough Foyle, which was navigable with good vessels above the Derry, and the land "at or near the Castle of Coleraine," situate on the river of the Ban, but navigable with small vessels only, "by reason of both these places (but particularly the Derry), is stated to be such as, with small expense and industry, might be made by land almost impregnable, and consequently afford perfect security to their inhabitants." To these towns the King, it is said, would grant corporations, and also the whole territory betwixt the holdings, measuring 21 miles in length, and including the sea on the north, the Ban on the east, and the river Derry, or Lough Foyle, on the west; and out of which 1,000 acres or more might be allotted to each of the towns for their commons, rent free, whilst the rest could be planted "with such undertakers" (or settlers) as the city of London should think proper.

The "land, sea, and river commodities" of a part of Ireland so to be conveyed are then pointed out; the land is described as well watered, having plenty of fuel, and stores of all things necessary for food, not only for home consumption but exportation; the soil is fertile for tillage, adapted for the breed of English sheep, growth in many places of madder, hops, and wood, and affording also abundantly fells of all sorts, red deer, foxes, sheep, lambs, rabbits, martens, squirrels, &c. Hemp and flax, it is added, grow there more naturally than elsewhere; the materials for building both of houses and ships are further said to be abundant, there being for the former timber, stone, lime, slate, and shingle, with proper soil for brick and tile; and for ships everything in the greatest plenty, excepting tar; also other sorts of wood for different services, as pipes, staves, hoopen-staves, chess-board-staves, wainscot, soap, and dying ashes, glass and iron works, "iron and copper being plentiful there." The sea and rivers are mentioned as offering equal advantages, and the document finishes by pointing out the profit that London shall receive by this plantation.

The king's proposals having been received, the mayor and citizens immediately thereon erected a company, consisting of a governor, deputy-governor, and 24 assistants (since called the Irish Society), to treat with the Crown concerning the new plantation; and the City having resolved to accept the king's proposal, and having raised by contribution among the principal companies £60,000 for that purpose, James, by his letters patent, dated March 29th in his 11th year, incorporated such society by the name of "The Governor and Assistants of the New Plantation in Ulster, within the Realm of Ireland;" and granted to them and their successors (upon condition of their building the town, setting the lands, and doing other services), various cities, manors, towns, villages, castles, lands, and hereditaments, in the said province of Ulster, with power to create manors of any quantities of lands not exceeding 1,000 acres, of such tenants as were in the letters patent limited, and to limit the said several manors so many acres of lands, distinct and severed for demesne lands as should seem necessary and convenient to the society. And a new county was thereby erected, which, uniting the old name of Derry with its new masters, the Corporation of London, was called "Londonderry."

The new settlement having been thus finished, the towns built, and the lands settled, the whole was mapped and divided by the Irish Society, as nearly as could be, into 12 equal parts, and the 12 companies who had equally contributed to the raising of the £60,000 mentioned, cast lots for the several shares which, on receiving, they were named from themselves, their armorial bearings, or other circumstances. Thus the drapers have their "Manor of Drapers," the ironmongers the "Manor of Lizard" (lizards being that company's supporters), the Salters their "Manor of Sal," &c. The Irish Society continued to act under the charter of James until the reign of Charles I., when it was revoked and declared void by a sentence of the Court of Star Chamber, and the crown resumed the lands as forfeited, on pretence that the covenants of the original grants were not performed. But Charles II., in the fourteenth year of his reign, granted a new charter, confirming the previous one of James, and restoring to the City and twelve companies all their former privileges and estates, and it is under this charter that the Irish Society continue to act as a corporation. They are invested by the crown with the most ample authority to enforce their own regulations for the general object of the plantation; and, notwithstanding the division of the estates amongst the twelve chief companies, such estates are considered to be still under the paramount jurisdiction of the Irish Society, and are liable to contributions, if necessary, in common with the indivisible estates in the society's possession, towards the general fund for maintaining public works and edifices, supporting the civil government of the city of Derry and the town of Coleraine, repairing Protestant churches and chapels, establishing schools throughout the plantation, and generally for the execution of such measures as tend to promote and improve the civil and religious interests of the tenantry.

Most of those companies which retain their Irish estates have brought them, by cultivation and liberal

treatment of their tenants, into a flourishing state. Some of them print annual reports of their state, for the use of their members of deputations previously sent to Ireland for that purpose. The "Reports of Deputations" of the Drapers' Company from 1817 to 1820, and again in 1827, form a very elegant and interesting work, illustrated with a plan and various pleasing views of their lands and buildings. These reports afford a most gratifying account of the great improvements which have been effected, the additional happiness and comfort thereby conferred on their tenantry, and the general high state of prosperity of their property there. Other companies, it appears, tread in the same laudable steps, so that the territories of the Irish Society and of the livery compa nies of London promise to become ultimately the best built and most cultivated portion of Ireland.

It may be added, in conclusion, that there are at present existing in the City of London, 76 companies, 36 of which have halls, 20 maintain almshouses, 14 have schools, and 35 administer trust funds.

GRAMME'S MAGNETO-ELECTRIC MACHINE.

By W. H. Walenn, F.C.S.

In a paper that recently appeared in this *Journal*, entitled "Cheap Electricity," Gramme's magneto-electric machine was alluded to as being one of the most likely means of obtaining this great desideratum. In that paper many of the possible applications of electric force were stated, the nature of electric power was defined, and the main difference between Gramme's magneto-electric machine and the ordinary magneto-electric machine was pointed out by means of a description of the general principle upon which each machine depends. In the present essay, it is intended to describe the action of Gramme's machine in detail, and to set forth the kind of work for which it is most applicable.

It has been said that the great advantage of this machine over all others is ensured by a triple combination of circumstances, which the simple construction of the apparatus makes possible. In fact, the production of (1) a continuous current implies that (2) no heating takes place in the bearings of the machine beyond that due to ordinary friction, and that (3) the current is supplied by a minimum of steam power; for the only drawback to the full attainment of the two latter points is the reflex action of any currents that are uncollected or wasted. The almost perfect realisation, therefore, of continuity, freedom from skilled attention, and cheapness of working constitute the salient points of Gramme's machine, and give it a position among electro-motors (including galvanic batteries and other magneto-electric machines) which is unique, and has hitherto been quite unattainable.

In practice, the tranformation of one kind of force or affection of matter into another kind of force, is never effected without more or less loss. In the best steam engines less than one fourth of the heat is utilised as mechanical power; many steam engines only give mechanical power equivalent to one-tenth of the heat used in working them. The transformation of electric power into chemical work is, however, more perfect, for a single battery cell can be made to deposit 96 ounces of copper by the loss of 100 ounces of zinc; the combining weight of copper being 63·5, and of zinc 65·5; this is more than 98 per cent. of the electric power used. The change of mechanical power into electric force, by the assistance of magnetism, has been hitherto subject to the above described drawbacks, namely, the loss, neutralisation, and reflex action of the electric currents, and the heating of the apparatus, and has consequently laboured under difficulties from which the continuous current is free; but as no experiments have hitherto been made to ascertain how much per cent. of mechanical force has been converted into electrical force by any of the magneto-electric machines, or, to the author's knowledge, by Gramme's machine, the saving of power and of money which it accomplishes cannot yet be told.

As the facile and definite recognition of an electric current in a given conductor is highly essential to the proper understanding of the action of Gramme's machine, and as many writers on electricity have failed to describe the method of determining this point with ease and certainty, this important point of the subject will be fully set forth. Not only is it necessary to realise the direction of a given electric current in the description of electrical apparatus, but also in the employment of electric force; for instance, if the effect produced by one condition, say the forward progress along a wire, is to heat the point of junction of the two dissimilar metals, then the backward motion of the same current will cool the same junction. In one direction through a chemical solution, the current throws a metal out of the solution on to a given metallic surface; in the other direction it dissolves the metallic surface which it had previously deposited, taking it into solution. In one direction, through the coil of a bar electro-magnet that is vertical, it causes a north magnetic pole to be uppermost; in the other direction, through the same coil, the south magnetic pole will be uppermost. Even scientific men have fallen into error in describing the direction of the electric current evolved from a galvanic battery. Dr. Althaus, in the first edition of his book on medical electricity, announces the remarkable fact (or rather fallacy) "that the direction of the current is different in the ordinary voltaic pile and in the constant batteries." He further states that, "if, however, the metals are plunged into separate vessels, as is the case in the constant batteries, the direction of the current becomes different." The whole of this paragraph is rewritten in the second edition, and the fact of the direction of the current in the instrument being the same in both cases is fully brought out, Dr. Althaus having evidently fallen into error in the first instance, in consequence of the original "pile" of Volta, of the year 1800, commencing with double plates and finishing with double plates; whereas a single negative copper plate for a positive pole at one end of the series, and a single positive zinc plate for a negative pole at the other end of the series, is all that is required. Perhaps the clearest way of stating the direction of the electric current in the galvanic battery, which is the key to all other electro-motors, is mentally to take a single cell—composed of zinc, acid solution, and copper—and to conceive (for the sake of convenience) that the electric force is torn away from between the particles of the zinc plate during its solution by the acid, and that, being set free, the electric force passes across the acid to the copper plate, thence along the wire to the work to be done, and back again to the zinc plate through its conducting wire, thus completing the circuit. If now the word positive be taken to mean the state of giving out electric force, and negative the state of receiving electric force, the following assertions will be true:—The zinc is the positive plate, and the copper is the negative plate. The wire connected to the zinc plate having at its other end a plate in a solution for depositing copper, for instance, and that connected to the copper also having another plate in the same solution at a small distance from the first, the plate connected by wire with the zinc plate is the negative plate, and receives the deposit, that connected by wire with the copper plate is the positive plate, and is gradually dissolved in the solution. If simply the wires be brought from the respective battery plates, and be left free to be employed upon any work that may arise, it therefore comes to pass that the wire from the zinc plate in the battery is called the negative pole, and that from the copper plate the positive pole; for, although the current, in the battery, proceeds from the zinc to the copper, in the connecting wire and through the work to be done, it proceeds from the copper to the zinc. The kind of mental certainty to arrive at, and of figure to be formed in the imagination, n the conception of the ideas I have endeavoured to

illustrate, is akin to that consummated and to the figure formed mentally when describing the direction of motion of the hands of a watch. We may either say that the hands of a watch move from left to right or from right to left; in the first case we mentally take the upper half-circle by which to describe the motion, in the second case we mentally take the lower half-circle by which to describe the motion. If we always describe the motion of the hands of a watch by reference to the upper half-circle, we must say that they move from left to right; just in the same way, if we always describe the direction of a galvanic current in reference to its passages through the galvanic cell, we must say that it passes from the zinc (as the giving out or positive metal) to the copper, which is the receiving or negative metal. There is this difference, however, between the description of the motion of the hands of a watch and the direction of a galvanic current —that it is scarcely ever necessary to describe the motion by reference to the lower half-circle, but it is very often necessary, when speaking of the work to be done by a galvanic battery or any other electro-motor, to describe the direction of the current by reference to that portion of the circuit which is outside the galvanic cell, and which includes the work to be done. To further elucidate the direction of an electric current, a thermo-electric arrangement of bismuth and antimony may be taken. In this instrument the electric current proceeds from the bismuth to the antimony across the heated junction; the bismuth is therefore said to be positive and the antimony negative. In the frictional machine, generally consisting of a glass plate and a silk rubber coated with amalgam, the current (if it can be called one) proceeds from the glass to the rubber, from the rubber to the earth, and from the earth back again to the prime conductor, thence to the glass plate; the glass plate is therefore said to be positive and tho rubber negative. In Armstrong's steam apparatus, called the hydro-electric machine, the issuing steam is positive and the boiler is negative; the current therefore goes from the issuing steam to the boiler, in that portion of the circuit which is internal to the apparatus.

Having stated the exact difference between Gramme's machine and all previous machines that are in practical use, in the article on "Cheap Electricity," it is simply necessary to compare the various mechanical means of applying the principle of augmentation or diminution of magnetic polarity (that upon which all ordinary magneto-electric machines depend), with the only practical means at present known of applying the principle of transition or translation in space of the same force of magnetic polarity, which is the principle of Gramme's machine.

The earliest known remark or notice which has reference to magneto-electricity is to be found in the *Monthly Magazine* for April, 1802. This states that at Vienna it was discovered that "an artificial magnet" decomposed water as well as the voltaic pile. From this point, the progress of discovery and invention divides itself into two parts, for in 1831 Faraday announced two independent facts; one was that the separation of a coiled keeper from a permanent magnet produced an electric spark in a divided portion of the coil; the other was that the rotation of a copper disc between the poles of a permanent magnet generated an electric current from the centre of the disc to the point placed between the poles of the magnet. From the first of these results sprang the magneto-electric machines with to-and-fro currents, which, by the inventive power of Wheatstone, Henley, and others, have been adapted to telegraphic work, without the intervention of a commutator; indeed, they appear peculiarly suited for that class of work in which alternate impulses are required and can be directly utilised. The result with the copper disc is connected with the theory of the Gramme machine, and never had its practical application until M. Gramme's machine was invented. Faraday evidently had a high idea of this, the latter portion of his discovery, for he remarks, "Thus was demonstrated the production of a permanent current of electricity by ordinary magnets."* Foucault searched in vain for the practical method of evolving this current; and Wheatstone neglected to publish his method of working because he did not find it practical.

In its simplest shape, the Gramme machine consists of an electro-magnet, or coiled armature, of an entirely new form, that revolves on an axis between the poles of a horse-shoe permanent magnet, the axis of revolution being exactly between the poles, and at right angles to the plane of the permanent magnet. As this electro-magnet is the main point of M. Gramme's invention, it will be well to trace its development from the copper disc of Faraday through certain successive steps. The analogy between Faraday's copper disc and Gramme's electro-magnet is not perfect, even regarding the first as the nucleus which, upon development, might yield the second; for the copper disc was mounted upon a horizontal axis, and its periphery revolved between the poles of a horse-shoe permanent magnet, the horizontal plane of which was at right angles to the plane of the copper disc, the horizontal axis necessarily being at some distance from the magnetic poles; whereas the axis of the Gramme electro-magnet or bobbin is exactly midway between the magnetic poles, and the bobbin is in the same plane as the magnet; but Faraday's arrangement was the first to show that a continuous current could be obtained by the motion of an electrical conductor near to a permanent magnet, or, as it is more distinctly described, in the magnetic field. Another discovery of Faraday's bears more directly upon the exact principle of Gramme's bobbin, although the arrangement only permits of a continuous current (in contradiction to a shock) being obtained for a limited time. About the same date as that of the copper disc experiment, in 1831, Faraday discovered that, during the introduction of a permanent bar magnet into a long hollow coil, an electric current was induced in the coil in a definite direction, and lasted for the time that the magnetic pole, so introduced, moved in the same direction in the coil. This effect is still better manifested, and the analogy with Gramme's bobbin is more perfect, if the long coil contains a soft iron core from end to end, and if this modified arrangement is moved in front of the pole of a permanent magnet, so that successive portions of the axis of the coil become opposite the pole of the magnet. The same result would be accomplished if the coil were fixed, and the magnet moved from end to end of the coil parallel to its axis and always at the same distance from the axis; but inasmuch as in Gramme's plan the coil moves and the magnet is stationary, the former supposition is more directly applicable to the explanation of Gramme's bobbin. Virtually, Gramme's bobbin may be considered as the long coil, with the soft iron core in it, bent round and joined at its extremities, so as to form a continuous annulus or ring. Not only are the extremities of the soft iron core perfectly joined so as to form a complete ring without a break, but the extremities of the insulated wire that forms the coil are soldered together so as to constitute a perfectly closed electric circuit. The axis of revolution of this ring is at right-angles to its plane, and passes through its centre. The action of the poles of the permanent magnet upon the soft iron core during its revolution, is to induce two poles of the same name upon that part of the core that is from time to time in close proximity to the pole of the magnet of the opposite name; that is to say, if the north pole of the permanent magnet be uppermost, that part of the core which is from time to time uppermost, and therefore nearer to the north magnetic pole, has induced in it two contiguous south poles. In the same manner it is evident that the lowermost portion of the core, being nearest to the south magnetic pole, has two contiguous

* "Experimental Researches," vol. 1, p. 27.

north poles induced in it. As the south pole of the core is always uppermost, and the coil revolves, the coil has an electric current induced in its upper half, continuous and in a definite direction. As the north pole of the core is always downwards, and and as the circumvolutions of the coil constantly pass this pole in the same direction as they pass the south pole, the electric current induced thereby in the lower half of the coil is continuous, but in the opposite direction to that induced in the upper half of the bobbin, because the opposite magnetic pole is active in inducing this current.

Now comes the question of the direction of the electric current that may be drawn from this machine, in the consideration of which the remarks and elucidations that have already been given, especially those connected with the galvanic battery, will be of essential service. It is simplest, in the first instance, to consider the electric current in the upper half of the coil totally independent of that in the lower half of the coil. An apparatus, presently to be described, is applied to the bobbin, so as to collect the current at the two points in the horizontal diameter of the bobbin that separate the constantly changing upper half from the lower half; the definite direction of this current in the upper half depends upon the polarity induced in the core at its constantly changing apex (south polarity), upon the direction of rotation of the bobbin, and upon the direction in which the insulated wire is wound, whether as a right-handed or as a left-handed screw. If the ring be driven in the direction of the hands of a clock (from left to right), and the coil be a right-handed screw (proceeding from right to left), having a south polarity induced in it, the electric current will be from the right-hand of the diameter of the ring to the left. If a galvanic cell be supposed to be in the place of the upper half of the ring, the zinc plate of that battery would be to the right-hand, and the copper plate to the left. In the lower half of the ring the analogous galvanic cell would also have its zinc plate to the right hand and its copper plate to the left. This is seen more clearly by the reader, if he constructs a sketch according to the above description and results from the fact previously alluded to, namely, that the current from the lower half of the ring is in the reverse direction to that in the upper half of the ring. When the sketch suggested above is made, it will be realised, that if two stationary wires were maintained in rubbing contact with the metal of that portion of the coil which is constantly passing the horizontal diametrical points above alluded to, one wire being in contact with one extremity of the diameter, the other with the other extremity, these wires would conduct away both currents in the ring, and as these currents always continue in the same direction, and never change either their absolute or relative direction, there is no necessity for a commutator, or pole-changer in the ordinary sense of the term, but only for rubbing contacts. To clearly understand that both the currents are able to be collected in the way above indicated, although they are neutralised in the continuous circuit of the ring, it should be realised that, thus wrought out, the arrangement is equivalent in electric action to deriving an electric current from two galvanic cells that are virtually two halves of the same cell. To illustrate this in a lucid manner by sketching, the direction of the currents may be indicated by arrows, according to the above description, in connection with a circle that represents, in the fashion of a diagram, the centre line of the ring, the two conducting or polar wires being placed at the extremities of the horizontal diameter. As plates of a similar name will be seen to be metallically connected, if the analogous galvanic cells are placed in this diagram, it will be easily understood that the galvanic analogy is enabled to be carried as far as that, by supposing the cells to approach each other, and then by removing the walls of each cell (all of which supposition may be carried out by successive sketches on paper), the arrangement is seen to be virtually the same as that of a single current proceeding from a single cell in the direction indicated by the plates of that cell.

The method of establishing the rubbing contacts merits a separate description. That rubbing contacts are essential is evident from the fact of its being necessary to take the electric current from those portions of the moving coil that successively arrive at two opposite points of a fixed horizontal diameter. This can only be done by fixed contact pieces placed respectively at the extremities of the diameter of another circle concentric with the shaft on which the bobbin rotates. To denude a portion of the coil of its insulating material, at the place where the rubbing contacts could conduct away the current (a circle, of more or less breadth, concentric with the ring) would be mechanically impracticable, for the coils are of fine wire, they overlap, and they are not in their external portions at all regularly disposed, at least not sufficiently so to be treated in this manner. It is, moreover, highly necessary that the contact pieces in connection with the coil, and therefore moveable, should be able to bear friction. This result is best accomplished by means of a cylindrical *frotteur* or rubber, in connection with the axis of the bobbin, the frotteur being fixed on the axis at a convenient place for the stationary contact pieces to bear strongly upon its cylindrical surface, and for the wires from certain divisions of the coil to be brought for the conveyance of the whole of the current of the machine to it. The frotteur itself consists of a cylinder of hard-wood, or other non-conducting material, driven tightly on to the axis, and carrying on its surface separate and distinct rectangular plates of metal, placed at equal distances upon its circumference. The plates are securely fixed with their longest dimensions parallel to the axis of the cylinder. Although the coil of the annulus is perfectly continuous, certain offshoots or branch wires are taken from it at equal intervals to the various plates of the frotteur. There may be twelve branches, or as many as forty, according to the size of the machine and the kind of work it has to do. The stationary rubbers may consist of wheels at the extremity of standards. Each wheel is pressed, by springs or otherwise, against opposite points in the horizontal diameter of the frotteur and its standard is furnished with a binding screw for holding the conducting wires of the apparatus. One binding screw attaches the positive wire to the machine, the other the negative wire.

Undoubtedly, the principal applications of the electric current from this machine are to the electric light in its various modifications, and to the deposition of metals in some cases from their ores. The separation of copper from its ores is waiting for a cheap electro-motor to make it a successful manufacture. The singular aptitude of Gramme's machine for manufacturing purposes on a large scale lies in its constancy as well as its continuity of action; as long as the motive power rotates the machine at the same speed, the current from it is the same in power, and the speed of rotation need not be great. There are some uses of the machine which have still to be tested; amongst them may be mentioned increasing the traction power of locomotives by electro-magnetic attractions, the firing of mines, and the treatment of iron, in a hot state, by magnetic induction.

There are good accounts of coal prospects in the Central Provinces of India. A large vein of coal is reported as being already "available," and of excellent quality.

It is stated that in the United Kingdom 150 tons of horse-nails are made weekly, about 2,500 tons being yearly exported.

The value of the Australian gold imported into the United Kingdom in January was £557,855, as compared with £1,289,952 in January, 1873, and £994,541, in January, 1872.

CORRESPONDENCE.

TYPE-PRINTING MACHINERY.

Sir,—In the interesting paper "On Type-printing Machinery," by the Rev. Arthur Rigg, which appeared in your *Journal* of the 13th inst., there are certain errors affecting myself which I request permission to to correct.

It is stated that rotating cylinders and continuous rolls of paper were principles first introduced into type-printing machinery by Mr. Nicholson in 1790, and further on it is asserted, in reference no doubt to the printing machine which I invented in 1835, that I "revived a proposal of Nicholson's."

Now, so far from Mr. Nicholson proposing to print from types on continuous rolls of paper, a reference to the specification of his invention (A.D. 1790, No. 1,748) will show that, excluding his proposals for calico and wall-paper printing, which have nothing to do with type-printing machinery, he invariably speaks of printing on sheets of paper; indeed, the means of producing continuous rolls of paper were not invented till several years later. Again, it will be seen that the means he proposes for attaching the types to his cylinder, the real difficulty to be overcome, are clearly insufficient for the purpose; indeed, as stated in the specification of my patent (A.D. 1835, No. 6,762), which was drawn by the late Mr. Farey—a man thoroughly conversant with the subject—"on account of deficiencies and imperfections in the machinery described in that specification [Mr. Nicholson's] the same has never been practised or brought into use."

Towards the close of his paper, Mr. Rigg seems to imply that hitherto all schemes for fixing moveable types on a cylinder have failed. I can only say that in my machine this difficulty was entirely overcome. Indeed, in a letter which appeared in the *Mechanics' Magazine* of November 12th, 1836 (when the subject was before the public), I was enabled to state that "in the opinion of many eminent printers who have seen my machine the end in view has been fully accomplished, for while any portion of type may be detached from the cylinder with a facility even greater than that with which a similar change can be made in an ordinary form, each letter can be so firmly locked in its place that there is no danger whatever of its being loosened by centrifugal force or by any other cause."

While upon this subject, I may as well add that a comparison of my specification with that of the "Walter Press" (A.D. 1866, No. 3,222) will show that, except as regards the apparatus for cutting and distributing the printed sheets, and excepting further that the "Walter Press" is only adapted for printing from stereotype ptates, while mine would not only print from stereotype plates but, what was far more difficult, from moveable types also, the two machines are almost identical. I gladly admit, however, that the enormous difficulty of bringing a complete machine into practical use—a difficulty familiar to every inventor—has been most successfully overcome by Messrs. Calverley and MacDonald, the patentees of the "Walter Press."—I am, &c.,

Rowland Hill.

Hampstead, February 26, 1874.

INDIAN TEA.

Sir,—The letter on "Indian Tea" in your *Journal* of the 20th ult., necessitates a few remarks from me. The writer states that I did not tell you that the catalogue I forwarded was published a week after his letter was written, and that I did not say it was one of the first, if not the first, of its kind. The catalogue was issued in due course; there was nothing extraordinary about it; and as to its being the first of its kind, I enclose you a catalogue of the same company issued in 1871, in which you will see the first lot is 41 chests, the second 59, and the last 136. If you will refer to the whole of the catalogues for the past three months, you will be satisfied how inadequate are the grounds for the statement, "Indian teas run in lots of two, six, and eight chests." It is fairer to quote the rule rather than the exceptions of the catalogues. It by no means follows, because the catalogues contain some small breaks of tea, that the bulk of the tea is sold in two, six, eight, &c., chests. I enclose you the catalogue of another company's teas to be sold to-morrow. The 132 packages are offered in four lots, viz., 42, 37, 27, and 26 chests. The words "bulked and re-filled" are the brokers' certificate that the teas offered are of uniform quality. The inequalities of the chests necessitates, for Customs' weighing, that the chests should be turned out. Knowing this, *i.e.*, that their teas will be bulked on this side, the planters pack their tea immediately it is manufactured. I have by no means forgotten the first line alluded to, and have no hesitation in repeating it, viz., "The supply of tea from India is limited;" but the brokers would find their time much too limited if they had to sell 18 millions of chests running in lots of two, six, eight, &c., chests. The copy of Mr. Tidy's certificate submitted by your correspondent by no means confirms his statement that his sample of Indian teas was "grossly adulterated;" it rather appears to be what your correspondent styles a good adulteration. I hope the manufacturers of Indian teas will not consider the addition of a foreign substance indispensable, but will, as advised by Messrs. Phillips in their letter of the 13th ult., "resolutely set their faces against any sophistication of the article at present bearing a very high character and value." Adulteration is an ugly fact, and cannot have too loathsome a name. —I am, &c.,

Samuel Ward.

THE SOCIETY'S MEETINGS.

Sir,—As an old member of the Society, I have always considered the discussions which follow our meetings of the greatest scientific and economic value. I should regret extremely that they should lose their high character, but I fear that there is a growing tendency on the part of some members to talk merely for talking sake, and without any special knowledge of the matter in hand. As an instance of what I mean, I enclose the following lists. One gentleman, since November, 1872, has spoken on lenses, &c., in street lamps, silkworm grain, British Settlements in Africa, improvements in manufacture of gun-cotton, improvements in rifles, Indian harbours, State purchase of railways, at the annual meeting, on Virginia, Eastern art, and bell-founding. During the same period a second gentleman has spoken on technical education, horse nails, incombustible wood, lighting street gas by electricity, edible starches of commerce, condensed milk, improvements in the manufacture of gun-cotton, State purchase of railways, at the annual meeting, on preservation of meat, jet manufacture, Virginia, and bell-founding. Now, of what value can such remarks be?—I am, &c.,

An Old Member.

OBITUARY.

Dr. Neil Arnott, F.R.S.—The death of this well known physician took place on Monday, the 2nd inst. Born in 1788 near Montrose, he was educated for the medical profession at Aberdeen, and afterwards in London. Though of high repute as a physician, it is as the inventor of the stove which bears his name that he is and will always be best known. In May, 1854, he read a paper on his then little known invention before the Society, and it was for his researches on this and similar

subjects, that he received the Rumford Medal of the Royal Society. Other inventions of his were the "Arnott Ventilator," and the "Water-bed." For all of these he refused to take out patents, with the idea that greater general benefit would result from them if no hindrance was placed in the way of their universal employment. Dr. Arnott was also well known as an author, his "Elements of Physics" having gone through many editions, and been translated into many languages. In 1837 he was gazetted as physician extraordinary to Her Majesty, and in 1838 he became a Fellow of the Royal Society. He received the chief gold medal in the class of medicine, surgery, and hygiene at the Paris Exposition of 1855, and the Emperor presented to him the Cross of the Legion of Honour. He was for some time a member of the Society, but retired from it some years ago.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

The following arrangements for Wednesday evenings up to Easter have been made:—

March 11.—"On the Manufacture of Cocoa." By John Holm, Esq., F.R.C.S. Edin., &c.

March 18.—"On the Channel Tunnel." By William Hawes, Esq., F.G.S.

March 25.—"On the London International Exhibition of 1874." By Henry Hardy Cole, Esq., Lieut. R.E.

Indian Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

March 13.—Dr. Leitner, Principal of the Government College of Lahore, will give an account of the Races of Dardistan (north-west of Cashmere), discovered by him. Dr. Leitner will introduce to the meeting Jamshed, a Siah Posh Kafir, one of the natives of the district. On this evening General McMurdo, C.B., will preside.

April 17.—"On the Indian Famine, with Especial Reference to the Means which should be Adopted for Preventing or Alleviating Famine." By General Sir Arthur Cotton, K.C.S.I.

African Section.

These meetings are arranged for Tuesday evenings, at 8 o'clock, and the following arrangements for papers have been made:—

March 17.—"Remarks on the Geographical and Physical Character of the Diamond Fields of South Africa." By the Honourable Theophilus Shepston, Secretary for Native Affairs in Natal. Communicated and explained by Dr. Mann.

April 14.—"On Trade in Western Africa with and without British Protection." By Andrew Swanzy, Esq.

Chemical Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

March 6.—"On the Paraffin Industry." By Frederick Field, Esq., F.R.S. This being the opening meeting of the Section, Professor Odling, M.A., F.R.S. (President of the Chemical Society), will preside, and will give a short address on "The Importance of Industrial Chemistry."

March 20.—"On Anthracene and Alizarine." By Dr. Versmann.

April 10.—"On some Recent Processes for the Manufacture of Soda." By C. W. Vincent, Esq., F.C.S.

April 24.—"On Pyrites, as a source of Sulphur, Copper, and Iron." By Dr. C. R. A. Wright, F.C.S.

May 8.—"On Sugar Refining, with special reference to Finzel's Sugar Crystals." By Dr. Griffin.

May 22.—"On the Manufacture of Chlorine." By W. Weldon, Esq., F.C.S.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Mon. ...Royal Geographical, 1, Savile-row, W., 8½ p.m. 1. Mr. Consul Thos. J. Hutchinson, "Across the Andes from Callao." 2. Mr. Clements R. Markham, "Notes on Geographical Progress in Peru and Neighbouring Countries."
British Architects, 9, Conduit-street, W., 8 p.m.
Medical, 11, Chandos-street, W., 8 p.m. Annual Meeting.
London Institution, Finsbury-circus, E.C., 4 p.m.

Tues. ...Royal Institution, Albemarle-street, W., 3 p.m. Professor Tyndall, "On the Physical Properties of Liquids and Gases."
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8 p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m.
Deaf and Dumb Association, 272, Oxford-street, W., 8 p.m. Mr. Charles Vincent, "On the Beginnings of Electrical Research." Interpreted by the Rev. A. Smith.
Photographic, 9, Conduit-street, W., 8 p.m.
Anthropological Inst., 4, St. Martin's-place, W.C., 8 p.m. 1. Dr. A. P. Reid, "The Half-breed Races of North-Western Canada." 2. Rev. George Taplin, "Notes on the Mixed Races of Australia."

Wed. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. John Holm, "On the Manufacture of Cocoa."
London Institution, Finsbury-circus, E.C., 7 p.m.
Geological, Somerset-house, W.C., 8 p.m. 1. Mr. R. Etheridge, jun., F.G.S., "On the Relationship Existing between the *Echinothuridæ*, Wyville Thomson, and the *Perischoechinidæ*, McCoy." 2. Mr. William Shone, jun., "Discovery of Foraminifera, &c., in the Boulder-clays of Cheshire." Communicated by Mr. D. Mackintosh, F.G.S. 3. Mr. Charles Callaway, M.A., B.Sc., of the New York State Museum of Natural History at Albany, "On the Occurrence of a Tremadoc Area near the Wrekin in South Shropshire." Communicated by Dr. H. A. Nicholson, F.G.S.
Graphic, University College, W.C., 8 p.m.
Royal Literary Fund, 10, John-street, Adelphi, W.C., 3 p.m. Annual Meeting. (At the House of the Society Arts).
Royal Society Literature, 4 St. Martin's-place, W.C., 4½ p.m.
Archæological Association, 32, Sackville-street, W., 8 p.m.

Thur. ...Royal, Burlington House, W., 8½ p.m.
Antiquaries, Somerset House, W.C., 8½ p.m.
Society for the Encouragement of Fine Arts, 9, Conduit-street, W.C. Mr. T. H. Wright, "The Music of the Harp, the National Melodies of Ireland, Wales, Scotland, and England."
Royal Institution, Albemarle-street, W., 3 p.m. Professor W. C. Williams, "On Cryptogamic Vegetation—Ferns and Mosses."
Royal Society Club, Willis's Rooms, St. James's, S.W. 6 p.m.
Mathematical, 22, Albemarle-street, W., 8 p.m.

Fri ......SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Indian Section). Dr. Leitner "On the Races of Dardistan (north-west of Cashmere) discovered by him."
Royal United Service Institution, Whitehall-yard, 3 p.m. Major-General J. L. Vaughan, C.B., "On the Retreat of the Ten Thousand, a Military Study for all time."
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting; 9 p.m. Dr. C. R. A. Wright, "On the Chemical Changes Accompanying the Smelting of Iron in Blast Furnaces."
Astronomical, Somerset House, W.C., 8 p.m.
Quekett Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.
Literary and Artistic, 7, Gower-street, W.C., 7 p.m.

Sat ......Royal Institution, Albemarle-street, W., 3 p.m. Mr. C. T. Newton, "On Ephesus."
Royal Botanic, Inner Circle, Regent's-park, N.W. Professor Bentley, "On the Properties and Uses of Eucalyptus Globulus, and other Species of Eucalyptus."

[The Editor will be glad to receive notices of papers for insertion in the above list.]

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,112. VOL. XXII.

FRIDAY, MARCH 13, 1874.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ALBERT MEDAL.

The following letter has been forwarded by H.R.H. the President of the Society to the Secretary:—

Museum d'Histoire Naturelle, Paris, 28 Janvier, 1874.

A Son Altesse Royale le Prince de Galles.

Je ne puis recevoir une lettre signée du President de la Société du Manufactures, des Arts, et duCommerce, de l'Angleterre, sans lui exprimer du sentiment de gratitude pour l'honneur qu'elle me fait. Associé étranger de la Société Royale de Londres depuis 1826, honoré en 1857 de la Medaille de Copley, je suis heureux à la fin d'une carrière ahsolument consacrée à la Science d'avoir à exprimer encore une fois ma profonde reconnaissance pour la témoignage d'honneur qu'a hien voulu me donner une Société Anglaise présidée par votre Altesse Royale.

Que votre Altesse Royale veuille bien agréer l'expression de mon respect,

E. CHEVREUL, Membre de l'Institut de France, et Doyen des Associés Etrangers de la Société Royale de Londres.

The Council will proceed to consider the award of the Albert Medal for 1874, early in May next. This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, hut have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labouis iu establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Mons. Michel Eugéne Chevreul, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, whihc for more than half a century have exercised a wide iufluence on the industrial arts of the world."

The Council invite members of the Society to forward to the Secretary, on or before the 11th of April, the names of such men of high distinction as they may think worthy of this honour.

COMMITTEE ON MUSEUMS AND PUBLIC GALLERIES.

The Executive Committee met at three o'clock on Tuesday, the 10th March. Present—Major-General F. Eardley Wilmot, R.A., F.R.S., in the chair; Mr. F. A. Abel, F.R.S., Mr. H. Cole, C.B., Dr. Dresser, Mr. U. J. Kay-Shuttleworth, M.P., Mr. A. J. Mundella, M.P., Mr. J. Hinde Palmer, Q.C., and Mr. Thomas Webster, Q.C.

The Secretary reported that a numerous deputation from this Committee had waited upon Lord Chancellor Selhorne, as Chief of the Commissioners of Patents, on the 17th of January, and had brought to his Lordship's notice the condition of the Museum of Patents under the Commissioners' charge, and that a detailed report of what had taken place at the interview had appeared in the Society's *Journal* of the 23rd of January.

The Committee, looking at the fact that Lord Selborne had since resigned, and that a new Lord Chancellor, Lord Cairns, had been appointed, resolved that a deputation from this Committee should seek an interview and bring before his Lordship the condition of the Museum of Patents, as well as the general objects of the Committee.

It was further resolved to recommend to the Council that the Secretary write to the Lord Chancellor, with a request that his Lordship will receive such a deputation, sending him at the same time the resolutions on which the Committee is formed, informing him of the previous deputation to the late Lord Chancellor, and stating that the Committee ventures to think that, if it should meet his Lordship's convenience and approval, advantage might result from the interview taking place in the Museum of the Commissioners of Patents at South Kensington.

The Committee then re-considered the resolution passed at a previous meeting, requesting Mr. Mundella to bring the question before the House of Commons

and resolved that Mr. Mundella be requested to give notice in the House of Commons that he will call the attention of the House to the present system of administration of the Museums and Galleries of Art and Science throughout the kingdom, and move a resolution affirming the principles and objects comprised in the resolutions upon which this Committee is formed.

The Committee further resolved to recommend to the Council to convene a conference of the Mayors of the United Kingdom to discuss the question, and arrange for a deputation to the Prime Minister, and that to such conference they also invite the attendance of members of the Legislature and others taking an interest in the matter, and that such conference be held on or about the 5th of May next.

The Committee further resolved that a circular be addressed to the new members of Parliament, asking them to join the Committee.

PROCEEDINGS OF THE SOCIETY.

CHEMICAL SECTION.

The first meeting of this section was held on Friday evening, March, 6th. The chair was taken by Dr. Odling, President of the Chemical Society.

The Chairman delivered the following address :—I have been desired by the Council to say a few words at this introductory meeting on the importance of industrial chemistry, but really to do so is to urge upon you a theme which requires no advocacy, I should think, on the part of anyone, and I am afraid it would be as tedious as a thrice told tale. If we look at the objects with which we are surrounded and consider how very few of them are in the state in which they are presented to us by nature, we shall find that the metamorphoses to which they have been subjected are essentially chemical ones; that is to say, wherever we find one kind of matter in nature, and some how or other the matter is turned into another kind of matter, it has undergone a chemical change; and how very few indeed of the different kinds of matter with which we are surrounded are really in their primitive forms. When we have mentioned coal, wood and stone, mean building stone, we have mentioned almost all. When we consider the gas which, though now gas, was a short time ago in the form of coal, or the glass of our windows which a short time back was in the form of sand, soda, and lime stone, or if we look at the plaster of our rooms, which was originally limestone but has undergone varied metamorphoses—and more particularly I might direct your attention to the metallurgical industries, especially iron, which was a short time before in the iron stone—all these are instances of the chemical metamorphoses to which we subject the different natural objects, and so change one kind of matter into another. Among all these metamorphoses which are of a chemical nature there are some to which we more particularly apply the name of chemical manufactures. In reality, a brick is a true chemical product; it was not originally the same matter it now is, but was produced by a change of chemical composition of its elements. But among these more particularly called chemical manufactures, the production of which is conducted in works which are called chemical works, are those performed in so called alkali works, and I think I need have no hesitation in saying that these works have proceeded to a far greater development in this country than in any other, notwithstanding the fact that among the constituents received and metamorphosed by these works are many which are of foreign extraction, more particularly the pyrites, or other sources of sulphur, and the manganese or other indirect source of the chlorine manufactured at these works. And we see that, in the course of lectures which have been provided for us, three have reference especially to the manufactures, which are conducted exclusively at works which are denominated chemical works. We have a process for the manufacture of soda by Mr. Vincent; another on pyrites, as a source of sulphur, copper, and iron, by Dr. Wright; and another on the manufacture of chlorine, by Mr. Weldon. Starting from the crude substances, coal and limestone, and pyrites and common salt, we have a production of soda which will be treated of more particularly in Mr. Vincent's address. Then we have the further manufacture of copper, sulphur, iron, and chlorine, which are the necessary economical concomitants. It is indeed remarkable, at the present day, how much the progress of chemical manufactures consists in the working up of what were formerly waste products. Perhaps we could not have a more singular instance of this than in the utilisation to which that class of refuse, which was formerly known as burnt pyrites, is now put. Not only do we obtain from the original pyrites much sulphur which was formerly thrown away on a very large scale, but, moreover, copper and iron, which was also formerly thrown away in the burnt pyrites. And we have also one very remarkable product now obtained from pyrites on a comparatively large scale, and I may say, with regard to the manufacture of copper from pyrites, that the amount now produced—as Mr. Wright will tell you—from a material which was formerly thrown away, constitutes a large proportion of the entire quantity now manufactured in the United Kingdom. But in addition to that there is a very considerable manufacture of silver now going on also extracted from these waste pyrites. This extraction of silver from these pyrites, in which it occurs in an exceedingly minute proportion, has an essential interest for chemists in this point of view, that the processes which are adopted for its extraction really resemble most closely the processes which purely scientific chemists adopt in the laboratory. The pyrites is first of all heated with common salt, whereby the copper is converted into chloride of copper soluble in water, and the silver into the state of chloride of silver, which is soluble in the common salt solution; and not only so, but in this process of removing the soluble copper and the soluble silver from these pyrites, the arsenic and the sulphur, which formerly prevented the burnt pyrites being put to any use, are got rid of, so that what remains is useful in a further stage of the iron manufacture. But with regard to the extraction of the silver, we find how important a knowledge of even delicate chemical processes is, in order to allow the extraction to be pursued with advantage. By the ingenious process of Mr. Claudet and Mr. Phillips, the solution is first of all examined by the nicest chemical means to see the exact amount of silver it contains, by a process rivalling in delicacy that which is pursued in laboratory research, and having ascertained exactly the quantity of silver contained in the solution, the exact quantity of that expensive re-agent, iodide of potassium, which is required, is added to it to precipitate the amount of silver; and when the iodide of silver is thrown down the iodine is recovered to be used over and over again, and the silver itself is set free by means of metallic zinc, which forms iodide of zinc, thus setting free the silver. In this way, a considerable portion of silver is extracted. I mention this as an illustration of the remarkably close association which is every day taking place between pure chemistry in the laboratory, and manufacturing chemistry in the factory. Now-a-days we have such out-of-the way bodies, as they were formerly considered, as these different aniline products, as alizarine and chloral, which were formerly barely procurable in the laboratory, now made on a manufacturing scale. On the other hand, we find these different processes of estimatiou, formerly confined to

the laboratory, are now carried on in the manufactory, and thereby such an element as silver is produced by processes which are essentially laboratory processes. In this way it happens that we find many improvements in manufacturing chemistry are now produced by men who have obtained a reputation in other fields. For instance, I need scarcely refer to the names of Hofmann, Perkin, and Nicholson, gentlemen known as scientific chemists and of the highest eminence, before their attention was directed to manufacturing operations, and they realise on a manufacturing scale the results of their laboratory experience. In mentioning them, I ought not certainly to dissociate from them our lecturer this evening, Mr. Field, who was so long and so highly esteemed in purely scientific circles for his admirable researches into a great number of compounds, more especially connected with mineral chemistry, before he devoted his great ability to the elucidation and improvement of the manufacture of aniline dyes and subsequently to the metamorphoses of the bodies which we now use for illuminating purposes in the form of paraffine and ozokerit, and similar bodies.

But while in this way many manufactures derive a very great advantage from the light thrown on it by purely scientific chemists in one way or another, I do not think we ought to overlook the benefit which pure chemistry derives, on the other hand, from manufacturing operations. I do not mean the mere material gain that purely scientific chemists have enjoyed by the opportunity of examining minutely a great number of bodies, which previously it was almost impossible for them to obtain, but I think they have gained a very much greater knowledge of the especial subject of their studies—I mean chemical phenomena. We chemists take as our province every change by which one kind of matter becomes metamorphosed into another kind of matter, whereby that which was ironstone, for instance, becomes iron, whereby that which was sand, chalk, and soda becomes glass, and which takes place wherever one kind of matter is metamorphosed into another; but, after all, a great number of the metamorphoses which we must study take place in the test tube and small vessels of similar character; and we are rather too apt, I say, to shut our eyes to those metamorphoses which take place on a large scale around us. Those changes manifest themselves particularly in two forms. We have those by which the different forms of agricultural produce are furnished us by the vegetable kingdom, and by which they are metamorphosed into the animal kingdom. Here we have one great illustration of industrial chemistry—the chemistry by which crops are produced, and by which stock is fed and flesh is made. This feeding of stock and production of crops is one very large function of industrial chemistry, and I would venture to say that any scientific chemist who devotes his attention entirely to what takes place in the test tube, and who neglects those changes which are constantly taking place around him, has a very imperfect notion of the subjects which he professes to investigate. And in addition to these changes thus taking place in natural processes, modified to a certain extent by art, we have three other processes which take place on a grand scale, by which from such substances as ironstone we produce metallic iron, from common salt, on the one hand, carbonate of soda, which is applied to the manufacture of glass and other useful purposes, and by which we provide also chlorine in its different combinations, which we apply to so many purposes, more particularly in the preparation of our wearing apparel, and in our linen and fabrics of every description. I think, then, that when we have the advantage of having these industrial subjects brought under our notice by men like our friend here, who are familiar, on the one hand, with the most recondite points of theoretical chemistry, and, on the other hand, with the greatest practical achievements which have been obtained in manufacturing chemistry, it will be of immense benefit to those who wish to study chemistry in its pure aspect, as they will see what can be done on a large scale, and what habitually is done, and what perseverence, assisted by chemical knowledge, has obtained for us. And, on the other hand, it must be interesting to practical men, by throwing out suggestions capable of improvement in various branches of manufacturing art. I think, then, that the Society of Arts has really done a very useful work in bringing together men engaged in the purely scientific pursuit of chemistry on the one hand, and, on the other, men who are pursuing the application of the science with a view to the practical good of their kind. I do not know that I need trouble you with any further remarks, but I have attended here this evening with the greatest pleasure, because I feel how much advantage is likely to be derived by all classes of the community by the discussion of these problems which are so interesting to all, and I would venture to say as much in a purely scientific as in a practical point of view.

The paper read was:—

ON THE PARAFFINE INDUSTRY.

By Frederick Field, Esq., F.R.S.

In pursuing his celebrated researches upon the tar obtained from the red beech, Reichenbach discovered in the ultimate portion of his distillates a white translucent substance, to which he gave the name paraffine (from *parum* and *affinis*), owing to the comparatively slight action exerted upon it by most chemical re-agents. The tar was submitted to repeated fractional distillations, and the portions passing over last were mixed with strong sulphuric acid and violently agitated. After standing in a warm place for some hours, the paraffine floated upon the carbonised residue in the form of a pale-coloured oil, which, after cooling, solidified, and was pressed between folds of bibulous paper. By frequent crystallisations from boiling ether, it was obtained as a brilliantly white body, highly plastic and somewhat unctuous to the touch, but not greasy. This interesting hydro-carbon for many years was regarded as simply a chemical curiosity, "and so it remained," wrote Reichenbach many years after its discovery, "a beautiful item in the collection of chemical preparations, but never escaping from the rooms of the scientific man." I remember distinctly having a few grains sent me by Professor Abel, carefully enclosed in a glass tube, to add to my collection of treasures when I was in South America. It is now annually made, as will presently be shown, by thousands of tons.

Before entering into the immediate subject of the paper, viz., "The Paraffine Industry," it may be as well, in a very brief manner, to describe some of the properties of the substance itself. Paraffine is a pure hydro-carbon, having no oxygen whatever, and its analysis has given the following per centage composition:—

	Paraffine from Boghead Coal. Gattelly.	Paraffine from Boghead Coal. Arderson.	Paraffine from Grey Shale, Addiewell. MacIvor.
Carbon	85·2	85·15	85·31
Hydrogen....	14·4	15·40	14·50

Paraffine, when pure, is perfectly colourless and translucent; after slightly warming, it becomes highly plastic, and can be moulded with the greatest ease. Hence it differs in some respects essentially from spermaceti, with which it has often been erroneously compared, as well as from

stearic acid and other bodies used for the manufacture of candles. From this plasticity, paraffine candles, in warm rooms (if not of a very high melting point) are liable to bend, while on the other hand, those made of sperm or stearic acid, although of a lower melting point, remain erect, Of course, as has been observed, this very much depends upon the fusibility of the substance, and the harder descriptions of paraffine are always selected for candles which have to be subjected to much heats. Liquid paraffine is very mobile, and can be filtered through paper almost as readily as water itself. It is scarcely acted upon, even by fuming sulphuric acid, unless at very high temperatures, so that it can be purified by this means from many other organic substances with which it may have been associated, they being immediately charred by contact with sulphuric acid. When submitted for a length of time to the action of chlorine or bromine, chlorinated or brominated compounds are formed, with disengagement of torrents of hydrochloric or hydrobromic acids. Mr. MacIvor, who has devoted many years to the study of paraffine, says that after this body is acted upon by chlorine, it first becomes a gummy looking solid, afterwards a liquid colourless and transparent, and as the passage of the chlorine is continued, a hard brittle resin is the result. This substance consists of—

Carbon	29·55
Chlorine	66·82
Hydrogen	3·39
	99·76

This gentleman has also remarked that the paraffines having the highest melting point are those which are most easily acted upon by the gas. Iodine dissolves in paraffine, imparting to it a beautiful violet colour, which becomes brown as the paraffine solidifies; but the action of this element upon the hydro-carbon is very feeble, no apparent decomposition taking place after prolonged heating for many hours.

By the action of strong nitric or sulphuric acids M. Campion discovered a new body, which he calls "paraffinic acid," and describes it as a bright, transparent liquid, of a very inflammable nature. Strong nitric acid yields a series of interesting compounds, lately studied by Schorlemmer and others. Mr. Fordred informed me some years ago that when paraffine is acted upon by sulphuric acid, to which a few crystals of permanganate of potash have been previously added, the action is so violent that light and heat are evolved, and even at times accompanied by explosion. The best way of trying the experiment is to heat up the acid and permanganate in a tube, and drop a small piece of paraffine in the warm liquid. When they are all three placed together in the tube and heated up, the action is not nearly so violent. Success does not always atttend the experiment, but it can be tried. The decomposition convinces us that the word paraffine (little affinity) is slightly a misnomer.

Paraffine is insoluble in water, very sparingly soluble in alcohol, even when boiling, more so in ether, and exceedingly in naptha, sulphide of carbon, and aniline. When heated with sulphur at a moderately high temperature it is decomposed, carbon separates, and abundance of sulphuretted hydrogen is evolved. This fact may be of interest to chemists, as affording a ready source of this indispensible re-agent in the laboratory. The two substances, the paraffine being in large excess, are heated together in a flask, when a steady and copious flow of the gas is obtained. We have here a tube containing paraffine and sulphur, and the characteristic action of the gas upon lead salts will be seen by the experiment. With regard to the beautiful translucency of paraffine, which in spite of certain drawbacks has made this body such an unusual favourite as a means of light, Mr. MacIvor informs me that if when melted it is cooled very gradually, and subjected to a slight and steady pressure, it becomes actually transparent, like ice, but that a blow or even a scratch will alter its molecular structure, and cause it to re-assume its normal appearance. As this change is also produced upon re-melting it, however cautiously, that triumph of manufacture in this department of industry, namely, making a transparent candle, is yet in the distance.

The specific gravity of paraffine has been variously stated at ·870, ·852, and ·880, and these discrepancies appear to have arisen from the fact that the experimenters have used different substances in their investigations. Mr. Gelletly has shown that the specific gravity rises with the melting point of paraffin. Thus paraffine melting at about 90° Fah. has only a specific gravity of ·823; at 128° Fah., which may be considered a very good average (rather high, perhaps), it has a specific gravity of ·911; and a specimen of an extraordinarily high melting point (176° Fah) was as high as ·940, more than ten per cent. above that at 90° Fah.

In attempting to give a sketch of the paraffine industry, which in the space of time usually allotted must necessarily be brief and imperfect, I must be pardoned if many of the names of those who have done good service in this branch of manufacture are omitted, considering that there have been more than sixty patents taken out during the last few years for the treatment of solid and liquid hydro-carbons. To describe them all would be, it may be imagined, a weary task both for reader and listener.

Dr. Lyon Playfair, in the year 1847, called the attention of Mr. James Young to a dark, oily substance exuding from the cracks in the roof of a coal mine near Alfreton, in Derbyshire. This body was distilled, and yielded a pale yellow oil, which deposited, on cooling, small scaly particles which proved to be the solid paraffine. An establishment was speedily erected on the spot, and the product from the mine somewhat extensively worked, until it was exhausted or nearly so. In the meantime, Mr. Reece obtained a patent (1849) for distilling paraffine from Irish peat, and works were erected near Ashby, in Ireland, for its production. It may be remembered by some amongst us, that at that time the natural resources of the sister island were the subject of much discussion, and the enormous amount of peat which is found in many localities was supposed to be, when properly treated, a source of unbounded wealth. It was stated that not only solid paraffine and illuminating oils could be obtained by its destructive distillation, but also acetate of ammonia

and other valuable volatile products. The idea was very popular. A company was started, and although the promised compounds were produced, the expense of obtaining them, the quantity derived from the original peat being so small, led to a commercial disappointment. The following table may give some notion of the amount of materials obtained from the distillation of peat:—

Watery matters........	30·614
Tar	2·392
Gases	62·392
Ashes	4·197
	99·595

The watery matters and tar yielding:—

Ammonia	0·287
Acetic acid............	0·207
Naptha	0·140
Volatile products	1·059
Paraffine.............	0·125

So that 100,000lbs. of peat would only yield 125lbs. of paraffine. Peat from the kingdom of Hanover appears to yield more than that from Ireland, 100,000lbs. yielding rather more than 300. Although in a monetary sense the Irish scheme was a failure, great credit must always be awarded to its promoters. It certainly led the way to other discoveries, and excited a wholesome interest in the hydro-carbon industry. The poverty of the original material operated upon appears to be the only cause of the non-success of the undertaking.

Mr. Young having been successful in his experiments at the Derbyshire mine, but finding his stock of available materials drawing to a close, experimented upon nearly every kind of coal which he considered likely to yield solid or liquid hydro-carbons. With his usual sagacity, he imagined that there could be obtained by heating coal gradually by artificial means, such as the application of a low red heat, a product similar to the one naturally produced he had first experimented upon at Alfreton. A highly bituminous coal procured from Boghead, near Bathgate, in the county of Linlithgow, was found to yield large quantities of oil, and a patent was granted to Mr. Young in 1850, "for treating bituminous coal to obtain paraffine and oil containing paraffine." An establishment was erected, and he was joined in this undertaking by Messrs. Meldrum and Binney. This Boghead coal, or Torbane-hill mineral, proved to be by far the richest source of paraffine and paraffine oil yet discovered, as much as 135 gallons or 50 per cent. of oil having occasionally been obtained as a product of distillation. Previous to the expiring of Mr. Young's patent in 1864, many works were in operation in Scotland for distilling oil from shale. Dr. Steele, of Wisham, erected several stills at Broxburn, which were eventually sold to Mr. Fernie, who again sold the establishment to a company (the Glasgow Shale Oil Company). There were also the West Calder Works, the Uphall Company, the Oakbank, the Levenside Oil Works, a few names amongst many more, but sufficient to give an idea of the extent to which, in so short a time, the paraffine industry had been developed.

In Wales also, this manufacture was commenced about the year 1861, principally from three varieties of coal, namely, Curley cannel, which yields 30 per cent. crude oil, sp. gr. ·875 to ·890; Smooth cannel, which yields 16 per cent., sp. gr. ·925 to ·940; and Bastard or Common cannel, an inferior variety. At Leeswood, in Flintshire, the beds of cannel in some places were found to be six feet in thickness. Mr. Hussey Jones, of Leeswood, was, I believe, the originator of the paraffine industry in Wales. His works became the property of Messrs. Fernie and Company, who were defendants in the great suit of Young v. Fernie in 1864, lasting thirty-nine days, a trial still fresh in the memory of some of us, and which occasioned perhaps at the time as much excitement in the technical world as a certain great trial at Westminster has recently done among the public at large.

Although many chemists had announced the discovery that oils, &c., could be obtained by the distillation of shale and other minerals (see Christison, of Edinburgh, on "petroline" from Rangoon petroleum in 1831, Butler in 1833, Hompech in 1841, Du Bussey in 1845, &c., and many others even anterior to these), Mr. James Young, who was the first to make this industry a practical success and to establish it beyond doubt as a new means of benefiting mankind, must be regarded as the father of paraffine. "It is true," said Dr. Reichenbach, with the generosity that usually characterises a great mind, "that the discovery of paraffine is mine, and I have announced it. To Mr. Young, however, belongs the merit of a second discovery, the merit of having elaborated a method which furnishes a comparatively large supply of this substance, and which is sufficiently remunerative to the manufacturer, a result which I have vainly endeavoured to realise." The professor speaks of a comparatively large supply. The table before you will show how enormous this has become; the figures were given by Mr. Kennedy in his speech at the complimentary dinner to Mr. Hill, late manager of the extensive works at Bathgate:—

Shale used in Scotland....	800,000 tons.
Crude oil produced........	25,000,000 galls.
Paraffine	5,800 tons.
Lubricatiag oil	9,800 ,,
Sulphate of ammonia	2,350 ,,

To carry out this manufacture about 500,000 tons of fuel were required.

But yet it appears that the credit of first manufacturing solid paraffine on anything like an extensive scale is due to Messrs. William Brown and Co., of Glasgow, and I will read an extract from a letter addressed to the Secretary of Juries of the Universal Exhibition of 1862, by a very eminent London firm:—

May 20, 1862.

Sir,—In reply to your communication received last week, requesting to be informed whether there is any peculiarity in the manufacture we exhibit, to which we are desirous of calling the attention of the jury in class 4, we beg to submit the following remarks. We have been using paraffine in the manufacture of candles since March, 1855. It was made by Messrs. William Brown and Co., of Glasgow, who were, to the best of our belief, the first makers of it in this country, and by whom we were regularly supplied; but from the smallness of the quantity produced (only three to four cwt. weekly), and its imperfection, especially in hardness, we abstained from offering candles made entirely from it, and merely employed it as an ingredient with other materials in the manufacture of the better class of candles. So far back

as 1851, we had assisted, in becoming shareholders to the Irish Peat Company, in the attempt to obtain paraffine from the bogs of Ireland. It was not until November, 1856, that they were in a position to deliver paraffine, at which time we received supplies; and from this source, and a quantity of Rangoon paraffine, we, in March, 1857, manufactured and put in the market for the first time paraffine candles of English make. The price at which they were introduced was 2s. 4d. per lb.

Mr. Butler has been mentioned as one of those chemists who had experimented upon oils obtained from coal, &c., previously to the patent obtained by Mr. Young, and there is no doubt he found also solid paraffine among his products, as will be seen from the following statement:—Extract from patent granted to Richard Butler, Jan. 29, 1833 (40 years ago it must be remembered), No. 6,375: "When the residue of No. 2 distillate is exposed to a low temperature, there will soon appear small flakes of a white, odourless, and light substance, which is a compound of carbon and hydrogen." There can be little doubt, I imagine, that this was paraffine. Nearly all the oil and solid paraffine in Scotland is now made from shale. The last of the Boghead coal was, at the commencement of the year 1872, stacked in a field near Bathgate to the amount of several thousand tons, the greater part of which was destroyed by an accidental fire a few months afterwards.

The following is an outline of the processes employed in Messrs. Young and Company's and other large works for the production of the hydrocarbons:—The shale is placed on the retort and heated, care being taken not to exceed low redness. This is of the utmost importance, as a higher temperature would inevitably produce gaseous products. When all the oil has ceased running, the operation is stopped. This crude product, which is highly impure, is redistilled, producing a certain amount of coke as residue, the distillate being technically known as "once run oil," a specimen of which is before you. This is agitated with strong sulphuric acid (in the original patent its own volume, but experience has shown that this quantity is not necessary), allowed to settle, treated with caustic soda, and re-distilled with steam, the products of distillation being fractioned. The first portion consists of naptha, which is run in the general naptha tank, to be ultimately distilled and fractioned to various specific gravities. The second contains the larger portion of burning oil. This is subject to two other treatments with acid and soda, and again distilled and fractioned; the first portion is placed with No. 1 distillate, and the last portion with No. 3. The third, heavy oil, is cooled and pressed for paraffine scale, of which mention will be made presently, and the expressed liquid treated with sulphuric acid, soda, distilled and fractioned until the desired specific gravity is obtained; and for its ultimate purification is again acidified, allowed to settle, and finally treated with soda. You will see from this that the crude oil appears to consist of three oils, naptha, burning, and lubricating oil, the heavy oil being the one that contains the valuable solid product, and that these are separated after treatment with acid by means of distillation. The series before you, and to which your attention is invited at the conclusion of the paper, will show the physical character of the various products. The paraffine scale, which, you may remember, has been pressed from the heavy oil, a specimen of which is in this bottle and still contains much adhering oil and a considerable amount of colour, is mixed with a portion of the naptha obtained in the process, cooled, and subjected to severe pressure. The oil and softer portions, being more soluble than the solid paraffine, are dissolved, and a cake, diminished in bulk, is taken from the press. This is again subjected to a similar treatment, and if not sufficiently refined for its ultimate purification, undergoes another pressure with naptha. The loss of this volatile hydrocarbon is somewhat heavy, and to obviate this Mr. Edward Meldrum patented a process, dated 4th June, 1867, No. 1,646, for reducing the impure solid paraffine to a powder, and then introducing or mixing naptha therewith, after which the mass is subjected to pressure, To give the exact words of the patent, an extract may be quoted:—

My said invention consists essentially in the purification of paraffine by treating it while in a cold, unmelted state with naptha, instead, as heretofore, in a melted liquid state. In carrying out my said invention, I reduce the impure solid paraffine to a powder, and then introduce therein sufficient naptha to make it into a paste or pulp, after which I subject the mass to pressure; or the solid impure paraffine and naptha may be ground up together, and the mixture may be then subjected to pressure. By repeating three or four times the operation of re-grinding the paraffine to a paste or pulp with naptha, and then squeezing it in a press, the paraffine can be freed from the heavy hydro-carbon oils with which it is contaminated in its impure state.

This must, it would be thought, save a loss in naptha; but whether the process has been successful or not, I cannot say.

The cakes thus purified are melted in a still, through which free steam is violently passed, as well as confined steam in a worm at about 25 lbs. pressure, in order to raise the temperature, until every trace of spirit is evolved and the condensed water contains no trace of naptha. The product from the still is mixed with from three to five per cent. of animal charcoal, heat is applied, and the charcoal allowed to settle. Some finely divided particles remain, however, suspended in the supernatant liquid, and these must be separated by filtration. You will observe on the wall a diagram of a filter employed in the works of Messrs. Young. It consists essentially of a jacketed case kept hot by steam, and lined with a cylinder of wire gauze which is coated internally with flannel, and to make the filtration still more perfect filtering paper is introduced, so that the paraffine flows through absolutely free from solid particles, and if pure, as colourless as distilled water. This is run into cakes of various forms and sizes, generally in shallow oblong tins. Messrs. Young, however, prefer the circular shape as more adapted for transport in casks. Specimens of either form are exhibited.

In the rapid description of the production and refining of solid paraffine from the oils and impurities with which it is associated, it will have been observed that naptha or other light spirit was employed in its purification, the object being to wash out the greater part of the colouring matter by means of these solvents, and to render the partially purified substance fit for its final passage through animal charcoal. No process can be more successful, as the beautiful results of many eminent houses abundantly testify. But there is an amount of danger attending the operation which many

manufacturers have endeavoured to avoid, and some with considerable success. Two or three of the most important it may be as well to mention, first, the patent of Mr. John Fordred, No. 1858, A.D., 1871.

This gentleman, anxious if possible to avoid the use of naptha or other inflammable liquid, imagined that by kneading, so to speak, crude paraffine scale in a slightly warm akaline liquor, the alkali would probably form a species of emulsion with the oleaginous portions of the hydro-carbon, and the heat rendering the solid part plastic, the oils and colouring matter could be separated by a rough filtration. The earliest experiments were kindly explained to me by the patentee; a little bag, such as this, was filled with the crude scale, and after being soaked in warm water for some minutes, was kneaded by the hand exactly as, in lecture experiments, the separation of starch from gluten is effected, in the proximate analysis of flour, the starch representing the oil, the gluten the solid paraffine which remains in the bag. After many experiments the apparatus was devised, which is thus described in the patent, and of which a model is before you:—

"In carrying my invention into practice I proceed as follows:—I take say one ton of crude paraffine, having, for example, a melting point of 120° Fah., and melt it carefully in an iron tank, and allow the mechanical impurities, such as tar, sand, and the like to fall to the bottom; after a few hours' repose I run off the clarified paraffine into a number of flat metal trays, in which it solidifies into cakes, weighing about ten pounds each; these cakes are then placed edge to edge in a long bag of peculiar construction, and submitted to heat in a warm room, or in a bath of warm water till brought into a plastic condition. When this object has been attained, the bag of paraffine is submitted to the action of the kneading machine, which is supplied with a solution of soft soap in water, made in the following proportions:—Soft soap 10 parts, water 10 parts, previously heated to about 100° Fah. This I call the soap bath. On the machine being set in motion, the oil and colouring matter contained in the crude paraffine will rapidly combine with the soapy liquor, and form a temporary emulsion. I find that any kind of soap soluble in water will answer for the above purpose, but I prefer to use the soft soap of commerce, and in the proportions named. I do not confine myself to the use of a bath of soap and water only, as I find that various other liquors will act upon the paraffine whilst in a warm and plastic condition, such as solutions of the carbonated and caustic alkalis, mixtures of these with solutions of soap, a solution of rosin in alkali, the residual acid or alkaline liquor deposited from acidified hydro-carbon oils after washing or neutralisation, and, for some purposes, even warm water itself is sufficient."

The little model on the table will explain the necessary manipulation. The paraffine, previously freed from dross, &c., is placed in the bag, which is tightly fastened to the drum. This drum revolves, and, by means of a little apparatus at the side, can be pressed nearer to a smaller drum underneath, which revolves in a contrary direction. In this manner the oil is squeezed out by a kneading process caused by the action of the spokes of the larger and smaller drums.

A second patent granted to R. M. Letchford and W. B. Nation, No. 890, A.D. 1872, comprises, say the patentees, two objects, first, economy in the materials and labour employed, and secondly, the freedom from danger arising from the use of paraffine oil in the usual methods of refining.

The process is conducted in the following manner:—

"We provide a tank, say about 12 ft. by 6 ft. and $2\frac{1}{2}$ ft. deep, divided by cross partitions into V form cells $2\frac{1}{2}$ inches wide at the top and 2 inches at the bottom. The cells are open at the bottom, as the partitions stop short at 2 inches from the bottom of the tank; their upper ends are 9 inches from the top of tank; there is a space of about 1 inch between cell and cell; there is a perforated lid or grating to fit into the tank resting on the top of the partitions. A grating with bars $1\frac{1}{2}$ inches apart is suitable. We fit steam pipes (free or closed) into the tank below the partitions. In using this apparatus we run water into the tank to the depth of 6 inches and fill crude paraffine into the cells of the tank, and then secure the lid or grating to prevent the paraffine floating. We run more water into the tank to within 2 inches of the top, and turn on steam until the temperature of the water is within about 10 deg. Fah. of the setting point of the paraffine under manipulation; then we shut off the steam to allow the heat time to permeate the material. In about one hour we increase the temperature, raising it gradually for about four hours to within 2 deg. of the setting point of the paraffine that was put into the tank; then we shut off the steam and take off the soft portions which have floated to the surface of the water. This being done, we run the water off to the top of the divisions, then melt the remaining paraffine in its cells, and let it stand to cool all night. In the morning the steam may be turned on again to repeat the operation, which is done as often as necessary to obtain the purity and hardness required. It is rarely necessary to do so more than four times; or the process may be conducted by first melting the paraffine in the cells and then cooling to 2 deg. below the setting point of the material. We then secure the lid, add more water, and float out the soft portions. In either way we finally remove the lid and take out the paraffine from which the low melting portions have been extracted; the low melting portions which have been removed are to be again treated like the crude.

"For obtaining fine degrees of whiteness, when the foregoing operations have been carried far enough, we remove the clean paraffine to a steam-jacketed pan, adding thereto about 7 per cent. of commercial ivory black in powder, and keep it melted for four or five hours, until the whole of the ivory black is precipitated. We then cast into cakes in the usual way; the ivory black may afterwards be used advantageously in making blacking."

There is one more patent which may be mentioned, among a host of others (No. 3,241, A.D. 1871, granted to Mr. Hodges):—

"The crude paraffine having, if desired, been first separated from rough impurities, is cast into cakes and allowed to cool slowly, so as to form into well-developed crystals. The cakes are then placed on a bed of absorbent or porous material, and are while thus placed exposed to a warm temperature, sufficient to render fluid the more easily melted portions with which the crystallised paraffine is mixed, but insufficient to melt the paraffine. The fluid and more easily melted portions then flow out from between the crystals of paraffine, and into, or into and through, the absorbent or absorbent and porous materials on which the cake rests. The cake—thus freed from the fluid, or fluid and more easily melted portions—may then be treated in any usual method to render it white, or as much lighter in colour as may be practicable; or the process may be repeated until the separation of the harder from the softer portions has been effected as completely as is desired, and then any requisite process for whitening the product may be adopted if needed." *

It will be seen that all these processes have for their object the removal of the liquid from the solid hydro-carbons. It would be out of place to give one the preference over the other. Each of the patentees considers, doubtless, that his idea is the best.

The partially purified paraffine, as you will observe from the specimens on the table, is by no means colourless, and upon a closer examination will be found still to possess considerable smell. One method for its further purification may be thus described. Let us take, for example, this

* This process is carried on upon a large scale at Price's Candle Company, and the manager has kindly lent me a model in order to illustrate its working.

material obtained according to the patent of Mr. Fordred. After being melted by free steam to separate any water or alkali which may be mechanically retained, it is poured into a tank and agitated by means of air, with from five to ten per cent. of strong sulphuric acid, the sulphurous acid evolved, resulting from decomposition, is conveyed away by a suitable apparatus. The agitation is carried on for some hours, very much depending upon the nature of the paraffine, and the experienced manufacturer can easily tell when the desired result is effected. Here are various specimens before us of acidified cake, as it is termed, both before the tarry mass has subsided and after remaining at rest for some hours. It will be observed that that which is immediately drawn off is darker in appearance than that which has been allowed to rest, containing as it does a large quantity of black specks, an aggregate of which is seen in the sample of tar in this dish. The best of these products is still, however, far from white, and the acidified paraffine has yet to undergo a further treatment. Animal charcoal, the substance previously mentioned as a bleaching agent, is generally employed, The paraffine is warmed and digested with the charcoal for some hours; the latter is allowed to subside, and the liquid, if not quite bright, is passed through a filter kept warm by a steam-jacket. But lately, other bleaching agents have been used which are deserving of notice.

A patent was granted to Messrs. Fordred, Lambe, and Sterry, in A.D. 1868, No. 610, for the use of fuller's earth as a decolouriser of paraffine and other bodies, an extract of which may be quoted—

"Fuller's earth we also use for finishing the bleaching of paraffine in lieu of animal charcoal, whatever the previous process of purification may have been. In that case about twelve per cent. powdered Fuller's earth is added to the melted paraffine, which is manufactured at a temperature of about 230 deg. Fah., and well agitated, and after subsidence the clear paraffine is run off. We find that in all our processes, where we have mentioned Fuller's earth as the agent to be employed, we can replace that substance in great part or wholly by marl clay, or other readily-attainable natural substance of like character. The Fuller's earth or analogous substances used in place thereof in any of the ways stated above, may be re-used, and the paraffine remaining adhered may finally be recovered from it by washing with agitation or by other suitable means."

This process is so simple and expeditious that it may be shown as a lecture experiment, and while the earth is being added, and the paraffine brought to the required temperature, and the particles allowed to settle, I will proceed to notice another method of bleaching lately patented by Mr. Arthur Smith and myself, which in many respects obviates certain disadvantages that accrue from the use of fuller's earth. Fuller's earth and many other natural silicates are undecomposable even by strong acids, although certain silicates of lime or magnesia on both these bodies are decomposed when the acids are concentrated, forming a gelatinous residue of silica and solutions of the bases. It occurred to us that, by forming artificial silicates and employing them as instead of natural as proposed in the previous patents mentioned, these compounds might be employed, and the paraffine or other hydro-carbons separated by the addition of very weak acidulated matter. We experimented with the silicates of lime, magnesia, manganese, iron, and some others, and although all answered admirably, we came to the conclusion that the magnesia salt was the best, a less amount being required to ensure the full bleaching action required. At the first glance, any of these substances, even the lime salt, seems too costly to admit of practical application, but it will be shown presently that this is not the case. The process of manufacture and of the re-construction of the salt may be illustrated by the row of beakers before you on the table.

No. 1 contains a solution of sulphate of magnesia.

No. 2 a solution of silicate of soda.

When the contents of these two beakers are mixed, there is, you will observe, an immediate precipitate of silicate of magnesia. This is washed thoroughly by decantation. The washing is exemplified in beaker No. 3.

No. 4 contains the substance dried by steam heat.

No. 5 contains the acidified paraffine, which, when liquified, is ready for the reception of the silicate.

No. 6 was exposed before the lecture to the action of the silicate, which has subsided as a dark mass, leaving the paraffine pure and colourless.

No. 7 contains a quantity of the contaminated silicate, which in No. 8 has been subjected to the action of weak acid, and you will observe three distinct divisions. That on the surface is the separated paraffiine; the centre a solution of sulphate of magnesia; and at the base, precipitated silica. The sulphate of magnesia arising from the decomposition of the silicate by sulphuric acid is neutralised and placed in glass.

No. 9, and the precipitited silica after washing is dissolved in caustic soda, and removed to glass.

No. 10. Nos. 9 and 10 when mixed, produce, as you see, the original salt employed, so that really, after the first cast, we can re-form the silicate at the expense only of sulphuric acid and caustic soda.

It is very important to mention that the success of this process depends upon the purity of the salt, and the manner in which it is dried. If the gelatinous mass in that beaker were simply desiccated without previous washing, and the soluble saline body (in this case sulphate of soda) retained, the porous structure, or whatever it may be of the silicate, would be, so to speak, stopped up, and all bleaching action impeded. And if the washed product were heated to redness, its decolorising power would also be destroyed. It must be dried at 212° and no higher, and thus the far cheaper and simpler operation of fusing silica with dolomite is inadmissable; the resulting silicates would be valueless. Fuller's earth, which is simply ground, contains naturally a large quantity of water, and this substance also, if heated to redness, is of no avail in paraffine refining. And yet a more singular fact is this, that although we must have a hydrated compound, no bleaching action takes place until the water is separated. Melted paraffine, as far as my own experience extends, may be agitated either with fuller's earth or artificial silicate for any length of time, without any perceptible action, at a temperature slightly higher than its melting point. The colour seems to disappear when the water is driven off, as if it took its place, and could not be dissolved from the

hydro-carbon, however long the operation might be extended. By this time, it may be hoped, you will be enabled to see the bleaching action of the fuller's earth in the experiment which was prepared a short time back, and is now awaiting completion.

It must not be supposed that the bleaching action of the two substances that have just been discussed is confined to solid hydro-carbons. Paraffine oil is rendered water-white by digesting it at a moderate temperature, with either fuller's earth, or an artificially prepared silicate. In conclusion, a few of the applications of this beautiful substance may be briefly enumerated. Independently of its chief employment as a source of artificial light, through the medium of lamps and candles, it has been advantageously applied for other purposes. It has been proposed to saturate gunpowder with melted paraffine, in order to retard its explosive action, if required; it having been ascertained that a smaller sized grain might be substituted for a larger, when subjected to this treatment. The powder is digested with the paraffine, and the excess of the latter removed by steam heat. It is a non-conductor of electricity, and has been used extensively as an insulator, in electro-telegraphic science. It has also been employed, when dissolved in naptha, as a preservative of stone and brick-work, permeating the interstices of the mass, and repelling the action of wind and rain. When melted with india-rubber, it produces a good waterproof compound, which can be applied to wearing apparel. It has been used advantageously for polishing cloths, giving them a fine and smooth surface. Dr. Lawson Tate has made use of paraffine in surgery, employing it as a covering for splints in fractured limbs with very considerable success. The laundress has discovered that by rubbing a small piece of paraffine on a warm flat iron, a beautiful gloss is imparted to linen, and the humble manipulation is much lighted by the ease and celerity with which the iron travels over the clothes, at the same time leaving no greasy stain in its track. The horticulturist has also found that paraffine, when mixed with bees-wax, can be excellently applied in the budding of roses, or the grafting of fruit-trees. Mr. Veally has shown that it is most useful in the preservation of beer barrels, preventing them from becoming foul; and it would be difficult, at the moment, to narrate its many applications, or to speculate upon its future. As paraffine will not dissolve the aniline colours, it may be asked how the beautiful tints are produced which serve to embellish the candles you see before you. The colours are dissolved in stearic acid, which is afterwards diluted with the paraffine, the colour remaining in a mechanically suspended state. If a candle, slightly tinted, is melted, and the liquid passed through bibulous paper, the filtrate is white, and the dye remains on the filter.

The insolubility of certain colouring matters, especially those from aniline, may be employed successfully in determining the freedom of paraffine from stearic or other fatty acids. The specimens before you may illustrate this fact. The first specimen is that of paraffine which has been subjected to a temperature of 212° with rosaniline. The second is the paraffine fused with 2 per cent. of stearic acid, and has, you will observe, a distinct pink colour. The third sample contains 5 per cent. of stearic acid, and the crimson colour is in this instance fully developed. Petroleum and the mineral ozokerit, both closely identified with the paraffine industry, would each demand a separate lecture, and however pleasant it would be for me to speak about these interesting bodies, I feel that I have exceeded the time allowed me, and that your kind attention has already been exercised too long.

DISCUSSION.

Mr. F. A. Abel, F.R.S., said he had been much interested in the lucid account given of the paraffine industry, especially with regard to the purification and the different applications of the paraffine itself. He had himself from time to time become practically acquainted with some of its applications, for instance as a means of retarding the explosive properties of gunpowder. Some extensive experiments were made in that direction in 1867 and 1868, at Woolwich, with different kinds of gunpowders. The grains were immersed in a bath of melted paraffine for a short time, and afterwards allowed to remain at a temperature of about 180° or 200° F., so as to allow the paraffine to thoroughly impregnate the grains, and the result was that the gunpowder became remarkably repellant of water, so that it might be preserved almost under water for some time without any great tendency to change. It also had the effect of retarding the combustion, so that the powder might be made to burn comparatively slowly, but on attempting to obtain a powder so treated which was available for projectile purposes it was found that a very great loss in power was sustained. According to his recollection, in guns of nine-inch calibre it was found necessary to employ 60lbs. of gunpowder so treated to obtain the same velocity as that given by 45lbs. of unprepared powder; it was also found that the comparative slowness of the combustion increased the recoil, and largely increased the fouling, because of the non-volatilisation of the paraffine, and the retention of a portion of unburnt carbon. On the whole, therefore, the results were not so valuable as was anticipated, and it was found better to obtain the end sought, by increasing the size of the grain, and the density and compactness of the masses. He had also become acquainted with another application of paraffine to the preservation of stone, having been consulted with regard to several processes for preserving the stone of the Houses of Parliament, some of the most promising of which consisted in the application of paraffine in different ways. It was found, however, that when applied after being heated to any considerable extent, the effect was decidedly detrimental, and the stone decayed much more rapidly than when left to itself; on the other hand, when applied with solvents, or at a very low temperature, it furnished more promising results. It had also been found very useful as an application to different fabrics for rendering them water-repellant, and it had been very useful in this way in connection with military equipments—for the preparation of tent cloths, sheets on which soldiers might lie during the night, treating the soles of boots, and for various other similar purposes. The late Dr. Livingstone had written to Dr. Stenhouse saying how grateful he had been to him for sending out some boots and ground sheets which had been prepared in this way. He should have much liked to have had some further information with respect to the peculiar property of paraffine—the great variations in the hardness of the material; sometimes it was almost so soft as to be readily moulded by hand, whilst at others it was comparatively hard. He recollected that in the early introduction of paraffine candles, sometimes they were so soft as to be very readily bent, and he should like to know

whether this was simply due to a difference in the refining, or whether there might be different varieties of paraffine possessing different degrees of hardness, with which they might hope to become more thoroughly acquainted by-and-bye.

Mr. Fordred said one property of paraffine which had not been noticed was its great tendency to become discoloured. He had examined very many specimens in different manufactories, but he had never found one which would permanently stand the action of light; it always became more or less discoloured in the course of time. A gentleman who had visited the Vienna Exhibition had told him that on mentioning this point to German chemists they said it was utterly impossible, and quite laughed at the idea of obtaining a changeless paraffine.

Mr. Grazebrook remarked that amongst the different uses of paraffine, one of perhaps as much practical use as any if more generally adopted, was the lining of casks and barrels for which it was eminently adapted. It was a perfectly pure material, which would not taint, and it had the further great advantage that it prevented the escape of carbonic acid gas by filling up all the pores and joints in the wood, thus fulfilling a great desideratum for the perfection of condition in both beers and wines. He believed it only required to be more generally known to be extensively used for this purpose. One of the great advantages of the Vienna beer was that it was kept in casks which were lined with a preparation of resin, but there could be no doubt that paraffine was in every respect a preferable material.

Mr. Abel said he was reminded by the observation of the last speaker of another application of paraffine which was a very valuable one. It was very difficult of attack by any chemical agent; so much so, that it might be left in contact with concentrated acid without undergoing any change, and this had led to its use as a material for lining the wooden boxes used in the construction of voltaic batteries which contained strong saline or acid solutions. Some years ago, when the manufacture of gun-cotton was first attempted experimentally in this country, the vessels in which the cotton wool was to be converted into gun-cotton consisted simply of soft wood thoroughly lined inside with paraffine, and these were used for several weeks together without any action upon the surface by the strong mixture of the most concentrated sulphuric and nitric acids. It was only when by some slight accident a part of the paraffine coating became removed that the acid got access to the wood, and of course an oxidising effect was produced at once.

Mr. Field, in reply, said he did not think the difference in the melting point of the different samples of paraffine was as yet understood. He had samples upon the table of paraffine, the melting points of which varied from 130° to 135°, being as hard as it was possible to make it, and there were others with melting points as low as 90°, which were yet exactly of the same chemical composition. He might mention, however, that a paraffine of low melting point had always a lower specific gravity than one with a high melting point. Thus, there would be about 10 per cent. difference in specific gravity between two samples whose melting points were respectively 90° and 140°. It was very remarkable, however, if stearic acid, which melted at 130°, were mixed with paraffine which melted at 130°, the product would be a fusible mass which would melt at 114°; and if you take a paraffine with a lower melting point, say 90°, and mixed it with stearic acid, you get an actual liquid produced which would keep liquid at the ordinary temperature of a room. This seemed analogous to the fusible alloy made of lead and bismuth, which would melt at a point much below either of the metals employed.

A vote of thanks to Mr. Field was then proposed by the Chairman, and carried unanimously. A similar compliment to the Chairman himself terminated the proceedings.

FOURTEENTH ORDINARY MEETING.

Wednesday, March 11th, 1874; T. R. Tufnell, Esq., Treasurer to the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Bartholomew, Alfred J., 5, Newcastle-place, Clerkenwell, E.C.
Coussmaker, Captain George, Westwood, Guildford.
Eschwege, Hermann, 6 and 7, Coleman-street, E.C.
Heath, Burr, 19, Carter-lane, E.C.
Higgins, P., 15, Bury-street, E.C.
Holliday, John, Meyrick-house, Hill-top, West Bromwich.
Hörstmann, F. Oden, Messrs. H. Hörstmann and Sons, Philadelphia, U.S., America.
Lawford, William, 1, Westminster-chambers, S.W.
Looker, Benjamin, Kingston-on-Thames.
Lotz, William Frederick, 19, Carter-lane, E.C.
Murton, James, 8, Argyle-square, W.C.
Robertson, David J. U., 174, Chatham-street, Liverpool.
Stark, W. Emery, 23, Bedford-street, W.C.
Weinmann, Dr. F. L., 5, Wykeham-villas, Wandsworth-common, S.W.

The following candidates were balloted for and duly elected members of the Society:—

Bland, Charles, White Horse-road, West Croydon.
Clark, Joseph, 69, Hamilton-terrace, St. John's-wood, N.W.
Deacon, George F., C.E., Borough and Water Engineer, Municipal Offices, Dale-street, Liverpool.
Gillett, William, White Horse-road, West Croydon.
Irvine, James, Messrs. Irvine and Wood, Dale-street, Liverpool.
Laws, John Milligen, 10, Askew-road, Shepherd's-bush, W.
Trickett, John, H.M. Dockyard, Keyham, Devonport.
Wickenden, Alfred Authorn, Cyprus-house, Friudsbury, Kent.
Wythes, George Edward, Copt-hall, Epping, Essex.
Zimmermann, Edward, 6, Great Winchester-street-buildings, E.C.

The Paper read was:—

ON COCOA AND ITS MANUFACTURE.

By John Holm, F.R.C.S. Edin.

The subject, the consideration of which will occupy our attention this evening, and which I have the honour of bringing before you—namely, "Cocoa and its Manufacture"—is one of considerable importance, treating as it does of one of the most valuable foods which man derives from the vegetable kingdom.

The cacao or chocolate tree, which yields the cacao—cocoa—or chocolate-nut, belongs to the natural order *byttneriaceæ*. Linnæus bestowed on it the name *Theobroma*, derived from the Greek words Θεὸς (God) and Βρῶμα (food); and is stated to have been given to the plant in consequence of that great botanist's delight in the food-drink prepared from its seeds, in which it is stated he largely indulged and somewhat ideally regarded as "food fit for the gods." Of the species *theobroma*, there are nine individuals mentioned by botanists, of which the *Theobroma cacao* is the most important, and yields the best and finest fruit.

Varieties of the Cacao Tree.

Name.	Country.
Theobroma Cacao (*Sativa*) (Linnæus)	West India Islands.
Theobroma ovalifolium (De Candolle)	Mexico (Soconuzco).
Theobroma angustifolium (De Candolle)	Mexico.
Theobroma Guyanense (Aublet)	Guiana.
Theobroma bicolor (Humboldt)	Brazil and New Granada.
Theobroma speciosum (Wildenow)	Brazil (Para).
Theobroma sylvestre (Martius)	Brazil and Jamaica.
Theobroma microcarpum (Martius)	South America (wild species).
Theobroma glaucum (Kusten)	

The cacao tree is indigenous to tropical America, and is there found in its wild state. The range of latitude in which it grows may be placed as between the seventeenth parallels, in which area it flourishes best; its cultivation has, however, been extended with success as far as the twenty-fifth parallels; its range of altitude extends from a few feet to 1,760 feet above the level of the sea. Mexico appears to be the original home of this tree, from whence it gradually extended into South America and the West India Islands. At the time of the discovery of Mexico by the Spaniards, it was almost the only plant in the cultivation of which care was taken; it was grown in large quantities, and great pains were bestowed upon it, it being regarded by the natives as the most valuable product of their country. The tree was called by the Mexicans "Cacava quahuitl," and also "chocolalt;" while the preparation made from its seeds was named "chocolatl," a name said to be derived from the noise made by crushing the bean between two stones. It is from this native nomenclature that we derive the words cacao and chocolate, the former of which has been corrupted into the better-known word cocoa, applied generally both to the seeds of the plant and the preparation derived from them.

The cacao tree is an evergreen of very beautiful appearance, and has been likened in height and form to the cherry tree. It is taller in its wild than in its cultivated condition, in which the height is curtailed. The height of the adult trees ranges from fifteen to forty feet. The wood is porous and light, but capable of taking a high polish. The bark is of a cinnamon colour, becoming deeper as the age of the tree advances. The foliage is profuse, the leaves being of a green colour, varying in shade according to the species and nature of soil. They are smooth and glossy, lanceolate in form, with plain edges. In size they vary from 7 to 10 inches in length, and from $2\frac{1}{2}$ to $3\frac{1}{2}$ inches in breadth, growing principally at the top of the tree. The flowers are very plentiful; they are small and clustered, and spring directly from the larger branches and the trunk itself, and according to Humboldt, even from the roots of the tree if these are left uncovered. They are of a saffron and sometimes a pink colour, and are devoid of scent. The buds are similar to cherry stones in size and form, and of a whitish-pink or green colour. Large numbers of the flowers fall before attaining maturity, and thus the yield of the fruit is greatly less than the number of the blossoms put forth; not more than one pod being usually produced from each cluster of flowers.

The cacao fruit, or pod, is of an elliptical ovoid shape, and pointed at the end; it varies con-

The Leaf and Flower of the Cocoa Nut with the Pod open.

siderably in form in the different species, and measures from 7 to 10 inches in length, and 3 to $4\frac{1}{2}$ inches in breadth. The surface is somewhat rough, with deep longitudinal furrows. In colour the surface is green, but as it ripens it becomes of a bluish red colour, gradually deepening to a decided purple; or else, in certain varieties, it becomes of a delicate yellow or lemon colour. The rind of the seed pod is about half an inch thick, is tough, and requires some force to break it. The pod is divided into five compartments, in each of which is ranged a row of five to ten seeds, lying in a gelatinous pulp. A single pod thus yields from twenty to forty seeds. It is these seeds which form the raw cacao, or cocoa of commerce, from which the various preparations of manufactured cocoa and chocolate are made. I shall now pass on to give a brief description of the general mode adopted in the cultivation of this valuable plant, merely premising that slight differences of method obtain in different countries and districts.

In the selection of ground on which to form a cacao plantation, it is necessary to choose a spot in which the soil is rich and loose to a considerable depth. It should also be near a stream, so that efficient means of irrigation may be ensured. The tree is found to flourish best on hilly slopes which face away from the quarter whence the cold winds which prevail may blow. The young plants should be reared in nursery grounds, where the seeds are sown in small mounds placed at short distances from each other. In each of these two seeds are placed, but when both germinate it is usual to destroy the weaker of the two plants. In ten or twelve weeks these should have attained a height of fifteen to eighteen inches, and are then fit for removal to the plantation. The ground has here been previously prepared, and as the cocoa tree requires protection from both the sun and wind,

banana and coral-bean trees, the latter called "madre di cacao," are planted at intervals between the spaces allotted for the cocoa trees, which are placed in rows at regular intervals, varying according to the nature of the soil, from fifteen to thirty feet. When the tree has attained the age of two years, it puts forth several branches, and the flowers now shortly begin to appear, but are removed that the strength of the tree may not be impaired. About the fifth year the tree is very rich in foliage and strong enough to bear, and the blossoms are now allowed to mature. It is not, however, until the eighth or tenth year that it yields a plentiful crop. It then continues prolific for thirty or forty years.

One of the peculiarities of this tree is that the leaves, flowers, and unripe and mature fruit may be seen growing plentifully at one and the same time. The fruit therefore has to be gathered when ripe throughout the year, but there are two periods at which the produce is most plentiful; these are the months of June and December, which are regarded as the harvest months of the cocoa plantations.

In gathering the cocoa crop the workman whose duty it is to select the pods (this requires great care and experience) is armed with a long, wooden fork, with which he disengages the fruit from the tree. He is followed by others, who collect the fruit into heaps and carry it into sheds, where the pods are opened and the seeds taken out. Each tree will yield from one pound and a quarter to eleven pounds per annum. The seeds have now to undergo a peculiar process, called "curing," before they are fit for use by the manufacturer. This process is one of great delicacy, and requires much experience and skill to conduct it successfully. Upon it depends in a very great degree not merely the preservation of the cocoa, but the development in it of a fine flavour. There are two modes of conducting it. The simpler one is merely to place the cocoa seeds, when taken from the pods, in heaps in the sun, and these are stirred at intervals. A sufficient quantity of the pulp in which the seeds are imbedded adheres to them to supply enough moisture to give rise to a moderate amount of fermentation, which ceases when the nuts are sufficiently dry to be packed. The other mode is by "claying," that is, the nuts are placed into holes or trenches dug in the ground, and covered with clay or sand; they are stirred at intervals, and great care is taken to prevent the fermentation which arises from proceeding too violently. When it has reached its proper point, the nuts are spread upon a platform or upon mats until perfectly free from moisture, when they are placed in bags.

The use of cocoa as a food by the Mexicans, at the time of the discovery of that country by the Spaniards is the first knowledge we have of it. With them it was esteemed the most valued product of the country, and Prescott informs us the Emperor Montezuma took no other beverage. The seeds were also used as coins, a fixed value being attached to them, and this custom Humboldt tells us was in existence in his time. The Spaniards did not at first appreciate the virtues of chocolate, and one of their earlier travellers describes it as a "drink fitter for a pig than a man;" but this feeling speedily changed, and their love of this beverage became almost a passion.

The method of the Indians was followed by the Spaniards, whose process is thus described by Simmonds:—

"The kernels are roasted in an iron pot pierced with holes; they are then pounded in a mortar, and afterwards ground between two stones, generally of marble, till they are brought to a paste, to which sugar is added, according to the taste of the manufacturer. From time to time, as the paste assumes consistency, they add long pepper, arnatto, and lastly vanilla. Some manufacturers vary these ingredients, and substitute cinnamon, cloves, aniseed, and sometimes musk and ambergris."

The introduction of cocoa into Europe may be placed at 1520, when Columbus brought home samples of the nut. Spain, however, for some time depended on the colonies for the manufactured article, but when the art of preparing it was conveyed there, the raw material was also imported. The Spaniards, by jealously guarding as a secret the mode of manufacture, were able to retain the monopoly of all trade in chocolate for many years.

The value of chocolate was speedily appreciated by the physicians of Europe, and Hoffmann wrote a monograph treating of it, entitled "Potus Chocolati" in which he recommends it in many diseases, and instances the case of Cardinal Richelieu, who, he states, was cured of general atrophy by its use.

It was probably more than a century after the introduction of cocoa into Europe before the English became acquainted with it. According to my late partner, Mr. Hewett, the earliest mention of its use appears in a newspaper called Needham's *Mercurius Politicus*, dated the 16th of June, 1659. For many years England continued to import all the chocolate she consumed in its manufactured state; but I believe about the commencement of last century several persons commenced the manufacture in this country. There is very strong reason to believe that a knowledge of the mode of preparation was brought into England by Sir Hans (then Dr.) Sloane.

Before considering the modes of manufacture which have been adopted in this country, it will be convenient to notice the characters and chemical composition of the cocoa beans. In shape these are something like an almond, but rather thicker; they vary both in size, shape and quality, the various growths having distinct characteristics. Our principal supplies are drawn from Trinidad and the Spanish Main, which yield the best qualities; and from Ecuador and Peru, the Island of Grenada, and Guiana. The following is a list of the cocoa growing countries:—

Country.	Commercial name of growth.
Trinidad	Trinidad.
Mexico	Soconuzco.
Spanish Main:—	
New Granada	Magdalena.
Venezuela	Maracaybo. Caraccas.
Guatemala	Central American.
Ecuador, Peru	Guayaquil.
Grenada (Island of)	Grenada.
Guiana	Surinam. Berbice.
Cuba, Guadeloupe, Martinique, St. Croix, St. Lucia	The name of each island.

Dominica	The name of each island.
St. Vincent	The name of each island.
Jamaica	The name of each island.
Brazil	Para. Maranham. Bahia.
Guinea (Western Africa)..	African.
Bourbon	The name of country; yield quite unimportant.
Philippines	
Mauritius	
Madagascar	
Australia	

I would now recall to your minds the manner in which the cocoa nuts or seeds are contained in the cocoa pod. If we examine the seed as imported, we find that it is enveloped in a husk or shell of its own. When this is removed, the surface of the nut is seen to be marked by slight grooves, which divide it into irregular portions. These depressions mark the position of a fine membrane, which penetrates into the substance of the seed and divides the two cotyledons from each other, and also each of these into several lobes. It is these irregular segments of the cotyledons which, when broken down, form cocoa nibs.

The chemical composition of cocoa is shown in the table before you, which gives the different analyses of any importance which have been made:—

Analyses of Cocoa.

	Lampedius.	Tuchen.	Payen.	Johnson.	Playfair and Lankester.	Miller.	Boussingault.	Mitscherlich.		Muter.	Average of several other analyses.
Fat (Cocoa Butter)	53·10	36·97	52·00	51·00	50·00	56·00	44·00	45·00	49·00	42·67	50·00
Albuminoid Substances	18·70	...		...	...	17·00	...	13·00	18·00	...	...
Albumin	...	...	20·00	...	20·00	...	20·00	...	...	...	18·00
Fibrin	--	...		...	...	...	...	...	...	...	
Gluten	...	30·20	...	20·00	...	...	...	..	...	12·21	...
Extractive Matter	...	4·14	...	...	...	...	...	...	...	...	...
Sugar	...	...	..	...	...	...	...	0·60	...	...	...
Starch	10·91	0·55	10·00	22·00	7·00		.	14·00	18·00	19·03	10·00
Gum	7·75	0·69	...		6·00		6·00	...	...	6·40	8·00
Lignine	0·90	...	...	...	...	22·00	13·00	...	...	.	...
Cellulose	...	30·00	2·00	...	...			6·08	...	5·95	...
Woody Fibre	...	...	...	...	4·00		...	..	...	...	...
Colouring Matter	2·01	6·61	traces	...	2·00	...	...	3·05	5·00	3·96	2·60
Water	5·20	6·81	10·00	5·00	5·00	...	11·00	5·06	6·30	5·98	6·00
Theobromine	...	0·56	2·00	2·00	2·09	1·50	2·00	1·02	1·50	0·90	1·50
Salts	...	3·00	4·00	...	4·00	...	4·00	...	...	..	...
Ash	...	...	...	...	...	...	...	3·05	...	2·90	3·60
Humic Acid		7·25	...	..	...	...	...	...	...	...	...
Parts unaccounted for	1·43	1·02	...	...	...	3·50	...	9·14	...	...	0·30
Total	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	...	100·00	100·00

It is a table which is not very flattering to chemical science, the analyses being of the most contradictory character, and containing discrepancies which can not be at all reconciled with each other. I should judge that the analysis prepared by Drs. Playfair and Lankester is the most correct, while those of Tuchen and Muter appear least so. We thus see that, taking the important constituents, cocoa contains:—

	Parts.
Cocoa butter	50
Albuminoid substances..............	20
Starch, sugar, &c...................	13
Salts..............................	4
Theobromine	2
Other constituents..................	11
	100

Taking these in the order of their importance, we first notice the fat, or cocoa-butter, which forms about half the substance of the nibs. It is a hard, fatty substance which, when clarified, is of a dead white colour. Its melting point is about 100° Fah., which being the heat of the body renders it of great value for therapeutical purposes. The fat never becomes rancid, however long it may be kept, a quality peculiar to itself. It is hardly necessary to point out how valuable this quality renders this portion of the bean, for it places cocoa-butter first in the list of the fatty class of our carbonaceous or heat-giving foods. The albuminoid constituents form about 20 per cent. of the nib. These are classed amongst the nitrogenous principles of food, and their presence renders cocoa one of the richest flesh-formers we have. The starch, gum, and sugar present, like the cocoa-butter, belong to the non-azotised principles; they form about 13 per cent. of the whole. The alkaloid of cocoa, *theobromine*, is very similar in its physiological effects to its analogues, *theine* and *caffeine*, from which it differs very slightly in chemical composition.

Essential Alkaloid Principles.

Yielded by	Name.	Composition.	Proportion.
Cocoa	Theobromine	$C_7 H_8 N_4 O_2$	2 per cent.
Coffee	Caffeine	All identical	1 to 5 per cent.
Tea	Théine	$C_8 H_{10} N_4 O_2$	
Guarana	Guaranine		
Maté............	...		In less quantities

In regard to these alkaloids, it is interesting to note that throughout the world the instinct of man has led him to seek some substance which contains one of these principles, which owe their value to the specific influence they exert on the nervous system, stimulating it and checking waste of tissue. *Theobromine*, when extracted, presents the form of a white crystalline powder of almost amorphous appearance, differing from *caffeine* and

theine, which have a very beautiful crystalline appearance.

In most of the analyses of cocoa the existence of a volatile oil has been overlooked. It is probably present only in small quantities, and appears to be developed by roasting; but upon it depends the flavour and aroma which exists in cocoa.

Having thus noticed the principal component parts of cocoa, a comparison with other foods, as given in the following table, will be of interest as showing its relative value to them.

TABLE SHOWING THE RELATIVE COMPOSITIONS OF

	Cocoa.	Milk.	Meat (Beef).	Wheaten flour.
Fat	50·0	3·5	2·87	1·2
Azotised substances	20·0	4·0	20·75	14·6
Starch	7·0	...	...	59·7
Gum	6·0	...	...	...
Sugar	...	4·3		7·2
Water	5·0	87·5	67·80	13·2
Salts	4·0	0·7	5·60	1·6
Woody fibre	4·0	...	...	...
Cellulose	.	...	...	1·7
Colouring matter	2·0	...	...	..
Ash	...	...	1·60	0·8
Extractive matters	...	...	1·38	...
Theobromine	2·0	...	...	...
Parts	100·0	100·0	100·00	100·0

By this it is apparent that in nutritive power cocoa holds an entirely exceptional position. It combines in a high degree of concentration nearly all the elements necessary to man's existence. It is deficient in moisture, which renders it comparatively richer in both nitrogenous and non-nitrogenous elements than any of those with which it is compared. Thus, although one-half of its weight consists of cocoa-butter, it still presents 20 per cent. of albuminoid material, as against 4 per cent. in milk, 20·75 in beef, and 14·6 in wheat. In addition it contains starch, which is present neither in milk nor beef, but in smaller proportion than in wheat, of which it forms 59·7 per cent. Comparing cocoa with milk, we thus see the former is richer in the nitrogenous substances analogous to those contained in milk, and that the fat also exists in a considerably larger proportion. The same remark applies to beef, and it further contains valuable substances which they do not possess. In wheat, the starch appears to hold the place that the butter takes in cocoa; otherwise, their composition has great similarities, but cocoa has again the advantage of possessing qualities which the other has not. The value of cocoa as a food is thus apparent, and fully justifies the high eulogiums which have been passed upon it by so many men eminent in science. I have noticed the large amount of fat that cocoa contains, and its especial value on account of its non-liability to become rancid. Its presence, therefore, constitutes cocoa as essentially a heat-giving food, of which class it is certainly the most valuable; and its value as such is fully recognised by the instincts of the people who use it much more largely in cold than in warm weather. Drs. Miller and Letheby, amongst many other authorities, state that cocoa owes its chief value to its cocoa-butter, and to this is undoubtedly due the benefit which consumptive patients derive from its use. But its possession also, in so rich a degree, of albuminoid substance, theobromine, and phosphatic salts, renders it almost equally valuable in other ways. Unlike tea and coffee, whose virtues can be extracted by infusion, and the non-soluble parts of which are useless as food, the whole substance of the cocoa nib, if properly prepared, can be taken into the stomach, and all but an inappreciable amount digested. The object of the manufacturer should therefore be, to prepare the raw cocoa in such a manner that the whole of its valuable properties shall be preserved to the consumer; that it shall be easy of preparation, and of such a price as to be within the means of the bulk of the population, for whom it is especially valuable, and far superior to tea or coffee. We will therefore proceed to consider how this end is best gained, and the modes of manufacture practised in this country; with their influence in causing the great increase which has taken place in the use of this food.

For many years after the introduction of raw cocoa into England, its manufacture was conducted in a very rude manner, no attempt being made to separate the husk of the cocoa nut from the nib. The mode of manufacture was to grind the whole bean with sugar and farinaceous substances. This was then either run into rude blocks and called rock cocoa, or cut into cakes or long rolls somewhat of the appearance of short rulers, and sold under the name of cake or roll cocoa. Gradually an advance was made in this rude method of manufacture, and in the preparation of what was called chocolate an endeavour was made to imitate the Spanish manufacturers. This led to the husks being carefully removed, and the ground nibs alone incorporated with sugar, or sugar and farina in the manufacture of what was called chocolate. The mode adopted in the manufacture of chocolate was to roast the nuts, and when cool, to break them down and separate the shell from the nibs. The nibs were then again subjected to a further roasting, and the extent to which this process was carried, then gave the distinctive character to the chocolates produced in different parts of Europe. The cocoa nibs were now placed upon a heated smooth stone, and crushed with a roller until the nibs assumed the form of a smooth paste which was then mixed with sugar, and sometimes some farinaceous substance. Various spices were also now incorporated, according to the flavour desired, and the mass when thoroughly mixed was placed into moulds, where it remained until cool and ready to be turned out.

Another form of cocoa, called flake, was also much used, and this consisted only of the cocoa beans, shell, and nib, crushed in a mill into the form of flakes.

Notwithstanding the inherent value of the food, none of these productions, however, met with any great consumption. They were all expensive, but the finer cake chocolates were of so high a price as to be only obtainable by the wealthy. The cocoas besides being dear were also unpalatable, and owing to the presence of the husk, very indigestible and irritating to the internal mucous membranes. Both kinds, in addition, laboured under the disadvantage of requiring boiling.

This drawback, which is common to all cocoas and chocolates of foreign manufacture, does not

appear in Spain and France to have militated against their large consumption; but for some reason or other—whether it be that we do not as a nation like trouble where it can be avoided—the tedious and somewhat unpleasant process of first having to scrape and then boil the cake of chocolate, carefully stirring the while, and afterwards milling it, has never found favour, and this is one of the reasons that its use was so limited until the last fifty years.

The removal of this drawback is due to Mr. Daniel Dunn. After a long series of experiments in relation to the treatment of cocoa, he found that by making a slight variation in the mode of the preparation and mixture of the sugar with the cocoa nibs, he was able to produce a substance in the form of paste, which only required the addition of boiling water to be ready for use. This cocoa or chocolate paste was the first form of soluble cocoa ever made. From the first, he discarded, in his preparations, the barbarism of grinding up the husk with the cocoa nib, a practice both wasteful and unwholesome.

Having succeeded in producing in the form of paste, a cocoa which did not need boiling, it was found that a serious drawback existed from the need of its being contained in earthenware pots or other vessels. These were not only inconvenient, but being expensive and heavy, they added both to the cost of production and transit. Mr. Dunn therefore further pursued his experiments, and found that by varying his process so as to reduce the amount of moisture, he was enabled to bring the paste into a condition sufficiently hard to enable it to be cut; at the same time the soluble properties still being retained. The cakes had the disadvantage, however, of requiring to be scraped into the cup, a somewhat sticky process; and were also not very pleasing to the eye.

Mr. Dunn, still pursuing his investigations, found that by adding some farinaceous substance (he preferred and only used arrowroot), he could bring the cocoa into the form of a powder, which was more readily miscible even than his previous preparations. This form is the most convenient one in which cocoa can be prepared, and although from the price usually paid, we are accustomed to preparations somewhat inferior in flavour to the finer French chocolates, there is no difficulty in making a soluble cocoa or chocolate powder quite equal in quality to them. The mode of manufacture of soluble cocoa or chocolate powder is as follows. The raw nuts are first picked in order to remove any mouldy or damaged nuts, the presence of which would injure the flavour of the cocoa. The picked nuts are then placed in revolving heated cylinders. When sufficiently roasted—a process which takes from three-quarters of an hour to an hour and a-half—they are either spread out thinly on a grating, or placed in coolers so constructed as to offer a large conducting surface, and are thus rapidly cooled down. The roasted nuts are then conveyed to a kibbling mill supplied with fans; the cocoa is here broken down and the shell winnowed from the nib. When this operation is fully effected, the nibs are slightly warmed before being ground.

A cocoa mill constructed to reduce the nibs into a fine paste consists of two parts, viz., the feed-mill and the grinding-mill. The object of the feed-mill is merely to regulate the supply of cocoa sent into the grinding-mill. The latter is not unlike a flour-mill, consisting of a horizontal bed, on which revolves a runner. These mills have to be heated, and the cocoa runs from them in a smooth, semi-liquid condition, when it is ready for incorporation with the sugar and farinaceous substances with which it is to bo mixed. It is afterwards reduced to a powder. This powder may be made either fine or coarse, it being a question of merely manipulative process, which has no relation to quality. If required very fine, it may have to be more completely pulverised in another mill. But whether coarse in grain or fine matters not; the cocoa is the same in quality. That is, either fine or common preparations may have either appearance. With slight variations of process, this is the only way in which soluble cocoa powder can be produced; that is, it must contain sugar and farina. The cocoa being in the first place very finely ground, the sugar causes it to mix readily, while the farinaceous substance holds the particles of cocoa in suspension, and the whole forms an emulsion.

This mechanical suspension renders the particles of cocoa more digestible, and keeping the globules of cocoa-butter in a finely divided condition, they also are more readily assimilated. Thus the farina, in addition to its important office in aiding in the production of powder, has another distinct advantage. It really causes the cocoa-butter to be in a similar condition as regards the cup of cocoa; that the fat globules of milk are in before rising to the surface as cream. And it does not need any deep physiological knowledge to know that we can take in milk a considerable quantity of these fat globules without inconvenience, whereas the same amount taken in the more concentrated form of cream, would produce indigestion and biliousness. Some chemists have denied that this effect is produced in cocoa by the addition of farina; but by practical experiment I can vouch for the fact. The reason they have fallen into this error is by looking at the subject only from the chemist's view, and not from that of the practical physiologist, and assuming that such a result could only arise from a definite chemical action produced by the farina on the fat. This is not so; there is probably no such action; but by separating the particles of fat, that is forming an emulsion, they are presented to the stomach in a form in which they can be readily assimilated.

As I have before said, soluble cocoa powder is of necessity a compound substance, and should consist only of cocoa, farina, and sugar. Unhappily, excessive competition, and the desire on the part of the public to obtain greater value for their money than is possible to be given, has caused several forms of adulteration to be practised in cocoa manufacture. The more harmless of these is the addition of animal fat to cover the use of a poor cocoa, and to enable the addition of an excessive quantity of sugar and farina; but, unfortunately, as one sin often leads to many, the result thus obtained requires further "doctoring" to render it acceptable to the public taste.

Cocoa, thus adulterated, would be poor in flavour and light in colour, and therefore the adulterating manufacturer must add something, which, while cheap, will impart a flavour which

under much disguise may be mistaken for cocoa. With this view chicory is added, and this is the most harmless of the adulterants used for this purpose of disguise. It is, however, a fraud, as the only object of its addition is to impart a flavour which shall be mistaken by the consumer for that of cocoa, which he will imagine present in larger quantities. *Terra japonica*, or catechu, as well as other substances, has been used to produce the same effect. Curiously enough, these adulterations appear to has baffled the analytical chemists, and this probably because of their addition in the form of concentrated decoctions. We have thus got a cocoa adulterated with foreign fat and chicory, and other flavouring substances, but we have not yet reached the end of these additions. The cocoa now, although seemingly rich in butter and of strong flavour, is not yet sufficiently pleasing to the eye, and therefore the adulterator adds some mineral colouring substances — the most harmless in use being perhaps peroxide of iron—but there are others, amongst which figure such abominations as red-lead and cinnabar, or sulphide of mercury. But for the credit's sake of even our dishonest countrymen we must hope such fiendish modes of adulteration as those just mentioned are no longer practised.

I have thus sketched the mode of manufacture of soluble cocoa powder, and have glanced at some of the frauds practised in its manufacture. As I have already stated, soluble cocoa powder can only be obtained by the addition of certain substances to the cocoa. But the cocoa nib can be flaked or ground into a coarse powder by itself, or, a portion of the fat being extracted, it can then be reduced to a fine powder. This mode of preparation is practised in what are improperly called the pure cocoa powders, but these cannot be regarded as cocoa pure and simple any more than can these prepared with farina and sugar. In them a larger quantity of the most valuable portion of the substance of the cocoa bean is abstracted, and it is, indeed, thus rendered analogous to skim-milk. Now, skimmed cocoa, like skimmed milk, is very good in its way, and when it is required, as it is in some diseases, but as the principal object in most cases in drinking cocoa is, or should be, the consumption of all the good qualities of this valuable bean, the unnecessary abstraction of the fat is greatly to be deprecated. The mode in which these powders are prepared is by subjecting the ground nibs, which are usually placed in bags, to strong pressure, the press being heated. The cocoa-butter then slowly runs off in the form of oil, which quickly solidifies on cooling, and a hard mass is left in the press. This is afterwards broken up and powdered in mills, and after being dressed is ready for use. Unfortunately, this form of cocoa powder is as liable to adulteration as are the mixed ones, and one of these, which has at the present time a great reputation, contains ash greatly in excess of what would be yielded by pure cocoa so prepared, and thus points unmistakeably to the use of some adulterant.

These powders also have the disadvantage of being very expensive, ranging from 2s. 8d. to 6s. the pound, while soluble cocoa powders range from 6d. to 1s. 8d. They are, further, not so miscible in boiling water, but require further boiling, and even then the particles sink to the bottom of the cup, and are thus wasted.

This objection also applies, but in a greater degree, to the use of flaked cocoa, and plain and ground nibs. However much these forms are boiled, but little substance is really dissolved, and the gluten is especially lost. When we also consider that in the cocoa made from the nibs or flaked cocoa the fat is generally carefully skimmed off, and the residue or grounds are thrown away, we must see how sinful a waste is made of this food when used in such a manner. This is apparent when we remember that with the exception of about 5 per cent., the whole substance of the nib is valuable as food, and when properly prepared, digestible as such. In the beverages made in the way I have described, the nutritive value derived is reduced to its minimum, and is but slightly greater than could be obtained by an infusion of the shells, which contain a small proportion of theobromine, and can be obtained for 2d. per pound. I may here mention that these shells are largely used in Ireland for the purpose of calf feeding, and also by the poorer people. They make an infusion with them, which is not inappropriately called "miserable." There are a few persons who use even nibs and flaked cocoa, and perseveringly consume the whole substance of the nib or bean, as the case may be; but they very speedily have to give up the use of cocoa from the dyspepsia which results from taking it in so rich a form. A glance at the composition of cocoa will fully explain this fact, from the highly concentrated form of nourishment it presents.

The present mode of making French chocolate in cakes differs somewhat from the mode of producing soluble cocoas. The nibs are placed in a heated mill, called a *mélangeur*, formed of a revolving granite table, with two heavy granite runners. When brought to the consistency of a smooth paste, sugar or sugar and farina (as is the case in the cheaper qualities) are added, and the whole well ground and mixed together. When thoroughly incorporated, the mill is cleared, and the partially prepared chocolate is passed between three horizontal rollers, which thoroughly crush any particles not previously sufficiently ground. This operation is repeated several times, to bring the chocolate into a perfectly smooth condition; it is then again placed in the *mélangeur* to be finally mixed, when it is ready to be moulded into cakes or fancy forms, or to be used for covering the bon-bons called chocolate creams. The mode of moulding the cakes is first to weigh the chocolate, which is then put into a number of moulds placed on a tray to receive it. It is then removed to a table, to which, by means of an intermittent action, a strong vibratory motion is communicated, and this shakes the chocolate well into the moulds, from which, when perfectly cool, the cakes can be turned out. A circumstance to be noted is that these are then in a highly electrified condition.

Having thus briefly explained the mode in which cocoa and chocolate are prepared, I would now conclude with a few words touching the operation of the "Adulteration of Food Act" as it affects cocoa.

This Act of Parliament, so ill-considered and faultily arranged, was not deemed of sufficient importance by the House of Commons to be worthy

of their careful attention, and it was at an important stage shovelled through a bare House at two o'clock in the morning. Its further progress was then the result of a stratagem, participated in by one of its prominent supporters and a member of the Upper House; and the Bill was finally passed in the House of Commons by about twelve members. It is not therefore surprising that it should have proved impracticable in working, and been the cause of much oppression and injustice. The wonder is that it has produced any good results, although even these are already diminishing, owing to the odium it has excited having already caused the commencement of a laxity in its enforcement. The subject of food adulteration is one of the most intricate and difficult on which to legislate, and one on which hasty legislation is most strongly to be deprecated.

The result of the present Act has been not so much to check the real adulterations which are practised, as to harrass small tradesmen caught tripping, on what are really technicalities. Whether it be that the amount of adulterations practised has been greatly exaggerated, or that the present race of analysts is unable to discover them, I know not; but certain it is, that almost the only adulterations they have detected have been the mixture of water with milk, and of chicory with coffee, the colour facings of teas, and the circumstance that wheat flour and turmeric frequently exist in prepared mustard, facts that were perfectly patent to everybody. An effort has also been made, but unsuccessfully, to bring mixed cocoas within the category of adulterated articles; but, unfortunately for the public, not a single case of really adulterated cocoa or chocolate has been prosecuted, although large quantities adulterated with chicory, animal fat, and mineral earths, are daily sold throughout the country. Of course I am aware that no Act of Parliament can supply discretion and intelligence to its administrators; but still it is to be regretted that one dealing with so all-important a subject should not have been more carefully prepared. Looking at it merely as it affects manufactured cocoa, we find all the prosecutions under it have broken down with the exception of two or three cases which were not properly defended, and in which adverse decisions were pronounced by country justices ignorant of the merits of the case.

Any Adulteration Act, to be successful in working, and which, while protecting the public against fraud, does not commit injustice against the trader, must be very comprehensive; and it is impossible to put, in a few short clauses, the power of dealing with all the various substances we use as food, especially those of a mixed character, such as cocoa, condensed milk, &c. It appears to me that the difficulty would best be met by appending, in the form of a schedule to the present or an amended Act, a list of the various mixed foods we take, and of what they should consist; but such a schedule could only be successfully compiled after an examination by a commission of the House, of practical as well as scientific men.

As regards the manufacture of cocoa, I most indignantly deny that the admixture of sugar and farina are adulterants in any sense. They are, as I have shown, necessary to make the article of commerce known as soluble cocoa, which, from being the form in which it is generally used, is known simply as cocoa. The public is but little acquainted with the raw nut, which, as I have said, is almost useless as a food without considerable preparation. Those, however, who like the unmixed forms of cocoa, obtain them at the shops by asking for them under their appropriate names. They are the raw and roasted and flaked nuts, and roasted, ground, and flaked cocoa nibs. These forms of cocoa have been accessible to the public almost since its introduction in this country, but have never been largely used on account of the time and trouble required to prepare beverages from them, the unsatisfactory nature of the result, and the wastefulness attending such a mode of use. We have seen that the only way to reduce cocoa into an elegant powder is either by admixture or abstraction; and in the earliest record we have of the use of cocoa as a food in any form, that it has been always prepared with other substances; the instinct of the Indian leading him to the same result as that attained by civilised man. This necessity has not only been fully recognised and sanctioned by high scientific authority, but also by Act of Parliament (3rd Geo. IV., c. 53) passed in the year 1822, to regulate, amongst other things, the manufacture and sale of cocoa. It is therein provided that it shall be lawful to manufacture "Cocoa Paste, Broma, and other Mixtures and Preparations of Cocoa with Sugar and Arrowroot Flour, or other Farinaceous Powders; such Arrowroot Flour, or other Farinaceous Powder not being baked, scorched, roasted, or otherwise disguised or altered from its natural state, except by being mixed with cocoa as aforesaid." The latter provision is an instance of how favourably some of these old Acts compare with much of the over-hasty legislation of the present day, in the care with which they were prepared; for it takes in the whole question of cocoa adulteration, and while not, on the one hand, prohibiting its preparation with other substances, yet guarding against a fictitious appearance of strength being produced in fraud of the consumer.

In the interests of honest cocoa manufacturers it is highly desirable that this clause should be incorporated in any future legislation, and a further enactment be made requiring a specification of the different ingredients employed. The proportions in which these are mixed it would not be just to require, as in this constitutes the difference of one manufacturer's preparation from another, and any such statement is quite unnecessary if the consumer is protected against deception, as he will then be able to judge fully the quality of his cocoa, and will refuse to take those preparations in which the admixture of sugar and farina is pushed to excess. Amongst the numerous eminent scientific men who have given their sanction to this mode of preparation, I will only name Drs. Pereira, Johnston, and Ure, and Messrs. Tomlinson, Brande, and Cooley, all Fellows of the Royal Society. The testimony of Drs. Normandy and Letheby is also of great value. The former states that "the preparation known as cocoa powder or chocolate powder, when genuine, consists only of cocoa nibs, sugar, and arrowroot," and states that the "butter of cocoa is thereby rendered emulsive and more digestible." Dr. Letheby states that cocoa and chocolate owe their

chief value, as food, to the fat they contain," and further states "it is necessary to reduce it with some easily digestible substance." Johnston, in his "Chemistry of Common Life," states "that the presence of the cocoa-butter justifies also, as fitting it better for most stomachs, the practice of mixing the cocoa with sugar and farina," and says, "both practices are skilful chemical adjustments." The testimony of Dr. Ure is perhaps the most important of all, he having been appointed by Government to inquire into the manufacture of cocoa for the navy in the year 1842. The reason of his appointment was, that the cocoa as then made at the Deptford Victualling Yard was found to produce a spurious form of dysentery amongst the men. Dr. Ure soon discovered that this arose from the practice of grinding the whole nut, husk and nib, in a coarse and ineffective manner. He therefore conducted a series of experiments, which led him to recommend to the Lords of the Admiralty the preparation of a chocolate combined with sugar and farina, but freed from the husks. This form is still used, and its value is shown by the fact that the virtues of navy cocoa are proverbial. That Dr. Ure should have arrived quite independently at conclusions so similar to those formed by Mr. Dunn so many years previously, is a source of satisfaction to that gentleman's representatives. The opinion is of the greater value from the fact that he is the only chemist of eminence who has studied this question with a view to practical results.

These facts show conclusively how unjust and unwise it is to assert that manufactured cocoas prepared with sugar and farina are adulterated articles, and it surely was never the intention of the legislature—even of the dozen members who passed the Bill—to annihilate a large industry supplying the public with so valuable a food in the best, and, indeed, as far as the poor are concerned, in the only way it can be rendered available for consumption.

The cocoa powders prepared without admixture, but which have a large proportion of the fat extracted, are deteriorated in value by such treatment, are not readily prepared, and are so expensive as to be beyond the reach of all but the wealthy classes. Yet this mode of preparation is justifiable, and in certain cases even desirable; the consumer being aware of the kind of preparation he is buying. The objection has been made to the use of sugar and farina that they are of less value than the cocoa with which they are admixed. This is perfectly true, but would also be an objection to almost every mixed article of food; and the effect of competition gives the full benefit in the difference of their price to the consumer, except in the cases where disguising adulterants are employed. The addition of sugar and farina to cocoa has also been objected to on the ground that, being carbonaceous elements, they are added to a substance which already contains them in excess. This would be a very valid objection were we condemned to exist on cocoa only; but as it is only one of many foods, it falls through. The necessity also exists of taking the carbonaceous elements in each of its different forms, and the presence of the cocoa-butter does not render them less necessary in the form of starch or sugar. The fact is, the deductions of mere theoretical chemistry have been pushed too far, as applied to the food of man. I do not wish, however, to disparage such investigations, or to deny their beneficial results when brought to aid the observations of the practical physiologist, and when kept in proper subordination. But it is undeniable that the instincts of man are a far safer guide as to the foods he requires, than mere chemical dogmas, founded on abstruse considerations, which vary from time to time. Reliance on these has, on more than one occasion, produced painful results in our workhouses and public institutions; and but recently Mr. Brudenell Carter, F.R.C.S., pointed out in how great a degree the recent epidemics of ophthalmia which have scourged our schools were due to insufficient dietaries, prepared, however, on the most abstruse chemical principles. He says that in the matter of food supply even the street Arab is in a better condition than some of these poor children.

The popularising of cocoa as a food was greatly aided by the reduction of the duties on the raw material. Until the year 1832 the duty on cocoa was 6d. per lb.; it was then reduced to 2d., and in 1842 to 1d. per lb. on that produced by our own colonies. A larger duty was levied on foreign produce for a time, but later on was wisely taken off, and the duties equalised. The duty is now 1d. per lb. on all raw, and 2d. per pound on all manufactured cocoa imported.

From these causes in combination, the consumption of raw cocoa has risen, as shown by the following tables, from 276,321 lbs. in 1820, to 8,311,023 lbs. in 1872, an increase equal to nearly thirty-threefold in about half a century.

Amount of Cocoa Duty paid for Home Consumption.

Year.	No. of lbs.	Year.	No. of lbs.
1820	276,321	1860	4,583,124
1830	425,382	1870	6,943,102
1835	1,084,170	1871	7,333,988
1840	2,645,470	1872	7,853,165
1850	3,080,641	1873	8,311,023

Consumption of Cocoa per Head in Great Britain (W. Hoyle).

Year.	lbs.	Year.	lbs.
1841	0·08	1868	0·17
1842	0·07	1869	0·19
1843	0·08	1870	0·20
1844	0·09	1871	0·23
1845	0·09	1872	0·23

So great a result is not only gratifying as a mere matter of commercial statistics, but in a higher degree as showing the wide and extending appreciation and use of so valuable a food.

DISCUSSION.

Mr. Arnold Baruchson said he had been drinking every morning for twenty years. He was certainly surprised to find, from the table showing the relative composition of different articles of food, that milk, and even meat, contained so large a proportion of water. He quite agreed that cocoa was more nourishing and wholesome for the majority of people than tea or coffee, but he did not approve of many of the preparations that were sold, and he had tried all sorts. Cocoa was advertised at 3s. 6d. and 4s. a pound, but that would not make a very cheap drink for the people. For a long time he had used nothing but pure cocoa nibs, which he considered more healthy, purer, a better stomachic, and less likely to cause indigestion than any of the preparations, and the cheapest sort,

Bahia, he considered the best. Some of the prepared cocoas sold consisted very largely of potato starch, or sago; in fact, the cheap kinds were only flavoured with cocoa, and did not really possess the nutritive qualities of the cocoa bean. The best way to prepare it was to take a quarter pound of Bahia oocoa nibs, roast them, put a quart of water upon them, and boil it down to a pint, and that would serve for three or four meals.

Mr. Branson said the question of cocoa was perhaps more important than a great many people fancied. If they considered the difficulty which the great masses of the working classes had to provide their daily food, and the high price of meat, they must know that cocoa was the most valuable substitute known for meat, and the most nutritious food in the smallest space that nature had given them in any shape or form, Looking at the table given, he did not think they had much to be proud of in the consumption of cocoa in this country; not being engaged in the trade he could speak quite independently on this question. The table showed a consumption of not quite 4ozs. per head, showing that cocoa was almost unused. One of the greatest difficulties in the way of a greater consumption of cocoa in this country, was the question of cooking. Cocoa contained 50 per cent. of fat, and the difficulty was to mix that fat with water. The lecturer would have them get out of this difficulty by mixing farina with the cocoa so as to suspend it, but farina did not make cocoa soluble, it simply pulped the water and suspended the cocoa in particles. They must deal with facts, and not with plausible theories. The supply of soluble cocoa to the masses was no doubt a very great boon, becauso they could not cook cocoa in any other way, but that was all he could say about it. The lecturer had stated that cocoa could not be prepared without such articles as farina and sugar, But in Germany, where they were very good cooks, and knew how to make money go as far as possible, cocoa was largely used, and was for the most part made without farina. It was possible to get the cocoa bean into a powder, and on the table there was some pure cocoa ground to an impalpable powder, and if the manufacturers sold the cocoa nib in a fine powder, and the public had the wit to use it properly, it would be the most economical food known. If he were shipwrecked and in an open boat he would sooner have a pound of impalpable cocoa than anything else, as it would preserve life longer. Impalpable cocoa powder required mixing with boiling water into a paste, and to be then mixed with more boiling water till sufficiently thin, when it was ready for drinking. Something had been said about the disadvantage of boiling cocoa, with which he could not agree, for cocoa was a bean, and all beans were better for being boiled. Soluble cocoa was better if boiled for a few minutes, as it eased the stomach of what was rather hard to digest. In the statement of the chemical composition, starch and gum were put down at 10 per cent., so that cocoa had these properties in sufficient quantities to suspend the fat if properly cooked. English people, as a rule, got up so late that they had only a few minutes to prepare their breakfast, and made their cocoa very imperfectly, but when they had got a food they ought to make the most of it, and cook it properly. If the public would only become a little more sensible and cook their food better, and if the manufacturers did justice to the public, the consumption, instead of being 6ozs. per head, would soon rise to a very large proportion, and become an important trade, which at present it was not in this country. English people did not know the value of cocoa. Although manufactures had improved lately in the manufacture of that article, they were still not supplied with pure cocoa ground to an impalpable powder, which it was quite possible to do. The previous speaker had spoken about cocoa nibs, and it might be very well to put 4ozs. of cocoa in a quart of water and boil it down to a pint, only in that case 3oz. were entirely wasted. The whole of the cocoa which went into the body was digested and turned into bone, muscle, and flesh, but when cocoa was stewed the best part was left in the pot. Making cocoa out of the nibs was like making a cup of coffee out of raw coffee-berries. He did not believe such a thing as essence of cocoa could be made. The essential thing in cocoa was fat, and nature had supplied it with the proper quantity, and yet people talked about expressing the fat and then calling it essence of cocoa; it was like putting a piece of beef into a press, and expressing the goodness and cooking the rest. He could not accede to the idea that the cocoa trade in this country was to be led into one channel, and he should be glad to see the public appreciate cocoa much more than they did at the present time, and if they did it would become the most economical food for them to spend their money on.

Mr. Critchett Bartlett said the principal feature of the paper seemed to consist in the advocacy of so-called soluble cocoas as being cheapest and best suited to the wants of the community. But this was really a very variable mixture, being mixed with farina—or starch—of various kinds and sugar. This was one great objection he had to it, because there was no standard what proporr tion the farina and sugar should bear to the cocoa; onsample might show 50 per cent. of cocoa, whilst anothee did not yield 25. He objected to an article being sold under a particular name when it really consisted, in a great degree, of other and much cheaper materials, and particularly when the public had no means of judging whether they were purchasing the cheaper or the better qualities. Mr. Holm had admitted that "emulsive" would be a more correct word than "soluble," but he said people would be frightened at it; he did not, however, consider that a sufficient reason for employing an incorrect term. However, a more important question was whether the addition of sugar and starch had any effect in making the cocoa more digestible. Sugar was very easily digested, but starch was only digested after a certain amount of boiling. If taken into the human stomach in moderate quantities, it became eroded by the continued action of the gastric juice, but the greater portion of it did not become soluble. Some six or seven years ago, Dr. Marcel conducted a series of very valuable experiments with regard to starches of various kinds, which showed that in the case of gall starches which had not been boiled, a considerable quantity passed out of the system entirely undigested. The addition of this article, therefore, could not be beneficial to the cocoa. Dr. Hassall also had spoken dead against the admixture of starch and sugar with cocoa, because he said it neither rendered it soluble nor digestible. Again, with regard to the cocoa-butter, it had a very firm texture, melting, according to his experiments, at from 84° to 97° Fah. When this was mixed with a fair quantity of flour or farina, it became of the curiously emulsive character best known in melted butter, which was so frequently objected to by medical men, especially in the case of persons inclined to be bilious. People did not have fat in their tea or coffee, and he did not see why they should want it in their cocoa. If the cocoa were used naturally the fat would float on the top, and most persons were wise enough to skim it off; but when mixed up with farina and sugar you could not do so. He maintained that for a refreshing drink you wanted something which cleansed the palate, and had a tendency rather to brace the nerves, something of an astringent character like tea or coffee; but so long as fifty per cent. of fat remained in the beverage, it was quite the reverse, more of an emollient character, very useful for people with coughs or suffering from irritation of the larynx, but not very well suited to the general public. No doubt cocoa contained a large amount of nutriment in a very concentrated form, and so did meat; but it was well known that a mutton chop as cut from the animal generally contained more fat than was agreeable to most people, and it might very well be the same with cocoa; and certainly he did not think that taking fat in the form of drink was best suited to our require-

ments. Mr. Holm had referred to the different analyses of cocoa, but some of them were 50 or 60 years old, when the means at command were not nearly so perfect as in the present day, and tho samples of cocoa also varied considerably. Tuchen, he knew, had analysed many different kinds, and he had found that the proportion of fat varied from 38 up to 51. There would always, therefore, be largo divergencies in the analyses; even beans of the same charactcr varied in different years. He had no doubt of the truth of Mr. Brudenell Carter's opinion that ophthalmic epidemics amongst pauper children had arisen from defects in diet, resulting from cutting the dietary too fine. But there were other defects also, and both Dr. Edward Smith and Dr. W. B. Carpenter had spoken very strongly of the evil of giving too much starch, to which the latter clearly traced the rheumatic diathesis which had been prevalent during the last 20 years; and this was another argument against the addition of starch to cocoa. He had followed the manufacturer's processes, which had been so clearly described, and they certainly seemed very admirable, but there werc other processes by which pure cocoa was prepared in a fine impalpable powder, and others in which it was *minus* a considerable portion of the fat. He would not mention any names, but one firm in particular he knew prepared a finely powdered cocoa, containing only 35 per cent. of fat, and another prepared it with only 26 per cent. He preferred a dry cocoa at night, but cocoa with as much of fat as could be conveniently left in for the morning. The question arose, how far it was miscible with water, but any cocoa, if finely ground, could be mixed with hot water, and would remain suspended for a reasonable time; if a settlement took place there was generally a teaspoon at hand, and it could be stirred up again; even soluble cocoas would settle if they were allowed to stand a short time. Almost every portion of the cocoa was nutritious if it were in proper proportion; but one important question was, what was the proper proportion of fat. In an ordinary meal, fat did not form nearly so large a proportion as it did in natural cocoa, and therefore, if extra fat were taken in cocoa, it would be advisable to take less in some other way. But cocoa-butter was valuable for various purposes, and therefore if a certain proportion were abstracted in the manufacture it was not lost, but simply applied to another use, and therefore he saw no objection to the excess of fat being removed. He could not see that this was in any degree analagous to the case of skimmed milk. He had seen advertisements from the firm represented by Mr. Holm, in which they announced nutritious cocoa from which all the fatty matter had been extracted, and he must put that as an answer to some of the observations in the paper. He did not desire to discuss the manner in which the Adulteration Act passed through Parliament, which did not really belong to the subject of the evening; but the way in which it interfered with the retail dealer was tbis. It stated most distinctly that no article mixed with foreign ingredients should be sold under the name of the article without the admixture being notified; now cocoa dealers had sold these mixed articles as cocoa, and even in some cases as pure cocoa, thus rendering themselves amenable to the Act. Unfortunately, some prosecutions had taken place under the 3rd clause, which related to fraud, and had failed, because it was clear that no fraud existed. Still articles were sold as cocoa, and even as pure cocoa, which contained but a small proportion of it; even some of the flakes contained starch and sugar. In France, nothing but sugar was allowed to be added to cocoa. He had heard within the last few days that about a twelfth of the whole of the raw cocoa imported was now made into pure cocoa powder, showing that there was some demand for it, though it had only been lately introduced, and he had no doubt this demand would steadily increase.

Mr. Eschwege also protested against the sale of articles as cocoa or "pure cocoa" which was not cocoa at all, and stated from his personal experience that cocoa could be prepared very well in a powder, so as to be readily prepared and easily digested, without the addition of starch or farina, and sugar. He hoped this kind of cocoa would find favour with the public, and that they would compare it with the so-called soluble cocoas, some of which did not contain 5 per cent. of the real article, when they would soon discover and appreciate the difference.

Mr. Holm said most of the questions which had been put had been already dealt with in his paper; in fact, the first and second speakers strongly supported him. As regarded the impracticability of using cocoa pure and simple, it would not be well to so use it even if desired. The last gentleman who had spoken had overlooked the cocoa powder, of which he had a sample on the table, which could be made very easily, although it was a very expensive operation. They were told by gentlemen who advocated the use of cocoa powder that there was as much nourishment and nutriment in a pinch of cocoa, which cost 2s. or 3s. a pound, as in a pound of cocoa which cost 6d. The commonest form of cocoa made by one of the largest manufacturers, costing 6d. a pound, was as good and wholesome as the finest French chocolate, but it was not pure powder when you had extracted something from it. If a man sold a packet of cinnamon as pure cinnamon after taking the oil from it, it was as much pure cinnamon as cocoa was pure cocoa which had had something extracted from it. The powder he referred to suited some people better than other powders, but for general use the others were the best. The name of Dr. Hassell had been mentioned, and it was well known that he condemned the use of starch and sugar in cocoa, but curiously enough, he (Mr. Holm) had the right of making Dr. Hassell's meal cocoa, which contained a large amount of starcb, farina, and wheaten flour, and yet that gentleman came forward and condemned fraudulent mixturcs. In spite of the theories put forward by Dr. Hassell, he was forced to use the same materials in preparing cocoa, and he considered it an absolute necessity. The whole question of the use of this food by the public turned upon the point of how it could be readily cooked. He did not know that any of the other questions put were such as really required answers from him.

Mr. Ward asked whether Mr. Holm would tell them the quantity of cocoa in the sample of powdered cocoa he had referred to.

Mr. Holm said certainly not, and thought any one of ordinary intelligence who bought cocoa powder should be able to judge of its quality, so as to be protected against fraud and being deceived.

A vote of thanks to Mr. Holm for his very interesting paper, proposed by the **Chairman**, having been carried, the meeting separated.

CANTOR LECTURES.

The last lecture of the second course of Cantor Lectures for the session, "On the Chemistry of Brewing," by Dr. Charles Graham (University College, London), was delivered on Monday evening, March 2nd, 1874, as follows:—

Lecture VII.

At our last meeting I called your attention to the nature of fermentations as carried on in different parts of Europe, and I pointed out to you that in our own immediate neighbourhood these fermentations were started or "pitched" usually at a high temperature, occasionally at a very high one, and that consequently the fermen-

tation was very rapid. On the other hand, I went with some detail into the Bavarian process of fermentation which is, as regards time, the opposite of that pursued in London, the temperature being low, and the progress slow. Intermediate between theso two extremes are the Burton and Edinburgh systems, and after calling attention to those, I went into the question of cleansing, and we saw how practical men performed this process in various ways. First of all some were in the habit of skimming the yeast off the top, using or not using, as the case might be, settling squares for the purpose of the more perfect elimination of tho yeast from the gyle. Others led the gyle into smaller vessels or barrels called in London pontoons, these being usually somewhat large. Others, as in Burton, use barrels united to each other, the gyle being kept in them at the same level. I pointed out to you that in that particular case a slightly greater pressure than that of the atmospherc was produced. Then I called your attention briefly to the Yorkshire stone square system which, though perhaps not an economical one, is still an interesting instance of the process of skimming and attemperating. Whether by one process or another, good ale seems to be produced by each of these different methods, depending much of course upon the skill and care of each individual brewer. If I might be permitted to make a remark, it would seem to me, coming to the matter unprejudiced, that on the whole perhaps the simplest arrangement is to carry out the fermentation through its first stages in the fermentation square or round, and then afterwards to complete the secondary fermentation in the settling squares. At any rate that method seems to me to present less waste, and to be very efficieut. But in carrying out such a process one must be excessively careful that in the settling square the beer should be covered with a layer of carbonic aeid; in other words, you must run off the gyle into the settling square before it has become dead. As regards the efficiency of these various systems, and as to which system praetical men should adopt, that of course is for practical men to decide. As to the chemical aspect of the question I can but once more refer to tho fact that a rapid process, no matter whether it be making beer or anything else, is not always attended with equally excellent results. It is perfectly true that such a process is perhaps, as regards turning money over quickly, well adapted for a running trade; but yet in summer you run an additional danger with these high temperatures, and you from time to time, in spite of all care, find the beer becomes sour even within a few days of being sent out; I have known many such cases. It perhaps may not be possible under present conditions to altogether alter the driving speed, and it may not be easy to insure that the yeast shall not become impure in the way in which it undoubtedly does by this system of fermentation. However, if you cannot alter all at once you may at least ferment a portion at a lower temperature, and use the yeast crop so produced as the yeast for the other portion of your fermentation. Those who are specially engaged in preparing store ales, must bear in mind that it is quite impossible for them by any rapid driving process to produce an ale of the highest excellence just as it is impossible for a French wine maker to produce wines of the highest excellence, whether Lafitte or Chateau Margaux, or for the German to produee an excellent Rauenthaler, Steinberger, or Rudesheimer in a short space of time. I then spoke of those very valuable and important chemicals which are used by you, sulphurous aeid, either in the free or fixed state, chloride of lime, or bleaching powder, and quicklime itself, and I pointed out to you how important they were, one as an absorber of oxygen, and the other two materials as being cleansing agents. I then referred to the fact that with the improper treatment of store ales it occasionally happens, especially in the country, that they become sour, and that in such cases it is neeessary to employ materials that contain quicklime, or other acid neutralisers, and in some cases sulphurous acid. If I remember rightly, I made use of the expression *antacids*, and from a chemical point of view they are antacids, but it has been brought to my notice that in using this term it might be thought by some of you that I referred to a particular company, who have almost appropriated such a word to a product of their own, made for the purpose of reducing the acidity of ales. At the time I was referring to the danger of allowing ales to become bad, and the consequent neeessity of using such materials to improve them, and I made use of the expression that "the less you have to do with such the better," not meaning that you should not employ such materials when you have got ales into such a condition, but rather that you should study the hygiene of the previous fermentation process so as not to obtain such a condition. I ought also to mention that the firm who apply the term "Antacid" to their product do not employ common "quicklime" to neutralise the acidity in ales, but prepare by a much more expensive process hydrate of lime, by precipitating a solution of chloride of calcium by means of caustic soda solution. This precipitated lime is then well washed, and I believe is mixed with neutral sulphite of lime. Carbonate of soda, carbonate of potash and other materials have been used also to neutralise the acidity in ales. While I deem it but right to remove any misapprehension in your minds, and any chance of injury which my remarks might do a highly respectable firm—who have the advantage of being excellent theoretical and practical chemists—or to any other firm in this country, I still assert that the less you are obliged to have recourse to these palliatives of disease the better. When we are ill we must take what the doctor gives us, but it is much better not to require his services at all.

I will now pass on to describe very briefly a proposition made by a very eminent chemist, M. Pasteur, by which he asserts that you may produee ales, sound, excellent, well keeping, and of delicate aroma, at almost any ordinary temperature. I refer to the process by which he carries on fermentation out of contact with the air. His proposal is, I am informed, being taken up by a large company in France, who propose to carry it out on a very considerable scale. The worts, after having been boiled, are to be cooled in closed vessels, and after they are perfectly cold they are then to be fermented by the addition of the ferments. While they are being cooled in these closed vessels, they are not to be allowed for one moment to be in contact with the air; the vessels themselves are to be filled with carbonie acid, which gas is to be perfectly free from all germs. So soon as the wort has become cold enough, then the ferment is to be added, the fermentation is to be carried on, and when completed the prepared beer is then to be run off into the barrels. Such a plan necessitates a totally different plant, and one so complicated that I did not dare to produee this evening a diagram showing the plan as he proposes it should be carried out, and I much question whether, unless he makes considerable praetical modifications, it would be possible for any practieal brewer who wishes to make money by his process to adopt it. It seems to me that the chief advantage of M. Pasteur's plan is that he may carry on the fermentation at 80° or 90° perfectly well, and yet not obtain the production of lactic acid ferment, or any other of the obnoxious *bacteria;* but it seems to me that we can very well prepare good sound ales that will stand well by slightly modifying our own process in the way I have pointed out; because, after all, M. Pasteur's beer, with its delicate aroma and wonderful sound keeping qualities, becomes as liable to receive germs from the air as our own, and the moment, therefore, that the bung of the cask, or the cork of the bottle, be opened, it may become impregnated in precisely the same way as our own with the ferments that are floating about.

I will now pass on to point out for the sake of those engaged in the bottling trade one or two points that I think are likely to be of more advantage than M.

Pasteur's method of fermentation. You may remember that I told you that it may be necessary for the bottler to carry on the German system of slow feeding, and as it is illegal to employ sugar for the purpose, I suggested that he should ask the brewer to supply him with a barrel or so of wort excessively rich in sugar, and containing of course but little of the malt extract. I forgot to mention that the wort ought to be very highly charged with bi-sulphite. If you feed your cask with a little of that—the small quantity of bi-sulphite that would come into each barrel would do good rather than harm—you would have the advantage of slowly feeding the store cask, and not in any way run counter to the Excise laws. The reason why I propose that such a saccharine wort should be very highly charged with bi-sulphite is to prevent the chance of spontaneous fermentation of the wort. If this were not guarded against fermentation would take place, and this ultimately would burst the cask. The bottler, however, requires also to guard against the serious losses which he sometimes suffers in theforeign trade.

Now if beer containing yeast cells, the *torula cerevisiæ* which I have spoken of, be heated to a temperature approaching 120° to 140° Fah. these *torula* cells are found to be killed. Some years since, M. Pasteur, in working at the subject of the wine trade in the south of France, found many cases of serious loss to the wine grower were due to ferments of one kind or another. either of the filiform *bacteria*, or else to the chaplet form, as the case might be. He found that all these, together with the alcohol cells of wine, were killed at a temperature of about 140° Fah., or even 120° Fah. In Germany similar experiments were made a few years ago by Lehrmer. However, as far as I know, little as yet has been done—in fact I am not aware that anything has been done—with regard to the application of these principles to the beer-bottling trade, and I have therefore prepared some experiments, with a view to suggesting M. Pasteur's valuable process as one which, carefully worked out by practical men, may lead to considerable benefit to them.

The method is very simple. In the first place the beer should be run from the store cask, and then should be corked by means of a paraffined cork, that is an ordinary cork saturated with paraffine wax; in that way you avoid the loss that occurs from the great bulk of our corks giving insufficient protection against pressure. After doing that, the next process is to destroy the ferment in the ale itself, because however bright the ale may be, there are always floating in it minute yeast cells. But if you were to place in a bottle, and were to heat to a sufficient temperature, ale that did not contain sufficient carbonic acid it would be excessively unpleasant to drink, because, after all, beer should be more or less effervescing. It is therefore necessary for the bottler to charge each bottle with carbonic acid. Now that he may do by a very simple plan, by merely allowing the bottles to remain until there is produced in the ale enough carbonic acid by subsequent fermentation; and if he has two or three weeks to spare, at the end of that time, by opening a bottle or two he would be able to tell whether the ale is sufficiently brisk. If so, if it has enough carbonic acid, he must then heat it up to the temperature I have mentioned—about 140° F. On the other hand, supposing he should be pressed for time and his ale be very flat, and he has immediately to bottle it and export it, and cannot wait for two or three weeks, then he may apply the ordinary plan of forcing carbonic acid in by an ordinary carbonic acid apparatus, and then afterwards heat the bottles up to 140°. In most cases—in nearly all cases, I may say—unless he has allowed the natural fermentation to go on too far, the bottles will be strong enough to support the pressure that will be produced. However, it may happen that the bottles cannot do so, and if he has any reason to doubt the strength of his bottles it is very easy for him to apply pressure upon the outside equal to that within, by simply heating the bottles in a closed chamber containing water, which he raises to the given temperature. Of course the pressure will be the same in the iron vessel, or whatever he may use, as in the inside of the bottles, and on heating to 140°, even if he has allowed the fermentation of carbonic acid to go on too far, he will find the bottles will stand perfectly well. On the table I have some samples of different ales; most of them are thick, and they are all out of condition. I intended they should be so, because I wished to see whether the heating up to the temperature of 140° would increase the amount of precipitate, or whether it would diminish it; and I find that in heating Burton ale up to 140° only, there is rather a lessening of the amount of haziness which is due to albuminous matter. I find with regard to Edinburgh ale there is a very distinct improvement in the brilliancy; as regards Burton I have also heated it up to a temperature of 180°, and even then, although I expected it might not be so, I did not find any increase of deposit, on the contrary, I find rather a brightening effect. I am told, however, by a friend who has tried the same experiment with some Burton ale, that occasionally if you heat too high you obtain a haziness in the ale. But you need not heat it higher than 140°, because even 120°, according to the experiments of Pasteur and Lehrmer, is perfectly sufficient to destroy these ferments. On the left side of the table are also some bottles of most excellent ales that were in good condition when bottled; they are perfectly bright, at the same time they are not very gaseous, because they were bottled for hot countries. They are made by the Anglo-Bavarian Company. I must, however, inform you that these ales do not in any way resemble the Bavarian beer I have been speaking about, on the contrary, they are alcoholic, or in other words English ales.

As regards the treatment of beer in the public-house and restaurant I know not that I have very much to suggest. Of course the process of feeding may be adopted there; indeed I have heard that some publicans are already acquainted with the method of feeding. But they use molasses; and the singular part of their process is, that with the idea of feeding these ferment cells they commence by the previous addition of "water," and I believe to some considerable extent, but that is not exactly the process I recommend. Abroad, and even here to some extent, it is a very common practice to employ the carbonic acid apparatus. Now carbonic acid gas has a very wonderful influence in deceiving the palate, and an ale that is flat and unpleasant well charged with carbonic acid becomes invigorating and fresh. This apparatus is much used abroad, and I should like to see it employed here, though not for the purpose which it is there. When I come to suggest my feeding process for private houses, I dare say some of you practical men will laugh at me, and tell me every old woman is acquainted with the process; but I do not know that they all practise it, and I am afraid many of the young ones know nothing about it. I do think, for those of you who have a household business, it would be well if you were to suggest that, after a little time, your customers should add a piece of lump sugar every day. You may make use of scientific reasons which will induce them to do so, and they will find it a very great advantage. It is the simplest process that I know of for the production of carbonic acid, and carbonic acid, producing a slight external pressure, is decidedly one of the best preservatives against acidity. A little sugar is an excessively simple way of making that valuable material. Those of you who agree with Pasteur in believing that the presence of ferments or small spores in the air produce lactic or acetic acid, may adopt the plan of filtering the air by means of a tube with cotton wool, and all that will be necessary will be to supply each customer with a small brass tube, containing a tap, and filled with cotton wool, instead of the present spigot.

Beers, when they are produced, differ of course very much in their composition, but still there are a number of products that they all have in common; first of all, the alcohol, then sugar, more or less, and dextrine. Now, the dextrine is a valuable constituent of beer, because so long as there remains some dextrine—there is some sort of guarantee that there shall be a slow conversion of the dextrine into alcohol and carbonic acid. In addition to these three important products there are, of course, caramelised bodies produced from the materials used—from the kiln drying of the malt or from the sugar—also albuminous bodies, and acetic, lactic, and succinic acids. In addition to these, I think one finds almost invariably malic acid, mainly from the hop, citric acid perhaps not so often, possibly from the barley, and an acid that a very eminent chemist, Dr. Griess (who probably knows more of the phenomena of brewing than any other chemist in Europe) has discovered, and which he has provisionally termed lupulinic acid, because its source is the lupulin of the hop. As regards analysing beers, I shall not detain you, as we have many other matters before us. I may say the same with regard to the question of adulteration. We have not come here to study adulteration; and I must say I think there has been more made of this question than it really merits. I believe the greater part of it, when it does take place in the retail trade, is of the same kind which takes place with our milk.

Now let me remind you of one or two points which I mentioned some weeks ago. When I spoke of malting, I animadverted somewhat strongly against the process of allowing the malt to remain wet and saturated for two or three days at a high temperature on the kiln floor, and I then suggested that you should adopt the German method of two kiln floors. However, the maltsters of England have already got their malt-houses built, and it is difficult for them to alter their construction. They may, however, carry out the principle I spoke of in a variety of ways. There have been several air-drying machines invented which may be employed, or they may devise for themselves a very simple air-drying apparatus for the purpose. By so doing, they will in a few hours dry the wet malt in the same way that grain has been dried by such machines, and then it would be placed in a proper state upon the kiln floor, thus avoiding many of the dangers I have drawn your attention to. The main alteration in the malting process which would be necessary in order that you should have a perfect command over the whole process, cannot be carried out so long as the Excise officer remains where he is, and this evening I shall have occasion to adduce some reasons why we should get him removed. When I was speaking of mashing, I pointed out to you, with some detail, how the nature of the changes depended upon time, upon temperature, upon the quantity of water, and so on. Now, I have received a large mass of correspondence upon various matters, and mashing, of course, forms one of them; and I am surprised to find such a considerable variety of proceedure amongst practical men in the way in which they carry out their mashing. In the first place, it is necessary for the brewer to ask himself two questions—What is the nature of the materials I have got? and secondly, What is the nature of the product I wish to prepare? Now, I have been asked what I consider a "right" temperature, no further information being supplied me. I have not been told whether a thin, alcoholic, well attenuated ale is required, or on the other hand, an ale which shall be round and full flavoured, and less alcoholic, nor have I been told the nature of the materials. Therefore it is impossible to say what is the "right" temperature. The right temperature and the right method of mashing depends entirely on the particular article you wish to produce, and upon the materials that you have to produce it with. I have pointed out what is the right method, providing you wish to obtain more alcohol and less dextrine, but that method would be decidedly wrong if you wished the opposite result. Now, as regards these alcoholic beers, and supposing you were using malt alone, I should recommend you to mash at about 140° to 145°, and then keep it at that temperature for three-quarters of an hour, or, as an extreme, for one hour. Then afterwards, by means of steam and circulating appliances, to raise it up to 165° or 167°, as the Germans do. And while I am speaking of this, I think I ought to mention that I have two or three times spoken of a steam coil in the "underback," I ought to have said below the false bottom, not in the underback, because that has naturally no connection with the mash tun, and could not possibly heat the goods. I have received a letter upon this question of the archimedean arrangement for heating worts, which I attributed to Mr. Oxley, and I am told I have made a mistake, and that it was invented some years ago—I believe the patent has now run out—by Mr. Crockford. Of course, gentlemen, you can heat your goods without adopting any particular form of apparatus.

If, on the other hand, you desire to have an equal ratio of sugar and dextrine you cannot do better than mash at about 145°, and then slowly raise the temperature, and run off your tap at the end of $2\frac{1}{2}$ hours or 3 hours, at a temperature of 152° to 155°, when you would have a ratio of sugar to dextrine about as one to one. Of course if you intend to use sugar in the after part of the process it may be advantageous to so conduct your mashing that you should have rather more dextrine than sugar. As regards the question of doing that, it can readily enough be done by infusing at a low temperature then raising it very rapidly up to about 170°. In that case the conversion is mainly into dextrine, less being converted into glucose at that high temperature. You may also employ maize malt. I regret I am not authorised to mention the name of the gentleman who drew my attention to this very valuable form of malt, but by employing this you are enabled to get rather more dextrine. In Germany they occasionally use maize, though they generally employ other grain for this purpose. You will get more dextrine also if you insist on your malt being less germinated, if instead of having the acrospire driven up nearly to the top of the grain, you take care it shall only have got up to the extent of one half, or if anything slightly below that, when you mash such malt it will yield a product giving you more dextrine than is usually the case. But maltsters do not prepare such a malt unless it be specially ordered, because it would not present those appearences which are supposed to be so valuable. Those, however, who wish to make a little malt go a long way, or, in other words, to make it bear a larger quantity of water, will find a very great advantage in having more dextrime and less sugar, and it is simply done by not carrying the germination quite so far.

I will now make one or two general observations. In the first place as regards the influence of mashing on the subsequent fermentation. The more sugar formed in the mashing process, or subsequently added, of course the greater is the attenuation, the more alcohol, but the less dextrine. And so soon as that amount of sugar has been used up, then, of course, the alcohol is liable to be converted into acetic acid. Hence therefore, the ales that have been too highly attenuated run a great danger of acidification, unless you adopt the system of feeding. When you have carried on your mashing in such a way that you have got more dextrine, you will have less attenuation and less alcohol, and if the process be carried on properly, and your tap heat be high enough and the fermentation good, you will have an ale that will stand well.

As regards the use of sugar, I think it would be well if I made one or two remarks. The sugar employed is of two kinds—the sugar which is made from starch, generally called dextro-glucose or glucose, and the cane sugar itself or else converted cane sugar. The starch sugar

I pointed out to you at our first meeting was prepared by simply acting upon starch by means of dilute acid at a high temperature, in the same way cane sugar is acted upon by dilute acid, and converted into glucose, not into the same material which starch is converted into, but into a mixture in equal proportions of dextrose and another form of sugar which is called lævulose, so that we have dextro-glucose and lævo-glucose, whereas when you have obtained sugar from starch, rice, maize or what not, by the action of dilute acid, you have dextro-glucose only. Now dextro-glucose, or ordinary glucose, as you know it, has a sweetening power of only about one half that of cane sugar, whilst the sugar which is made from cane by "*inverting*" it, as it is called, has of course the sweetening power due to the dextro-glucose and also to the lævo-glucose. Now lævo-glucose is quite as sweet as ordinary cane sugar, and consequently invert sugar is sweeter than starch sugar, having three quarters the sweetness of the cane from which it is produced. Therefore when cane sugar has been inverted, either by the action of dilute acid, in the way I have mentioned, or by the action of the ferment itself, because cane sugar is always "inverted," that is, converted into dextro-glucose and lævo-glucose by the action of the ferment cell before it is broken up into alcohol—those materials being sweeter, give a rounder flavour to the ales that have been prepared from them, and at the same time mask the acidity somewhat better than the starch sugar. Therefore to that extent sugars that are made from cane, or even cane itself, are slightly better than those made from starch. But, on the other hand, cane sugar, as I told you just now, no matter whether intentionally inverted by dilute acid, or inverted as it always is in the fermenting tuns by means of the ferment, has the drawback of containing this lævo-glucose, which is said to be slightly purgative in its action in warm weather, and especially if the beer be young, it is rather liable to produce diarrhœa.

Those who are using cane sugar largely for ales for the foreign trade should bear in mind that if the ale be attenuated too low they are likely to produce beers that are flat, because they have not there a sufficiency of dextrine to cause a slow production of carbonic acid, and I have heard an objection of that kind brought against ales that have been otherwise very excellent indeed. That is because there has been rather too much sugar added, or rather I should say, that their mashing process has not been specially arranged for the employment of the sugar; hence the beers are flat, there is not a bulky head to them, although in every other respect they may be brilliant and sound. Besides this, where cane sugar is used it is not well to employ too much of that material for ales for warm climates, for the reason before mentioned.

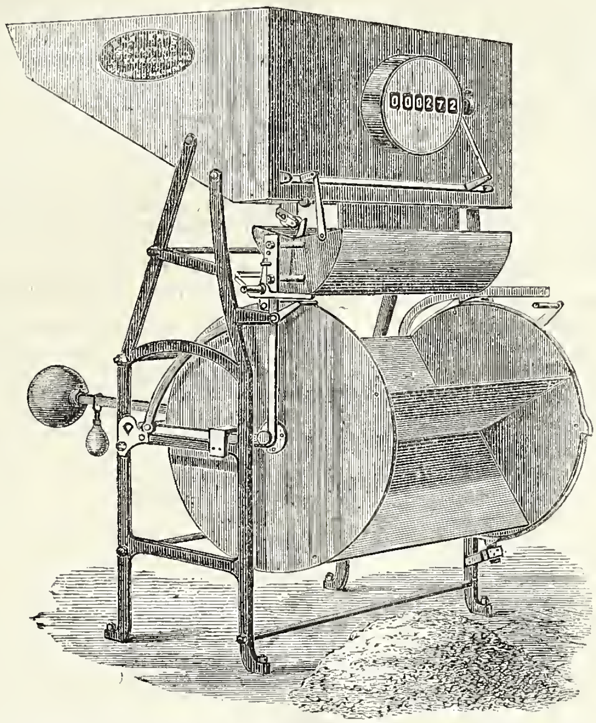
As regards the use of unmalted grain, this is employed very largely abroad. Raw grain, however, ought not to be used as such, but ought to be a high kiln-dried grain, and ought therefore to be treated on the kiln to a temperature of about 220° to 230°. In Germany they are in the habit of steeping it for two or three hours, to remove from the skin the unpleasant flavour that it sometimes imparts to ales. Tho materials that have been so used in Germany to a considerable extent are wheat, barley, oats, rice, and to some extent maize and also potato starch. Wheat and maize are richer in gluten than barley, rice is very poor in gluten, and potato starch contains none at all, or hardly any, consequently if the barley malt which you employ is to be the source of your chemical action it will be necessary to consider the amount of albuminous matter that it gives—in other words, you must consider whether it be a strong barley or a weak barley, one grown on a heavy or on a light chalky soil, and then you may decide on the amount of these other materials to be added; a very excellent mixture perhaps is half of light barley and half of maize. If on the other hand your barley be rather heavy it would be well to use a little sugar, or rice or whatever may happen to be cheap at the time. The Germans also use unmalted grain in their *dickmaisch* or decoction method; in the infusion method they mix the materials, and as a general rule use one-half malt to one-half unmalted grain, both being ground fine; they are mixed and then the first mashing temperature is about 140° Fah. After that has stood about one hour, they raise the temperature by the addition of hot water or piece liquor to 165° Fah., and then allow it to stand two hours. Now there is an objection to this process —the fine starch, especially of the unmalted grain, settles below the false bottom of the mash tun; occasionally they get over the difficulty by using chopped straw as a filter, of course taking care that it has been boiled previously to get rid of any unpleasant flavour. It seems to me that a better plan than that would be to carry on the process in a different way. I should be inclined to mash malted grain at about 100° F., and so soon as it has stood about half an hour, to run in my raw grain, previously heated from the cold up to boiling temperature; in other words, I should run in, instead of water, a thin starch paste. By this means it would be very rapidly converted into dextrine and glucose by the soluble diastase of the malt in the tun. At first the amount of dextrine, as previously explained, would be much greater than the sugar, by longer action more sugar would be formed. I do not now enter into the question of the amount of hot starch paste run in, as that would depend upon the amount of malt used, the loss of heat from the tun, the ratios of dextrine and glucose required, and other matters. From what I have previously said upon the question of mashing, you could easily carry out tho practical details in any given case.

Many years ago, Professor Balling, of Prague, made some experiments on a manufacturing scale with potato starch used as an adjunct to barley malt; the potatos being sliced, ground to a fine pulp, and then treated in one of the methods I pointed out to you at our first lecture, viz., by causing the pulp to ferment spontaneously, so as to get rid of some of the albuminous matter. Then the fine starch was separated off from the products, and that was employed in his process. He found, however, that it was necessary to boil the starch for some time in order to get rid of a little unpleasant flavour that potatos sometimes have. He used it to the extent of about half starch and half barley malt.

You may say of what interest is all this to us—we cannot use raw barley, or wheat if it should happen to be cheap, or maize. But, gentlemen, if you had freedom, if you were allowed to carry on your manufacturing processes as you might think best for the interests of yourselves and the public, you might soon find the advantage of using raw grain, because you would be then able to convert insoluble starch, no matter what its source was, whether Indian corn, or potatoes, or what not into soluble products by three distinct processes; either by the action of diastase, which produces dextrine and glucose in varying ratios as explained—or by the action of dilute acid, thereby converting the starch of such grain into glucose—or if you desired it, you might convert it nearly all into dextrine by the action of a high temperature, the details of which I explained in my first lecture when I spoke of tho main feature of dextrine, or British gum. We could, therefore, by one or other of these means, convert starch either entirely into glucose, or into dextrine, or into a mixture as we wished, before puting it into the mash tun. Now although you are not allowed at present to employ these unmalted materials the time may yet come when you will have such liberty, and in any caso I think it but right to draw your attention to the various raw materials used abroad with great success. Before leaving the subject of mashing, I wish to state that I can give no general rule applicable to all cases. I mention this in order to guard against misconception in future correspondence. I have explained the general principles underlying this chemical action,

and it is for each one to decide for himself; as the nature of the materials, the water which he has, and as his trade may dictate.

Before we can make any very great stride either in our mashing or our fermentation processes, we must have some considerable alteration made in the method in which the tax is levied. At present no one may use raw grain, simply because the law forbids him. But if the malt tax were abolished, and if the brewer were permitted to use what he liked, I think you must acknowledge the great benefit which would accrue from such freedom in the manufacturing processes. It may be asked, how then collect the tax? I answer, by placing the duty on the weight of materials used in the mashing tun. I have on the table a very ingenious automatic instrument which weighs and registers the weight of grain. While exhibiting this instrument to you as a self-registering and weighing machine, which would do for the mash tun much what a gas meter does for our gas supply, I yet wish you clearly to understand that I do not advocate the use of this particular instrument. I merely bring it forward to show you that such automatic machines, entirely under the control of the government officers, are possible, and hence, therefore, the ease with which the tax on the weight of the malted or unmalted grain could be assessed. While the machine is weighing and registering the grain from the upper box to the receptacle below, I will read the inventor's description of it:—



Baxter's Automatic Weighing and Registering Machine.

"The apparatus consists of a horizontal cylinder divided into compartments, so constructed that when the uppermost is loaded, the cylinder has a tendency to rotate on its axis; it is hung on one end of a beam, on the other end of which is a counterpoise and a weight, which latter slides on a graduated scale; but this may be replaced by a scale pan to contain the ordinary weights of the country. The cylinder is prevented from turning until the proper time by means of retaining catches, which are lifted on its descent. When disengaged from them, it is free to revolve. The machine is provided with a hopper, into which the goods to be weighed are fed, and a dial to register each tip or weighing. Between the mouth of the hopper and the cylinder, and fixed to the beam, is the cut-off, so shaped that when open it allows a free passage for the corn or other material from the former to the latter, and when closed it retains the falling substance, while the cylinder turns partially round; one advantage of this machine being that the flow from the hopper is never entirely stopped. The cut-off is made very sensitive, and acts as soon as the correct balance is attained; where convenient it may be operated by electro-magnetism. In machines above above a certain size there is a valve (not shown in the engraving) capable of partially closing the mouth of the hopper, which automatically comes into action, to reduce the stream of corn or other material after a portion of the 'weighing' has fallen.

"Its simplicity will be readily understood by the following description of its action:—In weighing, the substance may be fed into the hopper by hand or by elevators, or in any other convenient manner, but in many cases the machine can be placed under a shoot or spout (in connection with the bulk to be weighed), so that a continuous feed is secured without labour. Having determined the quantity that shall be registered at each tip of the cylinder, and adjusted the weight accordingly, the operation of weighing may commence. The material being led into the hopper, decends into the compartment beneath, until the quantity nearly equivalent to the weight indicated on the steelyard has fallen; the diminishing valve then reduces the stream of falling material to such an extent that its momentum is not sufficient to influence the beam; the actual weighing here commences, and as soon as a correct balance is attained, the cut-off instantly stops the supply to the cylinder;

the substance continues to fall, and its weight forms the power to depress the cylinder still further, so that the retaining catches, may be lifted to release it; it then turns and discharges its load. Being lightened, it rises presenting the next compartment to be filled, opens the cut-off (letting out the corn collected therein) and the diminishing valve, actuates the index, and the operation is continued so long as there is anything in the hopper. In reality this machine imitates the action of a man who shovels in large quantities until he has nearly got the right weight, and then sprinkles a little with his hand to obtain the exact weight.

"In using this machine to assess the duty upon grain ground or crushed for brewing, it is fixed over the rolls and is fed by a worm driven by them, so that when they stop the feed stops. The machine is constructed to weigh a fixed weight according to the grinding requirements, say 5 lbs. at each tip, and the index or register is made to indicate such quantity at the movement of the beam, so that an inspection of the dial immediately shows the quantity passed through in pounds (avoirdupois). The whole apparatus is enclosed in a case accessible only to the Excise officer and the proprietor of the brewery, but both must be present if it is necessary to open it."

Small though this machine is which you see at work before you, it is capable of weighing one ton per hour. The small machine which I have here, also on the table, is a model of one capable of weighing and registering 30 tons per hour.

Now either this, or some other automatic weighing machine, above or below the stones or rollers for grinding the malt or corn, would indicate the amount of materials used per week or per month.

It may be said, supposing you arrange any such machine as this to determine a given weight, and the Excise officer, at the end of the day, or week, or month, takes the weight of material used, what is there to prevent a dishonest man throwing sugar into the mash tun? Well, what is to prevent a dishonest man doing so at present? The Excise officer is not there; the police constable is not there; the only thing is the danger of being found out, and so it would remain then. Penal laws, after all, are the only ways of keeping dishonest men honest, and if you make them sufficiently severe, I think you will find that a dishonest man will not be pouring raw grain or sugar into the mash tun without having previously passed it through the apparatus. However, I doubt not it might be arranged so that even a dishonest man could not well put it into the mash tun. It must not be forgotten, with reference to this question of Government guarantee, that no licensed common brewer who is employing a number of working men, and who is also at the mercy of other people, would be likely to use raw grain, or malt, or sugar in an improper way, because he would be simply placing himself at the mercy of his workpeople and others, and therefore he would not be safe for a moment.

You may say "What are the benefits to be derived by the consumer?" In the first place, there would be a cheaper production, because the brewer would be more free to purchase cheap materials; he would have a wider choice than he has at the present moment. Secondly, we would have the advantage of a beverage less alcoholic, and containing more dextrine, and therefore, as a summer beverage, and for evening purposes, it would be a great advantage to us all, especially to working men. What we want is beer for quenching thirst—a beer that we may safely drink a great deal of. When I am thirsty in summer, I do not care for a pint of our present ale; if I take such a quantity it is barely sufficient to quench my thirst, and it has one great drawback, that of rendering me unfit for work. It is therefore useless to me as a beverage. I am speaking of English ales, the alcoholic ales we now brew. We want it also for conversational purposes. When we are sitting in the evening, we want a beer that shall just be sufficient to keep conversation going—sufficient to discuss politics, but not strong enough to stop conversation or to stop our power of taking more. Now the Germans, who are the greatest beer-drinkers in the world, for they drink six or eight times as much as an Englishman, are able to drink freely, because they are not drinking highly attenuated alcoholic ales—very admirable indeed for their own special purposes. And no one likes a glass of Burton better than I do, but I use it as a stimulant; but the Germans are able to drink these large quantities, because their ale does not contain much alcohol. You may say it contains a great deal of water, and that is perfectly true, but it is not by any means "small beer." It is a beer that is pleasant, full mouthed, round, and has a very fair gravity; it contains a considerable quantity of dextrine, soluble albuminous matters, a little sugar, and just about sufficient alcohol to keep conversation going pleasantly. And you must bear in mind, with reference to producing a cheap material, that dextrine or British gum has a wonderful property in imparting fullness and roundness to water, whereas alcohol has not. Therefore, I say, if we were enabled to do what we liked, if we could get rid of the malt tax, we should be able to make such experiments as would lead to the production of a material like German beer, though not carried out in the slow German fermentation process.

It will be necessary, however, for the brewers of England to associate themselves with the agricultural interests.

It is true that the experiments made by Messrs. Lawes and Guilbert—and I am bound to add with their usual thoroughness and accuracy—on the value of malt as a feeding stuff for cattle, go to show that for a given weight of raw grain it matters not whether it be previously malted or not when given to cattle. This, however, is not the general opinion of agriculturists, who demand the freedom to prepare their grain as they may think most beneficial to their interests.

While advocating in the interests of the working classes, and indeed of us all, a class of beer for evening meetings and as a summer beverage, I do not wish that we should give up our present alcoholic ales, since they are valuable at table and as occasional stimulants. I propose rather to add to the various kinds of ale, not to do away with some of great excellence in present use. I think in time we shall be able when we get rid of the present mode of collecting the tax, to produce first of all, a beer well attenuated and alcoholic, like the present one, and when bottled so deprived of albuminous matter, and containing so small a quantity of dextrine that it may be truly a substitute for French champagne. I am speaking of our future cereal champagne, and, on the other hand, a less alcoholic, but rich, round, full-flavoured ale, which I spoke of just now. Of course, between these two, there would be an endless variety of beers as there are at present.

But even if there be no alteration made in the law, there still remains a considerable amount for us to do before we have thoroughly mastered the employment of the materials which we are permitted to use. I have pointed out to you some of the complex phenomena connected with your art, and the more we have entered into the subject, the more we have found that there are a number of matters not cleared up, matters stil remaining uncertain, and I cannot take my leave of you this evening without urging upon you the necessity of following the example that has been set by other bodies, such as the Royal Agricultural Society, the Highland Society of Scotland, the Architects, Engineers, and other societies. I should like to see, for the purpose of future progress, a Brewers' Society. The matters that you would have to deal with would be the study of the laws of science and their applications to your own particular industry; and such a body should sooner or later

offer some of the following advantages to their members. I think there ought to be, first of all, a place of meeting; there should be a library and reading room, to be supplied with English and foreign periodicals and papers, and original memoirs referring to the art of brewing; there should also be a lecture theatre for the holding of monthly meetings, the reading of papers and discussions; and secondly, for an annual course of lectures to be delivered on engineering, chemical, and scientific matters; thirdly, for providing tutorial instruction to students and young men who might attend the institution. It would, therefore, be necessary to have a chemical laboratory, for the purpose of practical instruction of such students, and the carrying on of ordinary consulting and analytical work, for the members of the society, and for the purpose of original investigation. Lastly, a time might arrive when it might be well to add a small experimental brewery, and a journal of transactions.

All this will not come at once. Indeed, a place of meeting and of discussion might do as a commencement. In time the laboratory, the annual lectures, and the educational course for future brewers might follow. I think it would be well for some of you to think over the matter, for some of these points might at least be adopted soon. I feel sure that in a few years it must tend very greatly indeed to increase your power and your knowledge of the phenomena of brewing, and meanwhile it must help to lessen the losses that are constantly occurring.

I must now, gentlemen, bring my remarks to a conclusion. This course—a very brief one—has, from its shortness, necessarily precluded my entering on many matters of high importance to you. After all, it has only been suggestive. Its main object has been to raise discussion and to excite inquiry. I felt it necessary to devote most of my attention to the important manufacturing processes of malting, mashing, and fermentation: the analyses of beer; the composition of the different varieties of ales produced in this country and elsewhere, sound or unsound; the determination of original gravities of ales for the sake of those engaged in the export trade; and the interesting products which are formed in the storage of ale; these, and many other matters of great importance, have been left wholly untouched, or but slightly alluded to. Even as it is, I have felt at times that I was sadly pressed for time, and could not dwell sufficiently on matters which I was discussing. In conclusion, allow me to give expression to my grateful appreciation of the kind and unwearied attention with which you have honoured my remarks. Some of you must at times have been sorely tired by my criticisms of old cherished methods, and also by my want of a thorough knowledge of the practical details of brewing. My criticism, however, have been solely actuated by a desire to make you look at the matter from a new stand point, so that you might see the *rationale* of the processes employed. To the brewers of our own country and abroad, I am deeply indebted for their courtesy and for the great assistance they have always given me. On all hands I have received every possible help, and have been permitted to see every process, and even to look into the hidden arcana of their art.

Lastly, to the Society of Arts, the originators of these meetings, I tender my thanks, not only for the kind assistance given me by the indefatigable officers of the Society, but also for the opportunity afforded me to study a subject second to none in interest. I venture to assume that you will join me in thanking the Society; for the object that they have had in view has been to further the application of science to an industry, important as regards the capital and labour employed in it, and also as regards the public health and the general well-being. I am only too conscious of the extent to which their desires and your expectations have failed of their attainment. If, however, I have in any way contributed to your knowledge of the complex and highly-interesting phenomena underlying your art, and if I have to that extent increased your power—further, if I have aided by the hasty sketch this evening of the advantages to be derived from the alterations in the present Excise laws, alterations which will give you fuller freedom of manufacture, and which, joined to a more active interest on your part in the science of your art, must lead to that future state of excellence implied by the term "beer of the future," which will readily enable us to produce on the one hand highly attenuated alcoholic ales, and on the other a less alcoholic, but pleasant, generous, and thirst-quenching beverage, I shall indeed have been amply repaid for the labour this course has entailed. At present, free indulgence in our alcoholic ales tends to the injury of the working classes. This should not be.

The Germans, as I mentioned just now, while distinguished by their sobriety, industry, and love of order, are decidedly great beer drinkers. Their beer, however, is nourishing without being intoxicating, and it is their chief beverage on all occasions. So used it to be with us in the olden times; and although I personally would be the last to depreciate the value of "good" tea—when one can get it—as an occasional stimulant to the nervous system, I yet think that the cry of a "free breakfast table" which has been raised is—the question of the sugar duty apart—one that requires to be carefully considered, else we shall be inundated more than ever by poisonous and unwholesome Chinese productions. Let us rather, in the interests of trade and agriculture, in the interest of public health, and for the well-being of the working classes, ask for such modifications in the mode of collecting our tax, such modifications in the present antiquated laws as will enable us to produce at once a cheap, wholesome, nourishing, non-intoxicating beverage, and one that we can all as freely partake of as the German can of his. Then I think we may, with the poet, but far more truly than he could, and without his misgiving as to our future prowess, sing of our cereal wines

> Balm of my cares, sweet solace of my toils,
> Hail—juice benignant! * * *
> My sober ev'ning let the tankard bless,
> While the rich draught with oft-repeated whiffs
> Tobacco mild improves. Let tender swain
> Each morn regale on nerve-relaxing tea,
> Companion meet of languor-loving nymph.
> Be mine each morn with eager appetite,
> And hunger undissembled, to repair
> To friendly buttery, there on smoking crust
> And foaming ale to banquet unrestrain'd.
> Thus in ancient times,
> Our ancestors, robust with liberal cups,
> Usher'd the morn, unlike the languid sons
> Of modern days; nor had the might
> Of Briton's brave decay'd, had they thus fed
> With English ale improving English worth.
>
> Wharton.

At the conclusion of the lecture, Mr. Davenport proposed a cordial vote of thanks to Dr. Graham, saying that if it were desired to form such a society as had been alluded to, the Society of Arts would be very happy, he had no doubt, to give any assistance they could, either by lending their room for the purpose, or in any other way which might be suggested to the Council.

It is stated that the Government of Salvada has had to pass laws, with severe penalties, against those who destroy the telegraph wires. It has been found that the people are apt to cut off long pieces of the wire and use them as strings to dry clothes on.

Hopes are expressed that by the invention of a new system of hardening steel, the work of piercing the St. Gothard tunnel can be finished a year or two in advance of the expected date. The new invention was made by Mr. Knecht, the engineer of the tunnel.

The Secretary of State for India has offered a premium of £400 for the best machine to be selected by competition, for weighing salt at the saltworks in Bombay.

The gross receipts of the Indian railways have been £7,100,000 sterling in 1873, an increase of £340,000 over last year.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

THE INTERNATIONAL EXHIBITION OF 1874.

(From *Iron.*)

The Exhibition of 1874 is to be opened on Easter Monday, the 6th of next month, and preparations are now vigorously going on at South Kensington, that all may be in due readiness on that day. As will be remembered, we are to have a decade of Exhibitions, and the present will be the fourth of the series, which began in 1871. In it the plan of former years will be preserved, and there will be three divisions as usual:—Fine Arts, in which, of course, we cannot expect much novely; Manufacture, special classes being selected for illustration each year; and Scientific Inventions, the last, a wide division, which purports to offer space for novelties not available for the special classes of the year, and practically serves to include any miscellaneous matters really worth exhibition.

That the Commissioners had at their disposal a more convenient building is heartily to be wished, for a more bewildering maze than is offered to a visitor by the present range of buildings at South Kensington, it would be difficult to conceive. Occupying, as it does, a strip of ground surrounding an extensive garden, it is of as inconvenient a shape as possible, and the distances in this elongated building from one part to another are very considerable. Then even the uniformity of arrangement offered by a building which is only one long passage, is spoilt by the haphazard addition of annexes here and there, so that the whole plan of the building is such as to drive to distraction any visitor not unusually gifted with the sense of locality. There is certainly one suggestion that offers itself. Why should not the Commissioners have clear and distinct plans of the Exhibition hung up at various points? On each plan might be conspicuously marked the place where it was suspended, and the stranger could thus tell at a glance the precise spot where he was, and the way to the part he might next wish to visit. Such an arrangement would go far to prevent many of the complaints now made by puzzled and wearied sight-seers.

In one respect the Exhibition of the present year has a great advantage over its immediate predecessor. Last year there was a powerful rival in the field, for very many, especially among foreigners, who would otherwise have been exhibitors in London, sent their goods to Vienna instead. This year London will have it all her own way, and we may justly expect additional improvement. Of the vast benefits afforded to commerce and manufactures by the series of Exhibitions since 1851 there is now no doubt, and though it has been urged from many quarters that the world is getting tired of these "fairs" we fancy that their work is not yet done. For the general public, likely enough, a yearly Exhibition for ten years is rather a severe dose, and there need be small surprise if there is some falling off in public support but the results of each year's show must be looked for in the particular manufacture with which it deals. Here the workman can examine specimens of the best results of his own trade, can study the processes by which those results are effected, and can attain a knowledge of all the newest improvements connected with the special craft in which he is most interested. Such, after all, must be the chief objects of the present series, nor are those at the head of the executive at all blind to the fact. Under the somewhat high-sounding title of a "National Association for the Promotion of Technical Instruction," they propose to register a number of subscribers to whom packets of tickets for gratuitous distribution will be sold at a reduced rate. Artisans' tickets at sixpense, and school tickets at threepence each, will be issued, and though we fail to see why such tickets should be issued only in large packets and sold for gratuitous distribution, still, we must look on this as a step in the right direction, for it is only by making entrance to these exhibitions as cheap as possible that they can ever be expected to succeed, either pecuniarily or otherwise.

The Fine Art division we may expect to find much the same as in former years. It is said that Italy will be represented, and Japan, too, is sending specimens of her art-work, paintings, porcelain, and bronze. A new feature it that a gallery will be devoted to works of art by officers of the army and navy. Here will be shown pictures, sketches, photographs, sculptures, &c., remarkable either for artistic merit or for the interest of the subject treated.

Round the second division, "Manufactures, with the Raw Produce, Machinery, and Processes employed," the chief interest of the Exhibition centres. The classes for the present year are (1) Lace, ancient and modern; (2) Civil Engineering, Architecture, and Sanitary Science; (3) Heating; (4) Leather, including saddlery and harness; (5) Bookbinding; (6) Foreign Wines. In Class 1, a loan collection of ancient lace will attract visitors of the fair sex, who will also see with interest various processes of lace manafacture, both hand and machine. A prominent object in this department will be a large lace-machine in operation, promised by the Nottingham Chamber of Commerce. Class 2 will be large and varied, and though no part of it, perhaps, will prove very attractive to the general public, yet the whole collection in it is certain to prove both interesting and valuable to experts. To give an idea of the miscellaneous and comprehensive nature of the exhibits, it may be worth while to notice a few of the principal. The Admiralty sends a collection of models, including those of the extension works of Portsmouth Dockyard, and the dockyard at Chatham. The Trinity House supplies models of several lighthouses. From the Metropolitan Board of Works, as represented by Mr. Bazalgette, come drawings and photographs of the main drainage works and the Thames Embankment. Specimens of a new pavement composed of wood and asphalte, specially designed to obviate the slipperiness of the present asphalte carriage-ways, are contributed by the Société Française des Asphaltes; then there are models of houses sent by the Industrial Dwellings Company; brick-making, stone-dressing, wood-working machinery to be shown in action, besides building material of every sort. These, above all, belong to the civil engineering and architectural department, in connection with which it has also been proposed to carry out a series of experiments for testing the strength of materials, but this depends on the event of a fund being raised to defray the necessary expenses.

The sanitary appliances in the same class are also very various, but they are not quite so well adapted for exhibition. The secrets of Cloacina are not to be rashly disclosed, nor are her inmost shrines pleasant places even for the most ardent votary. Still the Commissioners are not to be daunted, and full preparations are actively going on for exhibiting in action the principal systems for treating sewage now before the public. The experiments will be carried on in closed tanks with glass sides, on sewage procured from one of the metropolitan sewers, and brought in air-tight vessels to the Exhibition. Considerable difficulty will be found in treating the subject properly, but all the inventors are sanguine as to their being able to carry out effectually and satisfactorily the contemplated experiment. The lime and cement method of General Scott, the A B C process of the Native Guano Company, and the dry charcoal plan of the Carbon Fertilising Company, are all to be thus shown, tho latter company having even set to work to build a house and stable to exemplify their system.

Class 3 (Heating) is under the direction of a Committee of the Society of Arts, and in it will be shown the stoves entered in competition for the Society's prizes of £500 for heating and cooking apparatus. The entries in this class are numerous, and show the attention that has been bestowed of late to the fuel question. At present the practical testing of the Society of Arts' stoves is being carried on in a building erected for the purpose. As soon as the experiments are completed, and a report issued by the examining committee, these will be shown with the rest of the heating apparatus sent for exhibition.

Class 4 is rather special. The operations of treating and preparing leather are of too dirty a nature to be fit for exhibition, and as some difficulty might be found in carrying them on in "air-tight tanks with glass sides," it has been determined not to attempt to show them. Machinery for cutting, sewing, and otherwise treating leather will be shown, but, it seems probable, not in action, and all the various sorts of prepared leather, curried leather, alum leather (white kid), and enamelled leather. Articles of leather are also to be included, such as machine belts, portmanteaus, fire-buckets, &c.; and as a contrast to finished work shown, some ornamental leather articles of native African manufacture (lent by Mr. P. L. Simmonds) are likely to be curious. In the same class, saddlery and harness form a sub-heading of themselves.

Class 5 (Bookbinding) will be generally attractive. Specimens of every sort of work will, of course, be shown, and a complete set of the machinery used in the various operations, by Messrs. Hopkinson and Cope, will be kept at work.

The last class (6) of this division—Foreign Wines—is to be located in the vaults of the Albert Hall. As this class appeals to other senses than that of sight, an extra charge of sixpence will be made for admission. In return for this, the visitor will be permitted to experiment on the vintages submitted by the only satisfactory method, namely, that of tasting them.

We now get to the third of the principal divisions of the Exhibition, that devoted to "Scientific Inventions and New Discoveries." Here the Commissioners exercise a judicious liberality in not scrutinising too closely the absolute novelty of each invention submitted. It is of course impossible to say what of special interest will be found in so miscellaneous a collection, but a good many attractive exhibits are promised. We are to have Gramme's electro-magnetic machine, the power of which has already been publicly manifested in the light shown last year from the clock-tower at Westminster; the Siebe-German diving apparatus is to be shown under water, with electric light and speaking apparatus complete; the great revolving light, for the South Stack light-house near Holyhead, will also be exhibited in full operation; Fowles' process of casting metal under pressure will be exemplified; and amongst other exhibits will be a model of Mr. Rae's floating bathing soloon, a portable gas-making apparatus, and some rock-boring machines.

Such will, propably, be the main features of the 1874 Exhibition, though there are several subsidiary departments whlch deserve notice. France and India will each have an annexe to itself, in which we shall probably find more variety than in any of the specialised departments. Then the ethnological collection, which it is proposed to make permanent, will be novel. For the present year the tribes of West Africa are to be specially illustrated, and Colonel Hardy, late Administrator on the Gold Coast, has been commissioned to collect objects of interest relating to these peoples. The Moorish House, which was a prominent object of attraction at Vienna, was to have been brought over, and erected in the Exhibition grounds, but we hear that this idea has been abandoned. Last, but not least, it is expected that the School of Cookery, the great success of last year's International, will be again got into working order, so that we may hope once more to be edified by that most useful, but somewhat eccentric, combination of the lecture hall and the kitchen.

The Society of Arts has been mentioned above in connection with the heating apparatus, but it should be added that this energetic body—the originator of all Exhibitions, great and small—also proposes to give its gold and silver medals for such exhibits as may show special excellence in any or each class of the Exhibition.

Probably the finest collection of ancient lace ever made has been lent for the forthcoming Exhibition by Messrs. Dupont, of Paris. The specimens will be arranged in chronological order, and will thus exemplify the origin and growth of the art of lace-making. There are upwards of 300 examples, some of which have an historical interest, as belonging formerly to sovereigns, such as Louis XV., Marie Antoinette, and Napoleon I. Many other possessers of fine specimens have promised to contribute loans to this section of the Exhibition. In view of securing the daintiest and most skilful manipulation for the delicate fabrics, the General Committee of Ladies, of which H.R.H. the Princess Christian is the president, have appointed a Sub-Committee of ladies, who will themselves superintend the arrangement of the loans, which will be undertaken by experienced needlewomen. All the specimens are to be sent in on or before the 16th March, after which day the Sub-Committee will commence its operations.

The following are the regulations to be observed in regard to wines (other than those sent from duty-paid stocks) forwarded to the Exhibition of 1874:—

1. The wines may be removed to the Exhibition without payment of duty, on bond being given by responsible parties to pay duty, at the close of the Exhibition, on the quantity and quality removed from the bonded warehouses, or imported for the purpose of being exhibited.

2. That in the case of wine remeved from bond the quantity, etc., be ascertained and the bond be given before the wine is delivered for conveyance to the Exhibition; and in the case of wine imported and removed without examination, that the bond be required so soon as the wine has been examined after arrival at the Exhibition, unless the duty be paid at once.

3. That the duty due on all wine so removed may ultimately be received by the officer of Customs stationed at the Exhibition, should the parties so desire.

4. All persons who may remove wine to the Exhibition are to be at liberty to pay the duties on the wine before its removal, in lieu of giving bond.

Collectors wishing to contribute specimens to the Ethnological department either by gift or loan, are invited to communicate with the "Secretary to the Executive" for the Annual International Exhibitions, Royal Albert Hall (East Side), Upper Kensington Gore, London, S.W.

A telegraph line has reeently been established between Woosing and Shanghai. This is the first successful attempt to introduce the telegraph through the main portion of the Chinese empire, as previous efforts have met with violent opposition fron the people, who cut the wires and destroyed the poles.

Mr. Mallett, of the Geographieal Survey Department, has made a yery important discovery of coal at the foot of the Darjeeling Hills. The largest seam is 11 feet thick; another is 7 feet; and there are several measuring from 2 to 5 feet. A sample from one of the beds has been analysed, and yielded as much as 83 per cent. of carbon.

A Yokohama eorrespondent of the *Augsburg Gazette* states that Oshina, the Director-General of the mines of Japan, in a report upon the mineral riches of the islands, mentions as likely to become one of the principal sources of the empire, beds of naphtha and silver ore in the Island of Tazinia.

EXHIBITIONS.

INTERNATIONAL EXHIBITION AT MARSEILLES.

It is intended to hold an Exhibition of Modern Inventions and Discoveries at Marseilles during the present year. According to advices received from the Administration, the principal aims of the exhibition will be to bring into public notice such inventions and discoveries as are likely to be of important practical service in the different branches of industry, agriculture, science, art, and domestic economy.

It is announced that valuable prizes, and more than six hundred gold, silver, and bronze medals, will be awarded, and that the jurors will include men of science, officers of both services, engineers, architects, shipbuilders, merchants, agriculturists, &c., &c.

The following are the rules for the exhibition :—

1. The exhibition will be opened on May 15, and will close at the end of the year. It will be held in the Parc du Chateau-des-Fleurs.

2. Objects of every description, patented or not, connected with industry, agriculture, science, art, and domestic economy will be amitted.

3. Each exhibitor subscribing ten francs will be allotted four metres.

4. For space beyond that amount he will be charged at the rate of ten francs the square metre.

5. To assist persons intending to exhibit, but unable to accompany their goods, the Administration will undertake the arrangement of exhibits, if properly consigned to them carriage paid, and in a state fit for immediate exhibition, at the rate of eight francs per package, including the cost of return at the close of the exhibition. It will also undertake the construction of show cases, tables, &c., according to the wishes of the exhibitors, and at economical rates. It will provide workmen for exhibitors who require them at the rate of two francs a day, such workmen to be directly under the exhibitor's orders.

6. In the machinery gallery motive power and shafting will be provided, but only for working models on a scale of $\frac{1}{5}$, $\frac{1}{10}$, $\frac{1}{20}$, &c. A special position will be assigned to motive-power machines at work, if the exhibitors wish it, at their own cost.

7. A spacious court is specially reserved for munitions of war, &c.

8. An extensive space of ground has been set apart for agricultural implements. A gallery will be reserved for trials, and for the sale of the implements.

9. Paintings, statues, &c., will be placed in the large rooms of the Chateau-des-Fleurs.

10. Each exhibitor is required to forward with his application for space a money order or cheque for the amount, calculated as above on the space required (see 3 and 4). A commission of two per cent. will be charged on all sales effected in the building. 10,000 metres of covered galleries, and 18,000 metres of ground in the park are available for purposes of the exhibition.

11. Each exhibitor is required to provide sheeting to cover his goods, and to transmit with them a statement, showing their use, advantages, &c. All goods must be received not later than May 10. From the date of the opening, extensive notices will be published in the principal French and foreign newspapers.

12. All communications should be addressed to M. le Directeur-Général de l'Exposition Internationale au Chateau-des-Fleurs, Marseilles.

Each exhibitor will receive a season ticket for himself and his workmen.

Philadelphia Exhibition.—It was stated in last week's telegraphic news that the United States Congress had refused to vote a subsidy for the purposes of this exhibition.

Permanent Exhibition Building in Athens.—In the early part of last month, the Queen Olga presided at the laying of the first stone of the "Palace of Olympus." This establishment, which will include large buildings, courts, gardens, and accessary galleries, with a racecourse and places for various games, is said to be due entirely to the liberality of a native of Athens named Zappas. According to the plan of the founder, the palace will be open every fourth year for the products of agriculture, industry, and the fine arts.

NATIONAL TRAINING SCHOOL OF MUSIC.

A preliminary meeting was held in Birmingham on Monday, the 9th inst., which was attended by about 16 gentlemen, and after the objects of the scheme had been explained to them, the following resolutions were put and carried :—

1st.—" That this meeting cordially approves of the undertaking, and desires that Birmingham should participate in the advantages of the school, and that a committee be appointed to make the necessary arrangements for holding a public meeting with a view to carrying out the scheme."

2nd.—" That the committe shall consist of the gentlemen present, viz. :—Mr. Peyton, Mr. Henry Richards, Colonel Ratcliffe, Mr. R. H. Milward, Mr. H. S. Smith, Mr. J. C. Smith, Mr. Harding, Mr. Charles Harding, Mr. Rotton, Mr. Kepewick, Mr. C. Lord, and Mr. G. W. Ingram, with the addition of the Mayor and F. Elkington, Esq."

It was the opinion of the gentlemen present that the future meeting should be held at the Town-hall, under the presidency of the Mayor.

It was suggested at the meeting, by Colonel Ratcliffe, that any county or town contributing a certain number of scholarships should have a representative on the London committee.

The object of a preliminary meeting was to make the undertaking known in the district, and it was considered that by that means a fair subscription list eould be announced at the public meeting.

Mr. C. Beale has offered £50 a year for 5 years, and several smaller sums have been announced.

The idea was generally expressed at the meeting that Birmingham and its districts should contribute at least 10 scholarships.

The following remarks are taken from an article in *Birmingham Daily Post* on the subject :—

One of the greatest drawbacks with which musicians have to contend in qualifying themselves for the practice of their art in this country is the want of a good national music school, or Conservatoire, such as we find established in most Continental countries, for the prosecution of musical studies, both in the theoretical and practical branches. The Royal Academy of Music is the nearest approach to an institution of this kind which has yet been attempted among us, and we need not point out how very inadequate in scope, means, and facilities for musical training our languishing academy appears beside the great Conservatoires of Paris, Leipsic, Brussels, and Milan. It is with much satisfaction, therefore, we are able to announce that a movement is on foot for remedying this obvious defect in the national educational curriculum, in a manner conformable to our requirements and congenial to English principles or prejudice, which, as a rule are very jealous of State subsidies for art-training purposes. The Society of Arts have set on foot a scheme for the establishment of a National Training School of Music, for which the Commissioners of the Exhibition of 1851 have granted a site, and a private individual has undertaken to provide the building at a cost of £20,000. Mr. C. J. Freake is the munificent donor of this valuable erection, the foundation stone of which was laid by the Duke of Edinburgh in December last, and the completion of which may be looked for by the close of the current year. Something more than a building, however commodious and costly, will, of course, be needed for the successful establishment of the school; and unless the public come forward liberally with their contributions for the foundation of scholarships, the engagement of competent professors, and the general expenses of administration, Mr. Freake's munificence will have been to little purpose, and we shall be as far as ever from the accomplishment of our object. It has been estimated by the committee for the permanent and effective establishment of the proposed school, that it is necessary to obtain at least 300 free appointments or scholarships for male or female students, of the

value of £40 a year. The appointment to these free scholarships will be made by public competition in every district in the United Kingdom, and in order to interest the country generally in the work of the school, and extend to every locality the new facilities for musical education, it is proposed that the scholarships shall be founded in connection with various towns and districts, and that local committees shall be formed for the purpose of carrying out this object. The required endowments may be made by public-spirited individuals in lump sums, calculated to produce the specified revenue of £40 per annum; by memorial endowments in honour of great musicians, as in the case of the Mendelssohn Scholarship; by endowments for the limited period of, say five years; or by a sufficient number of individual contributions or subscriptions to make up £40 a year.

PUBLIC MUSEUMS AND LIBRARIES.

The following returns of the numbers of visitors for February last have been made up to the present date:—

	Number of Visitors.
British Museum	(no return)
National Gallery (Trafalgar-square)	57,177
Kew Gardens and Museum	9,413
South Kensington Museum	52,500
Bethnal-green Museum	31,271
Geological Museum, Jermyn-street	3,917
Patent-office Museum	14,675
Edinburgh National Gallery	6,171
Edinburgh Museum of Antiquities	4,174
Edinburgh Museum of Science and Art	
Royal Dublin Society:—	
Natural History Museum	4,467
Botanic Gardens, Glasnevin	5,037
Dublin National Gallery	
Zoological Society, Dublin	6,291
Museum of Irish Society, Dublin	
Tower of London	4,935
Royal Naval College, including Greenwich Painted Hall	20,445

THE PROGRESS OF GREECE.

There are many persons interested in the welfare of modern Greece who will be glad to learn from Mr. Wodehouse, one of our Secretaries of Legation at Athens, who therefore possesses ample opportunities for observation, that remarkable progress has been made during the last twelve months, and many long-talked-of schemes are about to be realised. The following important undertakings have already been set on foot:—

Three new lines of railway are to be constructed. The first is to run from Athens through Thebes and Lovadea, to Lamia near tho frontier, a distance of about 140 miles, and thus, when connected with the Turkish lines, bring Greece into railway communication with the rest of Europe. The concession of this line has been granted to M. Syngros, of the "Banque de Constantinople." The construction presents little difficulty, and it is stated that it will not cost more than 28,000 drachmas (£1,000,000 sterling). The second line is to start from the Piræus, and to pass through Eleusis and Megara, and across the Isthmus to Corinth, thence to Vostitza, Patras, and Rhion. There the trains will be carried across the Anterhim on the other side of the Gulf of Corinth, whence the line will proceed to Mesolonghi and Vonizta, and terminate at the Gulf of Arta. The line was originally projected to run from Porto Raphti, in the Ægean Sea, and not far from Laurium, through Athens to Eleusis, instead of starting from the Piræus, and the change has been made in consequence of a protest from the inhabitants of the Piræus, and in consideration of a grant of land by the Commune free of all expense for the terminus. One of the objects of the line is to compete for the Indian traffic, and if the line had started from Porto Raphti it was expected that the journey from London to Alexandria would be performed in 127 hours—a saving being effected of 51 hours over the Marseilles and 13 hours over the Brindin route. With the terminus at the Piræus, the saving will be some hours less. The third railway concession has been granted to an English company, Messrs. Broadbent, Macdonell and Co., for the construction of certain lines in the Peloponnesus, from Corinth to Argos, thence to Tripolitza, with branch from Argos to Nauplia. From Tripolitza to Gythium through Sparta; from Tripolitza to Calamata, through Megalopoulis; from Messina to Kyparista, thence to Pyrgos and Patras.

A project has been lately brought forward for cutting a canal through the Isthmus of Corinth, and constructing docks in the canal, and a town and warehouses on its banks. It is proposed to use a new excavating machine, invented by M. Vandevinne, and it is expected that by this means the work can be accomplished in a very short space of time. The breadth of the isthmus, in the part where ships were drawn across in ancient times, is stated in Leake's travels to be only three miles and a half. The canal is to be forty metres wide and eighty and a half metres deep. The promoter only asks for the concession of 5,000 acres of land on each side of the canal. The principal object of the enterprise is to establish a port of transit to rival Syra and Constantinople, and to form a new centre for the Greek carrying trade in the Levant. One of the principal impediments to progress in Greece has been the want of roads, without which the construction of railways will not have much effect upon the material prospects of the country. A considerable sum of money has been annually disbursed by the State for the last forty years for the purpose of road-making, but very few have ever been constructed, and the number of really practicable roads in the kingdom is ridiculously small. M. Deligeorgis has laid before the Chamber a Bill for amending the existing law, in order to make use of these funds to better advantage. The government has also concluded a convention with the Oriental Submarine Telegraph Company for laying down new cables to connect the mainland of Greece with the various islands of the Archipelago, and also with Egypt, Italy, and Austria.

Besides the undertakings mentioned, several cotton, china, and glass factories, and other new industrial enterprises are to be started at the Piræus. Building is going on in Athens in every direction, and to judge from the continued rise in house-rent, more will be required. Amongst the buildings in course of construction are a town-hall and a new theatre.

THE PROVINCE OF TREBIZOND.

The eastern wing of the Province of Trebizond extends along the Black Sea coast, in a north-easterly direction from the town of Trebizond itself to the Kuman frontier, and has a total length, if the sinuosities of the shore be taken into account, of about 200 miles, by an average breadth of 50, giving a superficies of somewhat less than 10,000 square miles. It comprises three districts—that of Gurgistan, from the Russo-Caucasian limits to the mouth of the river Chorok; that of Lazistan, from the Chorok to Kemer Bornoo to the head town of the province. But the entire region is often popularly, though erroneously, termed Lazistan. Starting from Trebizond, Consul Palgrave travelled southward to Beyboost, and thence, going east, visited this entire region on its miner or mainland side, up to the frontier; then turned north, came to the sea, and retraced the whole length of the road by the coast track, thus leaving no point unexplored. The general features he describes as country of a narrow and marshy coast strip; behind it the seaward slope of the Anti-Caucasus or Lazistan mountain chain, up to the summit; and behind that the valley of the river Chorok. The mountains come nearest the sea in the mid-region, or Lazistan Proper, at the Trebizond end, and still more at the opposite extremity in Turkish Gurjistan, they recede somewhat from it. The climate of the lower or long-shore zone is every-

where relaxing, and in most places unhealthy; the atmosphere is constantly overcharged with damp; the barometrical readings generally low; the thermometrical range from 25° Fahrenheit in winter to 80° in summer. The middle zone is from 2,000 to 6,000 feet above the sea-level, and is comparatively healthy, but unpleasant to live in, owing to the prevalence of fog, mist, and rain, for eight or nine months of the year. The third, or pasture-ground zone, is covered with snow from the beginning of November to the end of April, and only inhabited in summer and early autumn. Across the mountain crest the climate is generally healthy, and the atmosphere dry and bracing; while the vicissitudes of heat and cold are much greater than on the coast. The soil, mostly composed of volcanic detritus, is extremely fertile; the water supply equable in the interior, and somewhat in excess on the coast. The character of the land produce may best be described by saying that whatever grows spontaneously, or under cultivation in Lombardy and the northern Appenines, grows, or would grow, if planted here. Silk alone must, it seems, be excepted from the possible list, since it has often been tried, but very rarely succeeded, owing apparently to the cold and prolonged fogs of the Black Sea spring.

The present value of the agricultural yield would be greatly increased if wheat were, as it might be to a large extent, substituted for the monotonous maize crop. Potatoes, too, turnips, and especially beetroot, ought to be introduced; they would all, under tolerable management, do well. Garden stock might be multiplied, and orchard growth improved infinitely, but the natives understand absolutely nothing of these matters. Lastly, the southern, or landward mountain slope, and many west-looking tracts of the seaward side, would, under proper industry and skill, become first-rate wine districts, especially in Gurjistan. Mineral wealth, in the form of mines actually worked, there is some in all this region. Copper is said to exist in the heights behind Of and Surmeneh. Good specimens of chromate of iron may be seen in the Ajarah, and in the Hamsheen mountains; also extensive traces of iron. With the exception of boat and smack-building along the coast, and of the linen and rope-making in the Rizeh district, the manufactures of this region are utterly insignificant. Consul Palgrave concludes that this coast still would—as by the numerous ruins of public and of domestic architecture that occur throughout it, it appears that it once did—support with ease a population of four or five times the actual number. The chief material requirements are, broadly taken, good vicinal horse-paths from village to village; bridges across the torrents and rivers; drainage works in the low grounds, and forest administration in the high ones; and a couple of waggon roads inland, one from Surmeneh, one from Batoom; lastly, landing-places, where possible, at the roadsteads. In addition, and for the special circumstances of the place, Batoum ought to be united by good and free land communications, notably by rail with Russian Georgia, of which it is the natural inlet and outlet. The principal social requirements in the same view are, an honest executive, upright law tribunals, effective police, practical education, and country banks, not one of which things is at present to be found in this region.

The project for a tramway from Milan to Tradate, in Lombardy, has just been laid before the Provincial Council, and there seems to be every prospect that in a few months its construction will be commenced; in this case a rich and productive agricultural district will be put into communication with Milan.

According to the returns lately published by the municipal authorities of Milan, it appears that in 1872, 9,935 head of cattle, representing a value of 1,262,788f. 85c. were slaughtered at the abattoir, and 8,324 head, representing a value of 1,147,306f. 60c. were slaughtered in the same way during the year in 1873.

CORRESPONDENCE.

SUB-AQUEOUS TUNNELS.

Sir,—The project of the Channel Tunnel being now under serious discussion, a few words upon a similar scheme may not be uninteresting, particularly as the feasibility of that scheme depends much on the same conception of geological facts—which is that the Channel chalk, the Thames Valley chalk, and the Great Mid-England Valley chalk have all been similarly treated by nature, namely, washed away by the continual action of current and tide, and not broken into cracks and fissures by volcanic action, and so crumbled, decomposed, and eventually moved by atmospheric or aqueous agencies.

Some time since I made myself acquainted with the following details, with a view of projecting a railway under the Thames at Gravesend, not more as a mercantile enterprise than as a completetion of the military strategic communication that ought to encircle our island.

It proposed to connect the present Tilbury and Southend Railway with the North Kent and London, Chatham, and Dover lines. The commercial advantages of the scheme were thought to be direct communication for passengers, manufactured goods, cattle, corn, coal, castings, &c., from north to south. The military ones I need not here discuss.

Many years ago there was a project for a similar tunnel, but it fell through, the science of the day was unequal to the task; and the fact of the surface chalk being somewhat crumbly and rotten, led the proprietors to assume that such was the character of the mass below, which view is opposed to that which I took when I went into the scheme.

The average depth of the Thames at Tilbury is 45 feet—the maximum 55 at one particular place—low water. The width of the river from high water marks on either side is eight hundred yards.

The chalk upon which Gravesend stands outcrops on the opposite side of the river at Little Thurrick and East Tilbury; it is covered with but a very few feet of a aluvial silt, under which and through the chalk the tunnel should be constructed.

I proposed to make a tunnel 33 feet high from the *terreplain* to the crest of the arch, including thickness of masonry or tube, of proportionable width for four lines of rails, and 900 yards long—at a depth of 110 feet below the river bed, at low water, giving a mass of 35 feet of soil between tunnel and water in the weakest part, and an average of 45 feet in every other place. The project connects this tunnel to two loops or branches on either side of the river, with the railways running east and west on both sides, and these pairs of loops, each loop 1,200 yards long with a gradient of 1 in 33 feet, are to meet each other at the tunnel's mouth, each keeping to its own line of rails through the tunnel or its own side, or entrance, so as to avoid points or crossings.

The whole line of railway including loops and main tunnel was 3 miles 420 yards.

Four pipes or tubes, such as Mr. J. Hadden, C.E., showed for his Bosphorus scheme, would answer admirably for the main tunnel, which might then be at a depth below the water merely sufficient to have a good bed in the firm chalk, and have a covering against dragging anchors and torpedo blast. Any other method of the numerous plans at the finger ends of our great engineers might be adopted.

Should this scheme be carried out before the Channel Tunnel and the homogeneous solidity of the mass of chalk in the Thames bed be proved, as I am confident it is—a fact—corroborative evidence would give confidence for the greater scheme.—I am, &c.,

T. B. Heathorn,
Captain, Half-pay, Royal Artillery.

7, Pall-Mall, 11th December, 1873.

MANUFACTURE OF COCOA.

SIR,—Our Mr. Cadbury was at the lecture delivered by Mr. Holm on Wednesday evening, and wished to have made a few remarks if time had permitted. Will you allow us to make a brief statement on some of the points which were touched on? Cocoa is admitted on all hands to be a valuable article of diet, but the important practical question is how best to prepare it. The objection to cocoa in its natural state, when simply roasted and ground, is the large amount of fat it contains, which renders it unsuitable for many stomachs, and not readily miscible. Two methods are adopted to meet this difficulty, one approved by Mr. Holm, in which starch is added, which renders the cocoa more readily miscible, and disguises the fat to the palate. This is open to the objection that the presence of fat in the cocoa, especially when combined with starch not properly cooked, causes it to disagree with thousands who, after a few trials, have given up its use, because they find it too heavy, causing headache, dyspepsia, &c. The addition of starch also diminishes the proportion of nitrogenous principles in the same way as water added to milk. The other and more recent plan of preparing cocoa is to remove a portion of the butter (about two-thirds), so that the nitrogenous proportion is increased instead of being diminished as by adding starch, as is also the *theobromine*, or stimulating principle which, like *theine* in tea and *cafeine* in coffee, renders cocoa refreshing—one great desideratum in any beverage. The largest proportion of cocoa sold in this country is composed of only one-fifth part cocoa, the remainder consisting of starch and sugar. In the lowest kind, treacle is almost invariably substituted for the latter. A thick porridge is thus produced which, though it may be cheap and suit some constitutions, ought not to be allowed to be palmed off on the public as cocoa; and we consider that it has greatly militated against the use of cocoa as a national beverage. Even were the fat of cocoa its most important element, to which we must take exception, one pound of cocoa from which two-thirds of the fat is taken contains as much fat as one pound of the best homœopathic or Iceland moss cocoa.—I am, &c.

CADBURY BROS.

March 11th, 1874.

MR. HUTCHINSON'S PAPER ON AFRICA.

SIR, — I notice in Mr. Hutchinson's paper on Africa some matters which might be rendered clearer.

It is useless to try to ascertain the profit of any of the nations trading on the coast by deducting their imports from their exports. I am engaged in the liquidation of a business at Ambriz, and I find that whilst English merchants send out goods either direct or by ordering them from Hamburg, and sometimes *viâ* Lisbon by steamer from thence, so that three nations might be supposed engaged in the trade instead of one, they partly bring produce to England for realisation, and partly send it (for the sake of a better market) to France.

The articles from Ambriz are coffee, ground mats, ivory, bark fibre (for paper making), beeswax, gum, and india-rubber.

The observation as to "sale by the candle" refers to a custom which continued down to our own time, of selling "by inch of candle," that length being burnt, and the highest bidder in time being the buyer. The "molly" I presume was rigged as a show.—I am, &c.,

THOMAS A. WELTON.

6, Offerton Road, Clapham, 9th March, 1874

P.S.—I am informed by the late manager of the Ambriz concern that a nigger dare not accumulate wealth, as he would be charged with witchcraft, and plundered as soon as found out; therefore if they save anything they invest it in the purchase of slaves, the only kind of property not the object of envy.

Your African Committee might feel an interest in referring to a very interesting paper written a few years ago by Mr. Tinné, and printed in the "Transactions" of the Historic Society (Liverpool), describing the expedition of some Dutch ladies up the Nile, where, I think, they saw Consul Petherick during their wanderings.

POTATO DISEASE.

SIR,—With reference to the question above mentioned, which I understand is being considered by your Society, I beg leave to submit an outline of the only method employed in the West Indies for the purpose, and which I have, since my return from that country, successfully tried here; namely, by the use of the haulm alone, treated in the following manner:—When it is in full flower, about a fortnight or so before lifting the tubers, it is cut off about four or five inches from the ground, and the stem part inserted, about the same distance, into ridges, about a foot high and about 14 or 16 inches apart, and at the end of the fourth month the tubers are lifted for use, at the rate of three crops a year. The result of the experiments I have made with haulms planted early in June, has given a good supply of excellent tubers, without the least sympton of disease (some of which, received for the purpose, I have just now planted here), from which fact I am led to think that the process in question might help to eradicate it, both in the haulm and tuber; possibly, I imagine, by the natural decay of the planted haulm attracting it therefrom, on the principle of *similia similibus curantur*.

I beg leave to mention that I am about to submit the view to the Royal Agricultural Society, whose botanical committee have the haulm plan which I suggested thereto under consideration.—I am. &c.,

W. H. BROWN, R.N.

Lyme Regis, Dorsetshire, 9th March, 1874.

GENERAL NOTES.

Production of Wax and Honey in Corsica.—Corsica produces the largest quantity of wax of all countries in Europe, if not in the world. In ancient as well as in mediæval times the inhabitants paid their taxes in wax, and supplied large quantities annually. Since wax is to honey as 1 to 15, the Corsicans must have gathered each year some millions of pounds of honey.

City Companies and Technical Education.—The Joiners', Carvers', and Ceilers' Company offer various prizes for competition amongst the students of the schools of art within the metropolitan area. For building construction, one of £5 5s., and a second of £3 3s.; for wood-carving, one of £5 5s.; for designs for carving, one of £3 3s.; and for designs for ceilings, frames, &c., one of £3 3s. The prizes are to be given in mathematical instruments, books, &c., to be selected by the successful competitors.

Technical Education in France.—In 1870 it was determined to establish a superior Council of Technical Education, to be attached to the Ministry of Agriculture and Commerce. This Council is now formed, and is composed of M. Ozenne, secretary general of the minister; General Morin and M. Vresca, of the Conservatoire des Arts et Metiers; M. Dumas, of the Institut; M. de Fremineville, naval engineer and professor; M. Delesse, mining engineer-in-chief; M. Gorin, president of the Chamber of Commerce of Paris; the president of the Tribunal of Commerce; M. Mayer, railway engineer; M. Martin, railway constructor; M. Breguet, maker of instruments of precision; the director of the superior School of Commerce; and two or three other gentlemen who fill official posts under the Minister of Agriculture and Commerce.

Steel Prize in Berlin.—It is known that steel, when quickly cooled after heating, assumes more or less hardness and brittleness; the colour, texture, and density of the material being altered. As to the causes of difference between hardened and unhardened steel, there are merely conjectures on the subject. At a recent meeting of the Berlin Academy of Sciences, one of the secretaries, Dr. Du Bois Reymond, announced that a prize of 100 ducats (about £40) would be awarded in July, 1876, to anyone who would best solve the problem, by experiment, whether the causes referred to were physical or chemical, or both. Accurate comparative analyses are required, especially of the relative quantities of carbon in the free and combined state, and also observations of the physical qualities of the materials. The memoir may be written in German, French, Latin, or English, and is to be sent to the academy (with sealed note and motto) before the 1st of March, 1876.

The Paraffine Industry.—The lamps for burning hydro-carbons, which were exhibited at the conclusion of Mr. Field's paper in the Chemical Section meeting of Friday last, were made under Mr. M. A. Dietz's patent, and are known by the name of "Paragon." The improvement is stated to consist in a metbod of dividing the currents of air impinging on the flame. Surrounding tbe holder in which the flat wick is supported is an air-chamber, supplied by openings below. The air drawn by the draught of the chimney courses along the sides of this chamber, and is projected in a heated state through a slot at the top of the chamber on to the bottom of the flame, this slot being also tbe opening through which tbe upper edge of the wick projects. Above this air-chamber is a second air space, open at the top, the surrounding wall of which is perforated at its lower edge. Through these perforations a second current of air passes, which is led over tbe dome-shaped roof of the lower chamber, and impinges upon the upper part of the flame, where the carbon present is rapidly consumed with an intense wbite flame. As shown on Friday, the lamps were all burning a pure distilled petroleum and showing a strong white light. It is stated that the same results are attainable with any oil of fair average quality.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

The following arrangements for Wednesday evenings up to Easter have been made:—

March 18.—"On the Channel Tunnel." By William Hawes, Esq., F.G.S.

March 25.—"On the London International Exhibition of 1874." By Henry Hardy Cole, Esq., Lieut. R.E. On this evening the Right Hon. Lyon Playfair, C.B., F.R.S., will preside.

Indian Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

March 13.—Dr. Leitner, Principal of the Government College of Lahore, will give an account of the Races of Dardistan (north-west of Cashmere), discovered by him. Dr. Leitner will introduce to the meeting Jamshed, a Siah Posh Kafir, one of the natives of the district. On this evening General McMurdo, C.B., will preside.

April 17.—"On the Indian Famine, with Especial Reference to the Means which should be Adopted for Preventing or Alleviating Famine." By General Sir Arthur Cotton, K.C.S.I.

African Section.

These meetings are arranged for Tuesday evenings, at 8 o'clock, and the following arrangements have been made:—

March 17.—"Remarks on the Geographical and Physical Character of the Diamond Fields of South Africa." By the Honourable Theophilus Shepston, Secretary for Native Affairs in Natal. Communicated and explained by Dr. Mann.

April 14.—"On Trade in Western Africa with and without British Protection." By Andrew Swanzy, Esq.

Chemical Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

March 20.—"On Anthracene and Alizarine." By Dr. Versmann.

April 10.—"On some Recent Processes for the Manufacture of Soda." By C. W. Vincent, Esq., F.C.S.

April 24.—"On Pyrites, as a source of Sulphur, Copper, and Iron." By Dr. C. R. A. Wright, F.C.S.

May 8.—"On Sugar Refining, with special reference to Finzel's Sugar Crystals." By Dr. Griffin.

May 22.—"On the Manufacture of Chlorine." By W. Weldon, Esq., F.C.S.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Mon. ... Royal United Service Institution, Whitehall-yard, 8½ p.m Mr. E. J. Reed, "Iron-clad Navies."
Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Discussion on the paper by Mr. R. W. Clutton, entitled, "The Self-sown Oak Woods of Sussex", and by Mr. D. Watney, entitled "Timber."
Entomological, 12, Bedford-row, W.C., 7 p.m.
Medical, 11, Chandos-street, W., 8 p.m.
Asiatic, 22, Albemarle-street, W., 3 p.m.
Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m.
London Institution, Finsbury-circus, E.C., 4 p.m.
Social Science Association, 1 Adam-street, Adelphi, W.C., 8 p.m. Mr. John Coryton, "On the Policy of Granting Letters Patent for Inventions, with Observations on the English Law."

Tues. ... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (African Section.) The Honourable Theophilus Shepston, Secretary for Native Affairs in Natal, "Remarks on the Geographical and Physical Character of the Diamond Fields of South Africa." Communicated and explained by Dr. Mann.
Royal Institution, Albemarle-street, W., 3 p.m. Professor Tyndall, "On the Physical Properties of Liquids and Gases."
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion upon Mr. Rendel's paper, "Gun Carriages and Mechanical Appliances for Working Heavy Ordnance."
Statistical, 12, St. James's-square, S.W., 7¾ p.m. Mr. Henry Beverley, "The Census of Bengal."
Pathological, 53, Berners-street, Oxford-street, W., 8 p.m.
Zoological, 11, Hanover-square, W., 8½ p.m.
Anthropological Society, 37, Arundel-street, W.C., 8 p.m.

Wed. ... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. William Hawes, "On the Channel Tunnel."
London Institution, Finsbury-circus, E.C., 7 p.m.
Meteorological, 25, Great George-street, S.W., 7 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.

Thur. ... Royal, Burlington House, W., 8½ p.m.
Antiquaries, Somerset House, W.C., 8½ p.m.
Linnæan, Burlington House, W., 8 p.m. Sir John Lubbock, "Observations on Bees and Wasps."
Chemical, Burlington House, W., 8 p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Professor W. C. Williams, "On Cryptogamic Vegetation—Ferns and Mosses."
Zoological, 11, Hanover-square, W., 4 p.m.
Royal Society Club, Willis's Rooms, St. James's, S.W. 6 p.m.

Fri ...... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Chemical Section), Dr. Versmann, "On Anthracene and Alizarine."
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting; 9 p.m. Dr. W. B. Carpenter, "The Temperature of the Atlantic."
Philological, University College, W.C., 8 p.m.

Sat...... Royal Institution, Albemarle-street, W., 3 p.m. Mr. C. T. Newton, "On Mr. Wood's Discoveries at Ephesus."

[The Editor will be glad to receive notices of papers for insertion in the above list.]

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,113. Vol. XXII.

FRIDAY, MARCH 20, 1874.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1874, early in May next. This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Mons. Michel Eugéne Chevreul, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

The Council invite members of the Society to forward to the Secretary, on or before the 11th of April, the names of such men of high distinction as they may think worthy of this honour.

ECONOMICAL USE OF FUEL.

This Committee has held two meetings since the last issue, viz., on Saturday the 14th, and Wednesday the 18th inst. Present:—Major General F. Eardley-Wilmot, R.A., F.R.S., in the chair; General Elliot, Dr. Mann, Dr. David S. Price, the Rev. A. Rigg, and Major Webber, R.E., attended by Mr. Le Neve Foster, Secretary, Mr. Davies, officer in charge of testing, and Captain Clayton, R.E., on the part of Her Majesty's Commissioners for the International Exhibition. The Committee inspected the testing of the apparatus now going on, gave directions as to the course of proceeding, and, acting as a committee of selection for the International Exhibition, continued their inspection of articles sent in for exhibition, and settled the list of those to be retained for display.

VISIT TO THE BRIGHTON AQUARIUM.

Arrangements are now being made for a visit of the Members of the Society of Arts and their children to the Brighton Aquarium, under the guidance of Mr. Frank Buckland, M.A., Her Majesty's Inspector of Salmon Fisheries, who will then deliver his Fourth Juvenile Lecture. Friday, the 10th of April, during the Easter Holidays, is selected for the visit, and a ticket can be had for 10s. 6d., entitling the bearer to travel first-class by special train to Brighton and back, with admission to the Aquarium and luncheon. A sufficient number of names has now been received to justify the Council in definitely carrying out the proposed arrangements, and the issue of tickets has consequently commenced. Members desirous of securing to themselves and friends the privilege of obtaining these tickets, are requested to send in their names at once to the Secretary of the Society of Arts, with remittance, and stating the number of tickets they will require.

TECHNOLOGICAL EXAMINATIONS.

The following is a complete list of the Prizes offered for the present year in Each of the Nine subjects:—

To the best candidate in Honours, £10.

To the best candidate in the Advanced Grade, £7.

To the best candidate in the Elementary Grade, £5.

The following special additional Prizes are offered :—

By the Worshipful Company of Clothworkers, a Scholarship of one hundred guineas, to be awarded to the best Candidate in Cloth Manufacture, presuming that in the opinion of the Council he reaches a sufficiently high standard. The Candidate who obtains this Scholarship must spend at least one year in some place of scientific instruction, to be approved by the Council of the Society of Arts and by the Court of the Clothworkers Company.

By the Worshipful Company of Spectacle Makers, to the Second Best Candidate in Honours in the Advanced Grade and in the Elementary Grade respectively, in the Manufacture of Glass :—

A Prize of	£5 5
A Prize of	3 3
A Prize of	2 2

By Wyndham S. Portal, Esq., to the Second and Third best Candidates in the Elementary Grade, Paper Manufacture :—

A Prize of	£3
A Prize of	2

By G. N. Hooper, Esq., to the Second and Third best Candidates in the Elementary Grade, Carriage Building :—

A Prize of	£3
A Prize of	2

By J. W. Peters, Esq., to the Second best Candidate in the Advanced Grade, Carriage Building :—

A Prize of.................. £3

By the Bath Gas Light and Coke Company, to the Second best Candidate in the Elementary Grade, Gas Manufacture :—

A Prize of.................. £2 2

Secretaries of Institutions are reminded that intending Candidates for these Examinations must make their returns to the Secretary of the Society of Arts not later than the 31st inst.

INTERNATIONAL EXHIBITION OF 1874.

The following letter has been received by the Secretary :—

Upper Kensington-gore, London, W., February, 1874.

SIR,—I am directed to forward to you, for the information of the Council of the Society of Arts, the accompanying programme relative to the formation of a National Association for the Promotion of Technical Instruction; and I am to ask you to be so good as to move the Council of your Society to have the kindness to assist the Board of Management in furthering the object which they have in view, by the Council's joining this Association.

I am to point out that in order largely to extend the opportunities of gaining technical knowledge, which exhibitions are so well calculated to afford, the Board of Management have resolved to supply admission tickets at half-price to the full amount of the subscription, and they have thought themselves at liberty to present the subscriber with a transferable complimentary season ticket, which, if sold at all to the public, would not be sold at less than £5. It is unnecessary to observe, that under this arrangement, the subscriber will not only obtain his own ticket gratis, but will be free to introduce artisans or schools at half the usual charges, receiving, for the amount of his subscription, tickets of which the money value would be equal to twice that sum.

Independently, however, of these pecuniary advantages, the Board of Management hope that the Council of the Society of Arts, agreeing with them in the educational advantages which are likely to accrue from an easy access to these Annual International Exhibitions, will be willing to co-operate with them in their endeavours to extend them to all those to whom technical education is so great an object.

I have the honour to be, Sir,
Your obedient servant,
T. A. WRIGHT,
Secretary to the Executive.

P. Le Neve Foster, Esq., Secretary Society of Arts,
John-street, Adelphi.

NATIONAL ASSOCIATION FOR THE PROMOTION OF TECHNICAL INSTRUCTION.

1. Her Majesty's Commissioners desire to enlist the active assistance of all industrial corporations, companies, schools, and producers, in a National Association, with the object of promoting technical instruction by systematically inducing artisans and schools to visit the International Exhibitions, where they may study the progress made in the industrial arts and the object lessons in technical instruction afforded by the exhibitions. With this view, Her Majesty's Commissioners have resolved :—

2. To issue packets of 200 artisans' tickets, price 6d. each, or 400 school tickets, price 3d. each, such tickets being for gratuitous distribution, the purchaser of every such packet to receive gratis one annual transferable complimentary season ticket, and to be registered as a member of the Association.

3. To issue packets of 120 artisans' tickets, price 6d. each, or 240 school tickets, price 3d. each, such tickets being for gratuitous distribution, the purchaser of every such ticket to receive gratis a personal season ticket, not transferable, and to be registered as a member of the Association.

4. To issue artisans' or school tickets, for distribution only, in packets of fifty at 6d. and 3d. each respectively.

5. The artisans' and school tickets will be available for use on Saturdays and Mondays in the months of August, September, and October, and arrangements will be made to give object lessons as often as possible. School children must be accompanied by their teachers.

6. Her Majesty's Commissioners will be glad to receive the names of subscribers to the Association for the year 1874 as early as possible.

SILK SUPPLY COMMITTEE.

The following communication has been received from the Secretary of the American Silk Association :—

The Silk Association of America,
Office, No. 93, Duane-street,
New York, February 14, 1874.

MY DEAR SIR,—I beg to own due receipt of your esteemed favour of the 6th ult., with enclosure as referred to, and also the series of "Hints to Colonists" on sericulture, which you correctly surmise will interest us here.

As in England, so in America, there are enthusiastic would-be silk growers, and "hints" dealing with practical difficulties are valuable in making better known the pathway assumed to lead to magical wealth with inconsiderable exertion. The "hints" of Mr. Cobb are well calculated to have the happy effect of aiding the earnest sericulturist, and of dissipating the hallucinations of the speculator.

I am exceedingly obliged for your attention, and possibly a republication here of some portion of Mr. Cobb's paper might prove of value, if you should have no objection to such use of it, due credit being given, of course, to your Society as the source of our knowledge.

I feel grateful for the suggestion in your postscript, and while I am hardly ready for the honour myself, I

take pleasure in giving you a better representative in the person of Mr. F. Oden Hörstmann, of Philadelphia, a director in this Association. Mr. Hörstmann is of the well-known firm of Messrs. Wm. H. Hörstmann and Sons, established by the senior in 1815, and represents one of the oldest silk-manufacturing firms in the United States.

Be good enough to have the *Journal* mailed regularly to him, and presuming it to be unnecessary for any more formal application, I forward herewith bill of exchange, Messrs. Morton, Bliss, and Co., on Messrs. Morton Rose account, London, in your favour for the amount of the annual subscription, £2 2s.

Again thanking you,
I am, dear Sir,
Yours faithfully,
FRANKLIN ALLEN, Sec.

P. Le Neve Foster, Esq., Secretary
The Society of Arts, Manufactures, and Commerce,
John-street, Adelphi, London.

INSTITUTIONS.

The following Institution has been received into Union since the last announcement:—

Potteries Mechanics' Institution, Hanley, Staffordshire.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

A meeting of this Section was held on Friday, March 13th, General McMURDO, C.B., in the chair, when Dr. LEITNER, Principal of the Government College at Lahore, gave an account of the Races of Dardistan (North-west of Cashmere) discovered by him.

Dr. Leitner, in commencing his observations, said he should have to speak about a country which until very recently had scarcely been known even by name; in fact, only a short time ago an Indian paper asked, where is Dardistan? This he considered to be the result of the present system pursued by Government of suppressing the information obtained by its officials. Dardistan was first visited by him in 1866, and his personal adventures on the occasion were rather startling. At that time the frontier or boundary of Kashmir was the river Indus, and that territory belonged to the Maharajah of Kashmir, a feudatory of Great Britain. A war was then being waged against Kashmir, in which all the tribes of Dardistan united against that Government. He was sorry to say that he could not mention the name of that potentate without a feeling of indignation, because of the singularly one-sided policy which had guided us previous to our annexation of the Punjab. It was then decided to give Kashmir to Ghulab Singh, with the idea that he would keep the Sikh power in check. We therefore sold him the country for 85 lacs of rupees, it being a country which brought in an annual revenue of 95 lacs. We also sold it from a rule which the people liked, to a rule which they did not, and we sold them without consulting their wishes. The consequence is that they have been subjected for years to the most abominable oppression, which has only within the last twelve or eighteen months been partially mitigated; and we sold them for a sum of money of which a large portion practically was already our own, because it was due by Ghulab Singh to the Lahore treasury. In limiting the Kashmir boundary to the East of the Indus, we did not include Chilas, as that country, although on the east of the Indus, was not then a dependency of Kashmir, and in the treaty of 1846 only the countries belonging to Kashmir were mentioned as being ceded to Ghulab Singh, whilst nothing on the West of the Indus belonged to that country. He (Dr. Leitner) was deputed by the Punjab Government, at the instance of the Asiatic Society of Bengal, to try and find out something about the language of Chilas and Kashmir, and he was furnished with strong letters of recommendation to the Maharajah. On arriving at Srinagar, the capital of Kashmir, every kind of help was supposed to be afforded to him, and some Chilasi prisoners were brought before him in Durbar, who tried to palm off Persian on him as their own language. Without being a great scholar, he could distinguish Persian from any other language, and knew very well that the Chilasis did not talk Persian. He asked that these men might be sent to his tent; according to the Maharajah's promise they were coming every minute, but they never did come, and he therefore determined to push on. Guides were offered to him, but finding that they were the same guides who, when an officer had previously wanted to visit Ghilghit, had led him a dance over the hills until, in about a month's time, they brought him back to the same place he had started from, he would not have anything to do with them, and selected other men. On a variety of pretexts, however, these were denied him. It was found that one owed money, that another was engaged. and all kinds of excuses were made, so at last finding he could not get the men he wanted, he started in the best way he could. Without wearying the audience with his personal adventures, he might mention that he had the greatest difficulty in proceeding in a country, the ruler of which declared himself, when he saw him, to be his brother! The reason of the Maharajah's secret opposition was that he thought Dr. Leitner would find out, whilst pursuing linguistic researches, that the Maharajah had for some years been fostering intrigues and making annexations without the knowledge of the British Government, and in distinct violation of the treaty which he had made with us. In fact, at Bangala, a conversation between two Sepoys was overheard, referring to an attempt to take Dr. Leitner's life, which he fortunately frustrated. He had got to Gurais, but he found it so difficult to obtain any provisions that he gave out that instead of going to Bunji, on the western frontier, he should go to Iskardo to the east; this with a view, not only to disconcert any possible opposition, but also and mainly to recover the body of Mr. H. Cowie, his companion, the brother of the then Advocate-General of Bengal, who had been drowned on a previous tour, and whose friends were very anxious to recover his body, and give it Christian burial. Therefore, although it did not come within his official instructions, still he thought humanity had an imperative claim, and he would endeavour to obtain some information about it. He came down by night to the Governor of Iskardo, and without wasting much time, told him he was convinced the body had been recovered. The result was that notwithstanding he had been told by the Maharajah that no information had been received, and that the body had not been recovered, he found in the Governor's book an entry showing that the body had been recovered six weeks previously, and that the matter had been duly reported to the Maharajah. He then turned back on his real route to Bunji, having recovered and fully identified the body, and having found out, after minute cross-examination, the whole circumstances connected with its discovery, &c. If he had not gone out of his way in this direction, he should probably not have found out what he did, namely, that the Dards had at one time extended right through Little Thibet; for side by side with some of the tribes of Little Thibetians he found traces of Dardu origin. He then went on to Bunji, having to run the gauntlet of a great deal of intimidation, for wherever he went the Maharajah's

employés used to come and tell him what dreadful sort of people he was going amongst; that one had lost a brother, and another a friend, that the Dards were cannibals, and all sorts of other equally horrible things. He did not pay much attention to these accounts himself, but it so acted upon his followers, that whereas he started with fifty he arrived at Bunji with only two companions. They also began to be very uncomfortable, and came and told him they were very sorry, but they should be obliged to leave him, and strange to say, though they each came separately they had each the same excuse, namely, that they had heard (which it was quite impossible they could have done) that their mother was ill, and they wanted to go home. After reproaching them with their treachery, he turned them out of the place, and went on alone, but had scarcely proceeded a mile when they both turned up again, and implored him to take them back into his service, and they had been faithful servants since. At Bunji his general instructions were not to go beyond the frontier, "as the country beyond, especially Ghilghit, was most unsafe, and did *not* belong to the Marahajah of Kashmir, who therefore could not extend to him any protection, though if he tried to get into Chilas proper he might find friends." At Bunji he wished to make a friend of the Governor, who protested against his living among the people in such a poor way, and wanted to provide him with better accommodation. At the same time, however, he prevented the people from coming to see him; and one morning, getting tired of this, he sent to say that unless men were allowed to come and see him in half-an-hour, so that he might learn the language, he would cross the frontier. An answer was sent back saying that the Governor was very ill, and making other excuses, to which he replied by sending him some medicine, and starting at the expiration of the half-hour. On crossing the river, he was received on the other side—which bore traces of a recent conflict—with very great distinction; they could not understand why it was an European should cross there, but seeing that he did so, fancied he must have some right there. It was very evident that the Kashmir invaders had a very slight hold indeed on the people of this country, which they now claim as their own, and which, was now included within the "red line" on some of the recent maps. He had a set of various maps of different dates, howing how gradually and insidiously the boundary was being extended so as to include a large portion of this country within the territory of the Maharajah. By the side of the road he found several men hanging from the trees, some of whom he knew were not rebels at all, but merely men who belonged to the country, who had been strung up in order that the Maharajah's troops might report a victory to their master, of which there had been latterly rather a dearth. On his way to the Niludar ridge, he met with a Nagyr chieftain, called Sekundur Ali, whose appearance was most striking. He did not look at all like an Asiatic, but had yellow hair, and had the appearance of a Russian. At first he thought he had met with a Russian Cossack, although it was a curious fact that the farther you went in that direction, the less the people seemed to know about the Russians. They interchanged compliments, and were very civil to each other, but it was a very curious circumstance that the following night the camp was attacked by this same gentleman. They crossed the Niludar ridge, a very interesting formation; these mountain ranges throughout the country served very much for purposes of defence, because if you loosened a stone imbedded in the sand at the side of the hill you immediately brought down an avalanche of stones and rocks. It was therefore a very common practice to set traps of stones, which, if disturbed, would bring down the whole mountain side, so that travellers had to be very cautious in proceeding. At the foot of these mountains there were generally very rapid torrents, so that there was danger of being carried away by these avalanches. Having gone to sleep in a kind of cave, he was suddenly awoke by a report of shots, but by the time he came out it was all settled. Their friend, Sekundar, was explaining that he had mistaken the place, &c.; but the fact was, he was astonished to find English revolvers so rapid in firing, and that he was defeated in his attempt to surprise the camp. He was at once desired to cease his explorations, and take himself off as speedily as possible. That man, it subsequently turned out, was in the service of the Maharajah of Kashmir, the supposed protector of the mission. Another incident which occurred was very useful. Having halted at a kind of little mill, which was used as a post-office where letters were deposited for the relay of couriers who ran the siege, he found there a letter written to the Governor of Ghilghit, to the effect that a European had crossed the frontier without being provided with any authorisation, and that he must suffer the consequences. He did not at first know to whom the letter was addressed, and as it was open, he took the liberty of reading it, and, of course, did not forward it to its destination, as doing so would have caused his being killed. On getting to Ghilghit they found two ponies straying about, and he and his moonshee rode on them into the fort. They found it in the most wretched condition, and although the place was being besieged, and it was in the middle of the day, they found the commandant was having a siesta from the effects of opium. After allowing them plenty of time to look about, he came up rubbing his eyes, and asking what they wanted. He (Dr. Leitner) was at the time dressed in the disguise of a Mohammedan priest, but being disgusted with this fellow taking to his opium in the midst of a siege, he threw off his assumed character, acknowledged he was an European, and ordered him to get the fort cleaned out immediately. This was done, though he said it was very extraordinary that an European should be there, and that too without any perwâna (passport), and he had had no communication with regard to his arrival. That Dr. Leitner could very well account for, having taken care of the letter. However, this commandant said he must try and protect him as he was there, and he gave him a place within 100 yards of the fort, though as far as safety was concerned, people were being shot down within 10 and 20 yards. He also provided him with a guard, but the stench from the bodies which were being buried under a thin layer of sand was so disagreeable, that he told him he preferred going a little way into the country, which he did, after giving what medicines he had with him for the Maharajah's soldiers. He was told afterwards that the Commander-in-Chief, Zoraweru, who was then away fighting in Dureyl, had been restored by this means. He did not see any of the natives, although all the various Dardu tribes had united to repel the Kashmir invader, and the Maharajah's sepoys were actually shot within a few yards of the fort by the natives, who were hiding behind stones. On getting into Ghilghit he sent one of his men with a drum to announce generally (although not a soul was to be seen) that there was to be an entertainment to the natives of the country in the evening, and sure enough by this means he collected a good many visitors from a number of widely different races, at that time fighting against Kashmir, and obtained from them various legends and songs, which showed what an interesting people they were. He even got them to dance, as was represented some time ago in the *Illustrated London News;* and after they had been dancing he was busy writing down such words as he could get from them. Having thus obtained what information he could, as there was no necessity for courting danger any longer, he returned, bringing back with him to the Punjab some men of the country. He returned safely, though not without encountering similar attacks on his life to those which he had before met with. The mother of one of the men from Ghilghit would not

let him go without her, and therefore he was compelled to permit her to accompany him. The son, however, was not agreeable, and he actually discovered him in the act of catching hold of her hair preparatory to cutting off her head. He at once put a stop to this mark of filial affection, when the son explained that he feared his mother would not survive his going away, and he thought it would save her a good deal of pain to dispatch her at once. However, he (Dr. Leitner) made provision for her, but she could not stand the journey, and returned to her home. Dardistan, in the widest sense of the word, embraced a large tract of country, which would have to be further investigated by other explorers. In a narrower sense, however, the Dards would only include the people of Chilas, Ghilghit, Dareyl, Tangir, Hodor, and Kandia, a district which he discovered in 1872. They professed the Mohammedan religion. The Chilasis professed the Sunni form, or the same as the Turks professed, but the people of Ghilghit were generally Shiahs, which was the form of Mohammedanism which the Persians professed. At Bunji and Astor they were generally Shiahs, but Sunnism was making progress amongst them, a fact which was to be deplored, because amongst the Shiahs old customs and legends lingered much longer than amongst the Sunnies, who were more orthodox and more austere. They brought everything down to the same level of monotony, and were more particular in the observations of certain provisions of the Koran. The people of Ghilghit at one time cultivated a kind of civilisation which, in some respects, was superior to what was now found in India. They had now been dispersed by the action of the Maharajah of Kashmir, who was annexing these countries, and were being scattered along the course of the Indus; and coming amongst a Sunnie population it was found that many of their ancient traditions were lost almost beyond recovery. In fact, if he had not visited the country in 1866, it would have been almost impossible to preserve a record of that ancient civilisation, particularly with reference to the legends and songs, which he had collected and committed to writing for the first time. These bear testimony, at the same time, to the richness and purity of thought amongst them, and did the greatest credit to the race. They were a marked contrast to many of the legends and songs of the Hindu races now prevalent, though it was well known that there was a time when nothing could be purer and more elevated than Hindu songs and legends. Still, at the present time, there could be no doubt that Indian songs, whether of Hindu or Mohammedan origin, were generally of an erotic description. Again, there was nothing of the exaggeration amongst them, to be found amongst the Dards, such as the making of gods with numerous heads and limbs. The furthest they went in that direction was in the form of a sort of Cyclops, or giant. The Dard race would in a wider sense also embrace Chitral and Yasin, because the languages spoken in those districts were cognate, not derivative of the Sanskrit, for for they had not suffered that phonetic decay which was found with languages derived from the Sanskrit. They are sister languages, if not indeed entitled to an older relationship. In a wider sense, therefore, Dardistan would include Yasin, and it might also be fairly said to include Chitral. It was flanked by the Kunar river on the west, and the Indus on the east. He doubted very much whether even the Kafirs, living west of the Kunar, might not turn out to be of the Dard race. The Kafirs of the Hindukush were almost a mythological race, about which much had been conjectured. Where nobody knew anything, all were at liberty to conjecture, and this liberty had been made ample use of by philologists. In the notice of this meeting, it was stated he would introduce a Siah Posh Kaffir, it being implied that a Kafir was a member of the Dard race, but he would not go so far as to say that it was positively the fact. However, he felt bound to say something about the Kafir. The relationship between the sexes in Dardistan was very much the same as in Europe. There was no degradation of woman, and at Chilas at one time it was said they took part in the administration of the country, and fought against the invading troops of the Maharajah of Kashmir by pouring hot oil over them. Although the people were nominally Mohammedans, they were great wine drinkers, by which he did not mean they got drunk, as some Mohammedans were apt to do, on the sly, but that they used wine in the same way as Europeans. Their marriage was so far similar to our own, that marriages took place by the consent of parties without much interference of the parents. Nothing could be done without festivities, drinking of wine, or eating of grapes, this latter ceremony being used even at funerals. The government was by chiefs. Unfortunately, it was the custom in Chitral to sell human beings into slavery, which ought to be put down by England, because if these countries were to be allowed to be annexed by the Maharajah, our feudatory, England ought to insist that he should conduct himself as befitted the feudatory of a civilised power; and if they were not to be annexed, then they should be allowed to work out their own civilisation in their own way. To a certain extent slavery had been stopped, but still he saw at Astor several prisoners from Yasin were distributed among the Sepoys of Kashmir as slaves; one woman was almost as fair as an European, and Mr. Hayward who went there some years afterwards had made a similar statement. He also stated that he had seen 600 skulls of women and children at Yasin who had been massacred by the troops of the Maharajah. Formerly that was a most delightful place, and was celebrated in their songs, the people having the character of being the most pleasant and easy-going in the region. But these had been singled out for the dreadful massacre in 1863, when it was said that 2,000 women and children were killed. The fact was that every wrong brought its own punishment; it was no use for us to meet Eastern races with diplomacy or cunning, or with a would-be insight into human nature. That might do for our friends the Russians, of whom he wished to speak with the greatest respect. They were very farseeing, had a good knowledge of Eastern nature, and were more familiar in their intercourse with the natives, and, having a certain amount of knowledge, they tried to acquire more, and devoted all their energies to that end. Still their tone was not of the same high character as that of a British officer. The British official might be wanting in many of the qualities of the Russian, but yet the very fact of being the representative of the higher civilisation at once connected him with truth and honesty—the best policy in the long run—so that he was placed at an eventual advantage, and therefore he only required to acquire knowledge and sympathy to hold his own against all comers. Whenever England departed from the straightforward line of policy, as in the case of the Maharajah, any so-called diplomacy only ended in complication and disaster. With regard to the people of the Hunza and Nagyr, it was rather difficult to say whether they could be called Dards. They were generally taller, and spoke a language unlike any other known. Mr. Hyde Clarke had made some investigations with regard to their language, and Count Lianeourt and Mr. Pincott, in their recent book on laws of language, went exhaustively into the subject. It was a very difficult question, and it could not be said what this race was, whether a Dard race, speaking an even more ancient language or what. The people of Nagyr were very clever in musical performances, and were generally supposed to be amiable, whilst those of Hunza were highway robbers, of a most dangerous character. He had lately seen a map in which this country was included in the red line, but if that were so the way in which we got it was no credit to us. This question introduced that of the "neutral zone," as it is genrally called, but it was neutral in a very different sense to that in which Palestine, for instance, might be neutralised

as a protection to Turkish bondholders; or Alsace and Lorraine might be neutralised for the purpose of introducing a neutral ground between France and Germany all the way from Belgium to Switzerland. There were a number of people and countries over which we had no control whatever, and yet at any moment they might commit us to all sorts of difficulties. That was the zone for which we were making ourselves responsible in the event of complications arising between the British and the Russian boundaries in Asia. We had, as it were, guaranteed the safety of Affghanistan to the Ameer of Cabul, but yet he would not allow us to send an European officer to Herat, to facilitate Mr. Forsyth's return. Of course, after he had received a subsidy and 50,000 sniders, there was no reason why he should allow us any influence, even for the temporary purpose in question. Again, he had the greatest respect for Mohammedans or Hindoos, and all other races generally, but when one race wished to exterminate another, and that race was under English influence, we should exert that influence in order to prevent it; and that was especially the case considering the interesting races of this country. Many of the Dard population had an appearance rather European than Asiatic, and some (the Kafirs) were supposed to be the descendants of a colony left there by Alexander the Great when he invaded Northern India. Whether that was the case or not, the Kafirs were a very ancient race. In many ways they were different from Asiatics, sitting on chairs, eating at table, not observing any Mohammedan precept on the one hand, nor burning their dead like Hindoos on the other, but only wanting to be let alone. If we had cultivated a friendly intercourse with them formerly, not only should we have prevented a number of them being carried into slavery, but we should have a good road open into central Asia by the Kunar and Chitral valleys, and need not have required the expensive and roundabout road *viâ* Leh and Yarkand, on which Mr. Forsyth was now despatched for the second time. Instead of making our frontier policy a kind of secret, if everything had been done openly, we might now have had a direct road by Chitral straight up into Central Asia, by which we could have brought down the wealth of those countries, and obtained all the benefits of free intercourse with them. Some of the Kafirs also pretended to be a sort of Christians, but this could scarcely be correct; at the same time they were professedly in want of further instruction, which we could have afforded them, and we could also have solved many philological and anthropological problems, about which many people in this country gave a loose rein to their imagination, without facts upon which to base any conclusions. Government might have allowed all the facts which were known to it to be given to the world of letters, and thus much information would have been diffused. Thus many mistakes would have been avoided, as, for instance, the putting of one place down as two separate places twenty miles apart on a map, because it was spelt in two different ways. All this was due to our system of red-tape, which led to a great portion of the world being shut off from England without reason. It was to the interest of the Society of Arts that the commerce and manufactures of the whole world should be rendered accessible to the British public, and this it was probably which induced the Society in 1869 to memorialise the Secretary of State to allow the Yarkandi, whom he had brought over, to remain here, in order to tell us what manufactures his country produced, and with what articles England might most advantageously supply it. It was not a proper state of things that commerce should only be allowed to filter through by bribing some barbarous chiefs in Affghanistan, when it ought to be thrown open to the whole world. The native states should remain independent, but if they wanted British protection they must deserve it. In 1869, the Philological, Ethnological, and Anthropological Societies asked the Secretary of State for India that he might be allowed to remain in England for a time, in order to elaborate the materials he had collected, and which those societies thought, from what he had already published, would be valuable. It was then thought, perhaps, that his discoveries with regard to the Kashmir frontier would be unpalatable. At any rate he did not get the leave for which the Societies applied, and he had to return to Lahore. He had then information with regard to Hunza, Nagyr, Ghilghit, and Yasin, which if it had then been made public, might have saved those countries, and England would not have committed the weakness of conniving at the breach of a treaty made with her. As a literary man, to whom a great favour had been shown, he felt bound to show himself, if possible, worthy of it, and he had therefore on returning to India continued his labours. He had now collected the vocabularies of eleven dialects, spoken between the Hindukush, Kabul, Badakshan, and Kashmir, had written down many songs, legends, names of chiefs, roads and cross roads, and had brought over one of the natives of the mythical Siah Posh, in order to put an end to conjecture. The way in which he had been able to secure men from these distant tribes was by the exercise of a cheap hospitality. In Indian compounds there was always plenty of room, and he made a rule when anybody crossed the frontier to give them free entertainment and accommodation for as long as they liked to stay. This made friends of the people, and gave the English a good name, which was by no means unnecessary after the massacres which had taken place in Yasin by a feudatory of our own. His belief was that if he had been allowed in 1869 to have his way, Mr. Hayward would not have been murdered, because he would have pointed out the character of the man whom Hayward unfortunately trusted. This showed the result of endeavouring to hush up the truth, which, after all, could not be hushed up, for it was sure to make its way sooner or later. He had brought from these countries about 177 ethnographical articles, and about 197 industrial specimens, a few of which were on the table. These people, and those of Thibet and Central Asia, were open to purchase broad cloths, long cloths, chintzes, knives, scissors, and Birmingham and Manchester goods generally, giving in return wool, silk, tea, stuffs, and skins of all kinds, some belonging to animals of as yet unknown species. There was also immense mineral wealth in these regions—mines of *lapis lazuli*, jade, quartz, turquoise, emeralds; and in all the rivers there was a good deal of gold. Washing for gold was carried on to a considerable extent in Ghilghit, though not systematically, the only system known there being that of rapacity, under which every one tried to rob as much as possible. The real quantity produced, therefore, could not be estimated. Even so far down as Jhelum, in the Punjab, it was the practice of certain families to go up every year, at considerable risk, to the Kuner river, and wash for gold. There were also reports that large deposits of virgin gold existed in some parts of the mountains of Nagyr. Even in ancient times it was said by Arrian that the marmots in these mountains sometimes scratched up gold, which was not impossible. Then, again, there was the *Pashm*, or wool for shawls, one of the most important articles of export. It came from Thibet, being manufactured in Kashmir, where it was virtually a monopoly. With regard to art, there was art, and of a high class, long before the Mohammedan conquest. Some of the sculptures which he dug up, and which would shortly be on view in the Albert Hall, showed conclusively that there was art of a very high character, probably inspired by the Greeks. Even now it was impossible to examine many of the illuminated manuscripts to be found in Central Asia without feeling that they were remnants of an ancient civilisation, showing cultivated taste. There were many things which Europeans might learn with advantage; indeed, it was by going there in a spirit of humility, as students as well as teachers, that we were most likely to benefit

both them and ourselves. Dr. Leitner then drew attention to some of the articles in the collection which he had exhibited, many of which showed both taste in design as well as skill in execution. It occurred to him that pressure ought to be brought to bear by the Society, by commercial men, and by the public, to bring about a complete change in our frontier policy. The cause of civilisation and commerce, arts and manufactures, could not wait until all these races were sold into slavery, or exterminated by a prince acting in our name. If the empire of thought had been given to Germany, and that of style to France, the cause of humanity had always found a response in England. Therefore he believed that, selfish as the present times might appear, and indifferent as people might seem to everything beyond their own immediate range, yet the time was not wasted which was spent in urging on public attention those great questions which had made England famous—which had given her a past, a present, and which he hoped would give her a still greater future—those great questions of the abolition of slavery, of the spread of freedom and enlightenment, and the development of self-government. In these matters we must have a thorough change of system, no longer bottling up the information which was obtained, but circulating it from department to department, and giving it to the whole world. Russia and the Amir of Cabul must be induced to allow free play to commerce, or else his subsidy should be withdrawn. Countries must not be annexed without our knowledge; but men must be sent out who would devote themselves to gaining information, study the language of the people, and learn their wants, and thus strengthen instead of weakening the hands of the Government. Men should not go out there with either Conservative or Liberal notions, and endeavour to make the facts which arose under their eyes fit into their pre-conceived ideas. Happily we had a great many able officers in India, of whom the country might well be proud, but they were placed under a system which, in the very interests of the Government, they were obliged to condemn. The very Government which they had sworn to maintain put so many obstacles in their and its own way, that it was very difficult to continue to serve it when one felt one could serve it so much better in another and more independent way. The policy of concealment should be utterly abandoned; if any of our feudatories took a step, let it be done openly, and then let us bear the responsibility, not go on in the underhand method of allowing them to take possession of neighbouring countries, winking at the process while it was going on, and then incorporating it in the "red line," than which a more unworthy proceeding could hardly be imagined. If we had got Yasin it was by means of a most shameful massacre; if we had Ghilghit, it was by practically conniving or ignoring a breach of treaty, and by exterminating an ancient civilisation; and probably the same means would lead to the annexation of the Siah Posh country by the Amir of Kabul, for though those people had defended themselves successfully against Tamerlane, they could not do so with their bows and arrows against the snider rifles which we had given to the Amir of Cabul. The proper policy for England would be to join hands with Russia across a well-defined boundary, and to have full power up to that line; or, at any rate, let the "neutral zone" be thoroughly under our influence. By all means, allow native governments to work out their own civilisation; but let England insist on its being civilisation. Just the same as we professed to be ready to give up India when it was fit to govern itself, so also let us insist on our civilisation being really represented in these frontier regions. And then let there be friendship and alliance between England and Russia, not resting on treaties which could be torn up at any moment when it suited either party, but a combination which should rest on interest, on power, and on the strength of our respective civilisations. Then, indeed, the alliance would be a prosperous one, and would do both good. England would learn a great many things—a certain insight into human nature, and a certain way of dealing with Asiatics; and the Russians might learn that there were higher things for nations to aim at than to put 40 per cent. duty on the goods of an English ally and try to get their own in at $2\frac{1}{2}$; that the cause of commerce was not benefited in the long run by stringent monopolies; and that education would be their best friend in Turkistan, as it had been ours in India, where every educated native was a source of strength to the Government. At the same time that education required to be broadened and deepened, and to be connected with the indigenous elements of civilisation. We must be students as well as teachers, for by so doing we should be better able to push our civilisation right up to the frontier of Russia in Asia. We should not then have travellers murdered, and a tax levied, as it were, on people's lives. He really thought the time was come when the Society of Arts in the interests of commerce, and other societies in the interest of philology, and ethnology, and geography, and the public in their own interest, and every free-born Englishman and educated man as the representative of a higher civilisation, should put a pressure on the Government to induce them to do their duty, and to insist that men who are sent out there should do theirs, or make way for others more capable. But civilisation and English influence must be made synonymous, which at present was not the case beyond the frontier by any means. The idea of hushing up information and persecuting a man because he expressed an independent opinion must be given up. Independent opinions, however hostile or disagreeable, should always be welcome, for by that means only could we obtain information, and information was the best source of strength. The Government had been afraid of information, instead of receiving it and acting accordingly, which was the only true policy for British interests and for advancing freedom and civilisation throughout the world.

The following articles of commerce from Dardistan and Central Asia were exhibited, and remarks made, as follows:—

1. Silk fabrics, handkerchiefs, and scarfs from Bokhara, Khotan, and Yarkand.

The manufacture of silk is the occupation of every Turki household from China to the sea of Marmora, near where (at Brussa) the best silk is still produced. Bokhara silkworms are much prized, but have not yet succeeded in the Punjab or Asia Minor. (Attempts are now made in Kashmir to domiciliate the silkworm.) The Japanese worm, which is of an inferior kind, seems to get acclimatised in Asia Minor, and should be tried in the Punjab and Kashmir.

These fabrics are interesting as indicating the taste of the Central Asiatics as regards the price they are willing to pay, and the patterns which they affect.

2. Blanket from camel hair (Kabul).

3. Pattu (rough woollen stuff) from Ladak.

4. Specimen of Lhassa brick tea.

This tea is pressed in the form of a brick, and is prepared, when used, with butter and salt. It is preferred to all other teas by the natives of Central Asia and Thibet, but the supply has lately ceased from China on account of the recent wars with the Mohammedans of Yarkand. There is now a very great opening for Indian teas, which are much appreciated.

5. Yarkandi jade pipe stem, waist-clasps, wristlets, and armlet.

Jade, it is said, can only be got from one quarry in Khotan, and is highly prized in China. It is used to make the button and bars which constitute the distinctions of mandarins. Jade is also made into cups, bowls, pipes, &c. The pipe stem has also been sent, with various other articles, by Niaz Mohammad Akhun, the first Yarkandi who visited Europe (in 1869, when he was brought over by Dr. Leitner).

6. Specimens of shawl wool from the Thibetan goat.

7. Charas from Yarkand. (Charas is a gummy exudation from the flower heads of the hemp, a favourite narcotic largely smoked in water pipes with tobacco, in India and Central Asia.)

8. Wheat from Ladak.

9. A Huka top, in silver, made in imitation of a Lotus (like which it opens and shuts), with enamel and little figures of birds on silver chains attached to it. Ludiana workmanship. (Imitation Kashmiri.)

10. The rolls of paper from Thibet are made from some durable material, and have lasted for many centuries. The Thibetans print on leather, linen, bark, &c., from wooden blocks. It is well known that they possessed the art of printing before we did.

11. Attention is drawn to the numerous flutes and pipes of Zanskar (Thibet), Ladak, and Dardistan.

12. Dresses, caps, girdles, boots, stockings, &c., from Dardistan, Thibet, Central Asia, and Northern India.

The following ethnological articles were also exhibited:—

1. Picture, in distemper, on canvas, found in a temple near Gya, Ladak, representing three Chortens (offering and relic repositories in Thibet) and flowers.—*Ladak, Middle Thibet.*

2. An Astori woman's bonnet with strings and *Dardu* frontlet.

3. A pair of stockings, knitted, obtained at Bonji, on the Chilas and Ghilghit frontier, a yard long, exquisitely done.—*Dardu.*

4. A Red Lama's (Thibetan priest) ordinary cap.—*Zanskar.*

5. A picture, in distemper, on canvas, representing a goddess sitting on a throne, composed of an open flower, holding the red lotus, and surrounded by figures in the margin.—*Lhassa.*

6. A woman's bonnet, obtained at a village at the foot of the Nangaparbat.—*Dardu.*

7. A woman's girdle, checkered pattern of black, white, red, and yellow wool.—*Ghilghit, Dardu.*

8. A pair of stockings, thick woollen, obtained on the Ghilghit frontier, one yard and a-half long.

9 and 10. Jade waist-clasps, white.

11 and 12. One large and one small cup of serpentine, obtained at Skardo.—*Little Thibet.*

13. Ghilghit stockings, usual Dardu pattern, with heels.

14. A pair of jade wristlets.

15. A Shia (Dardu) woman's toilette apparatus, consisting of a semi-circular box-wood (imported) comb, with a covering in cloth rudely embroidered with silk; two small bags embroidered also, to contain trinkets, and a brass brooch. —*Dardu.*

16. A Zanskar shepherd's cap, black, thick, wool, long nap.

17. A Nagyr (Dardu) chieftain's cap of black cloth, studded with little coils of straw to give the appearance of gold studs, with a plume of short white feathers and a crimson silk border.

18. A girdle, worsted work on coarse grey cloth, worked with blue, dull red, yellow, and green; very strong.—*Dardu.*

19. A red Lama's holiday cap; border, crimson cloth, and upper part embroidered in flower pattern, with crimson, blue, and green silk.

20. A *Balti* (Little Thibet) woman's cap, edged with pink silk, and two small peaks also edged with silk behind.

21. Kafir oil lamp from some metal; a Kafir arrow, quiver and boot.

The Kafir oil lamp is marvellously well done for so savage a race, which still so much uses arrows tipped with iron (as in this callection) against its Affghan enemies, who are armed with matchlocks, and often with English rifles.

22. A Grand Lama's festival dress, of blue Chinese satin, elaborately embroidered with silk and gold in form of dragons, &c., and a woven silk border representing waves and curved bands of colour.—*Lhassa.*

23. Specimen of a few yards of *Kargyil Pattu*, thick woollen cloth, undyed, of narrow width.—*Ladak.*

24. A *Shina* flageolet, made of two halves, placed together, and joined by metal and bamboo rings.

25. Two Ladaki pipes; one of iron, the other of black wood and brass.

26. A Chinese opium pipe used on the Tatary frontier.

27. A prayer bell, Drilbu, with a winged figure at the top. —*Ladak.*

28. A well-executed prayer bell, got at Lama Yuru, Thibetan Rosicrucians.

DISCUSSION.

Mr. Drew said he did not like to remain silent, as he might perhaps bo the only one present beside Dr. Leitner who had visited Dardistan; but time would not allow of saying much, and therefore between the two lines of thought—one criticising to some extent some of the political conclusions arrived at, and the other rather rending to supplement his description of the people of Dardistan—he would choose the latter. It was very difficult to give in words any complete idea of this people, and even the photographs which had been handed round did not do them justice. They were a race, certainly fair, but at the same time with a touch of brown greater than was to be found probably in any European race; they had good features—a well-formed brow and nose, bright eyes, not blue, but hazel or light brown. In figure they were strong, not very stout-built, but active, real mountaineers, and well able to get over difficult ground. As to their character, Dr. Leitner had not done them more than justice. Probably the words—

> "By forms unfashioned, fresh from Nature's hand,
> Fierce in their native hardiness of soul,
> True to imagined right beyond control,"

were as applicable to them as to the people for whom they were first written; and they were a race who would naturally excite interest in any one who became familiar with them. They were divided into castes. One curious custom amongst the higher caste might be mentioned as peculiar, as far as we know, to this race. Unlike the Hindus, who revered the cow, they held this animal in the same sort of disgust as the Mohammedans the pig; they would never touch one if they could help it, and though they were obliged to handle them, as they were used for ploughing, they did not do so more than they could possibly help; nor would they drink cows' milk or eat butter made from it. As to their religion, besides the two sects mentioned by Dr. Leitner, the Sunnis and Shiahs, there was a third, which he had not met with elsewhere, called Motai or Mautai, the derivation of which word he was not sure of, but thought it to be derived from the Arabic *Mauta* (God), the sect thus calling themselves "The Godly." They were very near the Shiahs in their belief, but there were some difference in their customs as to prayer and the drinking of wine. Again, there was in another part of Dardistan, in the valley of the Indus, between Leh and Iskardo, a few villages, the inhabitants of which, though Dards, professed Buddhism; they were probably the remains of an earlier wave of migration of Dards from the west, who by contact with the Thibetan Buddhists had been led to acquire their faith. With regard to the historical side of the question, he was much surprised at the statement that England had handed over the country of Kashmir to the Maharajah, taking it from the Mohammedan dynasty, which then ruled it. The fact was, Imam-ud-Din, who then ruled it, though a Mohammedan, was the Sikh Viceroy; and it was no more a Mohammedan dynasty than if by chance a Roman Catholic Viceroy of Ireland were appointed, Ireland could be said to be under a Roman Catholic dynasty. The ruling dynasty of Kashmir at that time was that of the Sikhs, so that it was really taken from one Hindu dynasty, the Sikhs, and banded over to another, the Maharajah Gholab Singh. With regard to the boundary at the time of the treaty by which Kashmir was taken over from the Sikhs, as he had mentioned, they occupied the country on the right bank of the Indus, a little further than Ghilghit, so that the north-west boundary was very near to the red line shown on the present map. It was quite true that in the year 1858 or 1860 the boundary had got shifted to the Indus, the reason being that some five years after the country was handed over to the Maharajah by treaty, he had be expelled from Ghilghit by the forces of Gaur Rahman of Yasin, and for sevoral years was confined to the Indus as his boundary. Then in 1859 or 1860 the present Maharajah again advanced, and restored the boundary to where it was now marked. He thought it only right to mention that point, and his silence on other political points must not be taken to indicate acquiescence in what had been said.

If time had permitted, he should have liked to referred to the strictures passed on the Maharajah of Kashmir and his durbar, to which he himself had belonged. But passing by that, there was one topic which seemed directly to meet the objects of the Society, viz., the opening of the road by the valley of the Kunar to Central Asia. The physical characters of the route rendered it very eligible because it was readily passable by camels, and if it were opened up would lead vastly to develop commerce with India, especially as the railway approached Peshawar. But in order to do this, he did not think it would be a wise policy to bring the "red line" farther south, but rather to extend it to the north-west. The actual boundary at present was, he believed, much as was represented on the map. The only way to extend British influence would be by extending the boundary farther to the north-west, by inducing the Maharajah, if he would, to occupy part of the country of Yasin; and if this were desired, there were very good reasons for quarrelling with the ruler of that place, against whom there was many a black mark scored. This seemed the only course to pursue if this route were really to be opened up, the doing of which would doubtless lead to both commercial and political advantages.

Mr. Sankey said he had been delighted with the instructive and interesting lecture of Dr. Leitner. The case of these people, who were supposed to be descendants of Greeks who accompanied Alexander the Great, reminded one of the Florentines in Italy, who had retained for centuries, in the midst of a dark, swarthy complexioned people, the same characteristics they brought with them from the far north. It was very likely then that these people were descended from European ancestors. It seemed to him of the greatest importance, in the interest of civilisation and commerce, that these countries should be opened up, and he believed if a little pressure were put upon the Government something might be done.

The Chairman said the aggregation of races of which Dr. Leitner had spoken lay in a small compass as compared with the rest of the frontier, but they occupied the most important point at the present moment of the frontier, which was a very weak one, especially towards the north-west. It comprised the aggregation of races between Kashmir and Affghanistan; that district had its past history, and probably the Siah Posh Kafirs were the living remnants of the ancient inhabitants. The works of art which were dug up from time to time, some of which were going to be exhibited at the Albert-hall, appeared to show traces of Greek origin. But there was a future history as well as a past, and as Alexander passed Cabul and entered into this district before he crossed the Indus, so now there was another great power advancing from the north by the Oxus towards Kashgar and Yarkund. There was no doubt the advances of Russia in that direction were giving the British Government in India grave cause for anxiety, not altogether in connection with commerce, though he hoped that would form a great part of the object of Mr. Forsyth's mission to Kashgar. He believed the main object, however, was to provide for the protection of India along the frontier, seeing the road mentioned by Dr. Leitner up the Kunar valley would afford opportunity for advances towards India. Not that he expected for a moment that the Russians were contemplating such proceedings, but if we should quarrel in Europe, no doubt the assemblage of a Russian army upon a weak frontier would necessitate the detention of a large British army in India, which would thus be taken away from other fields of operation. This was the great object of the mission to Kashgar, and it appeared from a recent telegram that a road had been opened up, and actual communication made to Cabul. This was the beginning of what he hoped would take place to a much greater extent, in the interests both of war and commerce. He concluded by moving a cordial vote of thanks to Dr. Leitner for his valuable lecture.

The motion having been passed unanimously,

Dr. Leitner, in responding, said he was very glad to see Mr. Drew present, though he represented to some extent an antagonistic policy. He was glad to be corrected if he had made a mistake, but his impression was that he had spoken of the people of Kashmir being sold for a rule they liked to one they disliked, not a dynasty. He could not agree with Mr. Drew as to the treaty of 1846. It was quite true that in 1846, the ruler of Ghilghit wanted the Maharajah of Kashmir's assistance, the details of which were given in his (Dr. Leitner's) book on Dardistan, which for want of a better was at present an authority. Ghilghit was not a dependency of Kashmir. The fact was, the Sikhs sent men to instigate an attack on the Kashmir territory, then in repelling that attack, they endeavoured to obtain a territorial advantage, asserting that they only acted in self defence. This had been their policy all along, and the whole details were recounted with names and dates in his book on Dardistan. It was simply a masterly system of intrigue. The Maharajah had availed himself of Sir Henry Lawrence being rudely treated to vindicate our outraged honour, as he called it, but of course to his own advantage. Though called in to assist the ruler of Ghilghit, he had intrigued for the purpose, and then made an arrangement to administer the country jointly. With regard to Yasin, Mir Wullee was the man who was supposed to have murdered Hayward. A seal had been put forward by the Maharajah, as showing that another person was the murderer, but he had a photograph of it there, an examination of which raised doubts of its authenticity, since it was written in the mongrel Persian, common in Kashmir, and did not bear those peculiar titles which had been in use since the time of the grandfather of the present ruler of Chitral. By diligent inquiries he had obtained full particulars of of this crime, which it was not necessary to refer to more at length. He occupied an entirely different standpoint from Mr. Drew, having refused very liberal offers not to say what he had now made public, while Mr. Drew occupied the position of a man who had been for many years in the service of the Maharajah, and could not therefore view things independently. As Hayward had been murdered in order to bring about complications in Yasin, so it was now suggested that they should make that road up the Kunar valley for their own purposes. If the road were required, England could make it with- the assistance of the Maharajah, and without outraging civilisation. If annexation were determined on, let it be done openly. It was an unfortunate fact that the "red line" was now, as shown on the map, including Ghilghit, though by the treaty of 1846 it was expressly excluded, and when he crossed the frontier in 1866, Sir Donald MacLeod wrote to him expressly to say that the Maharajah had no possible influence there. Two things were plainly evident from the correspondence—first, that the Government did not know what was going on, and secondly, that they knew nothing of the people across the frontier, or the language they spoke. They were even supposed to be cannibals, whereas he found them some of the nicest people he ever came across.

General Abbott said he was sure the Chairman had the full feeling of the meeting with him in the cordial expression of thanks to Dr. Leitner for his paper. He must, however, as one who had served in the Punjab war and knew what difficulties the Government was surrounded with at that time, dissent from the view Dr. Leitner took of the treaty by which Kashmir was then handed over to the Maharajah Gholab Singh. He considered that, on the whole, it was the best policy that could have been adopted under the existing circumstances; and he considered, too, on the whole, that circumstances since had rather confirmed the wisdom of that policy; and that on the whole, too, we had no great grounds for complaining of Maharajah Gholab Singh or his rule. He would conclude by asking for a vote of

thanks to the Chairman, whose personal knowledge and experience added so much to the value of his presidency on this occasion.

AFRICAN SECTION.

A meeting of this Section was held on March 17th, Vice-Admiral Erasmus Ommanney, C.B., F.R.S., in the chair. The paper read was—

REMARKS ON THE GEOGRAPHICAL AND PHYSICAL CHARACTER OF THE DIAMOND FIELDS OF SOUTH AFRICA.

By the Hon. Theophilus Shepstone,
Secretary for Native Affairs in Natal.

The discovery of a diamond-producing region in the centre of the southern portion of the African Continent has added fresh interest to the question, as to how diamonds are formed, and has furnished some additional light that may be thrown upon the investigation. Nor would the advantage of successful inquiry in this particular be confined to the mere gratification of curiosity, because the information gained would, in all probability, not only direct search where it might be successfully made, but prevent the expenditure of money and labour where it would be fruitless.

The conditions under which the diamond is found on the Vaal River are, as a rule, identical with those accompanying its presence in all other diamond-producing countries. And, although there are variations of accompanying circumstances, even these all fall within the limits of one general condition, namely, the presence of water of considerable depth during the formation of the gems, which, although it lay in repose for long periods, also had epochs of violent disturbance.

If we consider this general coincidence and the minor variations included in it, together with the known peculiarities of the diamond itself, we may possibly find an answer to the question which has been alluded to. But it will be necessary first to glance at the surface conformation and appearances of the African Continent south of the Equator; secondly to notice the circumstances under which diamonds are found in Africa and other countries; thirdly, to consider the peculiarities of the diamond itself, as far as they are known, and then to draw the inference which should, if the facts and the deductions from them be correct, supply the required answer.

I. We notice at once that Africa south of the Equator consists of a great central irregularly-shaped basin, whose rim conforms more or less to the line of coast, at a distance from it varying perhaps from 100 to 300 miles, but, towards the Equator, crossing the Continent, being there formed by the southern watershed of the Zambezi. The present height of this elevated margin varies from 4,000 to 10,000 feet above the level of the sea, and it forms the great watershed of Southern Africa, separating everywhere, except where it crosses the Continent, the long from the short river systems. The Orange and Limpopo rivers constitute the former of these systems; they rise inside the basin, cut through its rim in their way to the sea, and their waters are the aggregate drainage of this huge saucer-like cavity. The numerous streams of the short-river system take their rise on the sea-face of the watershed, and run a short and mostly straight course to the ocean.

In some places the watershed margin above described presents an unbroken mountain chain, as where it is formed by the Draakenberg or Kahlamba range; in others it is reduced merely to a high ridge with isolated peaks standing upon it, corresponding in height and formation to each other, and to the mountain range of which it is a prolongation.

The surface inclination towards the centre of the continent is gradual, and in some places almost imperceptible; while towards the sea-coast it is abrupt, and frequently so precipituous that the level of the country drops many thousand feet in a very few miles.

All the country between this rim or ridge of high land and sea suggests to the mind the idea of vast and violent water-action in the past.

Let us now glance at the present surface condition of this great basin.

The deepest or lowest part of it is several thousand feet below the average height of the rim or watershed which surrounds it. Fossilised remains of animals and plants, extensive plains, sandy deserts, and the presence almost everywhere of water-worn pebbles, all point to the probability that it was once the bed of an inland sea; while, on the other hand, dried-up channels of ancient rivers, waterless beds of lakes, the evidently rapid decrease of lakes still existing, and the failing, within the memory of man, of large fountains and strong springs of water, proclaim that desiccation is still going on, in proportion probably to the rate of annual deepening, by erosion, of the channels of the two rivers whose function it is to drain this basin; and it seems probable that man is now witnessing the last stage of a process which once presented water-action on its grandest and most gigantic scale, namely, that of a large inland sea, filled to its brim, and then emptying itself by upheaval of portions of its bed from time to time, its waters rushing in all directions over its rim to the surrounding oceans.

If in addition to this we take into account the presence almost everywhere, in this now empty sea-bed, of signs of extensive igneous action, by which displacements and great disturbance of the earth's crust have been caused, we shall have included as many of the leading features, which distinguish the surface of this sea-bed, as are necessary to enable us hereafter to notice the effect of the action they represent more in detail.

II. It is in this strange basin that diamonds of extraordinary size and unsurpassed beauty are now found. They are associated in many places with the same silicious pebbles, zeolites, water-worn agates, and ferruginous matter as in other countries, and these minerals were at first thought to be necessary accompaniments of the gem. But diamonds soon began to be found in clay and lime silt, where no such pebbles exist, except perhaps on the surface; so that the criterion agate or zeolite, upon which the digger had begun to build his faith as the sure sign of a rich claim, was suddenly and for ever deprived of its value as an indication, and he was thrown back into his original bewilderment, without any appearance to

guide or encourage his efforts, except the actual discovery of the gem.

It seems to be beyond doubt that, wherever in any part of the world diamonds are found, the circumstances which accompany their presence have invariably been caused by water-action. The conglomerate made up of rolled silicious pebbles, the gravel, the water-worn agates, zeolites, and other fragments of kindred substances with which they are associated, the Itacolumite rock out of which they are said to be quarried, and the peculiar silty lime or chalk and clay in which they are now being found in the neighbourhood of the Vaal River, are all alike, as regards their arrangement and present condition, the results of aqueous action.

Why diamonds are so usually found among silicious pebbles, as to have caused the belief that they are necessary accompaniments of each other, although there is no affinity between carbon and silica, and how these gems came to be deposited in the situation and matrix in which they are found at Du Toit's pan, the famous Colesberg Kopje and other places in the Vaal River country, unaccompanied by such pebbles, are questions which an attempt will here be made to answer. But first it will be necessary to consider some of the peculiarities of the gem itself which have been ascertained by scientific investigation.

III. The diamond, we are told, is resolvable by heat, in an atmosphere of oxygen, into pure carbonic acid gas. This gas, chemists say, is capable of being converted into a liquid state by a compression equal to the weight of between 1,300 or 1,400 feet of water or about 40 atmospheres, and scientific observers are said to have recognised microscopic water plants (Algæ) and splinters of ferruginous quartz enclosed in the diamond. Such facts seem capable of throwing much light on the question we are now investigating.

We know that all lime, chalk, or clay deposits contain a large proportion of carbonic acid in a solid state, this acid becomes set free by heat in the form of gas, and that then it contains the sole material of which the diamond is found to consist, in the proportion of about six parts to sixteen.

We know also that carbonic acid gas occurs in enormous quantities in nature, that it is evolved in abundance in all volcanic neighbourhoods, and by all subterranean igneous action, that there are spots where it is produced in such quantities as to be dangerous to life, and that in some industrial processes it is necessary to take precautions against its effects. But, although we see produced such immense stores of the material of which the gem consists, the observed fact that it is produced, in any quantity, and in any part of the world, affords no well-founded hope of finding the diamond, and is no sign of its presence.

That such is the case seems, at first sight, to forbid the idea that the evolution of carbonic acid gas can be any part of the process by which diamonds are formed; or why should they not be found in localities where it is so abundantly poured forth? But, if we add the condition of its being sent up under water of a certain depth, we shall see that the results become so altered as to favour rather than forbid this idea; and a further consideration of these altered results will probably incline us to adopt the theory, that diamonds are formed only where carbonic acid gas has been ejected by the action of subterranean heat through fissures, into the bed of some body of water, sufficiently deep to imprison and liquefy the gas after evolution.

The emptied sea-bed which we have described exhibits abundant signs of the previous existence of the conditions which this theory requires, namely, water of sufficient depth and frequent violent igneous action under the water.

If we consider for a moment what the process set up by this combination must be, we shall see that, wherever subterranean heat has acted upon carbonaceous rock, large quantities of carbonic acid gas must have been liberated, provided the pressure of water above was not great enough to produce fusion of the rock. The accumulated expansive force of this elastic vapour would ultimately burst up the confining crust and discharge itself into the bed of the overlying sea; the chasms or fissures opened up by these eruptions would become filled up by the rushing into them of the water, which would carry with it the soft silty material of which its bed is composed; the bursting process would probably force upwards, more or less, the edges of the sedimentary rock, and thus form the knoll or kopje, surrounded by what diggers call "the reef," dipping in all directions from the centre, but soon assuming its natural horizontal position. Obviously such chasms formed shafts or passages of communication with the igneous rock below on the line of least resistance; and, according to our theory, these chasms now became the factories, so to speak, in which the diamonds were formed. Filled as they were by the silt of the sea, and the first burst of expansive force being expended, the gas, as it became liberated below, would continue to discharge itself, but with less violence, through these channels. There is at present no necessity to discuss what proportion of it would, when it reached the water, be taken up by it. But the less energetic detachments or bubbles of carbonic acid gas would be from time to time caught and become imprisoned in the silt, just as we know from daily observation that this gas does lie in the soft beds of stagnant pools, until liberated by being disturbed.

Here then we have the raw material of the diamond conveniently placed, in detached quantities, under a weight capable of changing it from a gaseous to a liquid state. It does not seem rash to suppose that such a change would take place; but, before the diamond could be formed as we find it, the oxygen must be separated from the carbon and the latter must be crystallised.

What processes there may be in nature capable of affecting these changes are as yet unknown to us; whether they are produced by electric or magnetic currents, or the potent influence of iron in some of its numerous forms, or all these combined, is a question which it is to be hoped will soon be solved by scientific investigation.

But, supposing the process above described to be so far true, then also we have the incipient diamond situated exactly as we find it when fully crystallised, and in a condition capable of receiving into its substance either a water-plant or a splinter of quartz. Where, but under water, could it meet with a water-plant? And in what condition, except gelatinous or liquid, could it

receive and enclose either a minute vegetable organism or a fragment of quartz?

We must now return to the question why diamonds are found so usually associated with silicious pebbles as to deceive people into the belief that they are necessary accompaniments of each other. There is no affinity between silica and carbon, no relationship of kind between a diamond and an agate or zeolite; but diamonds have hitherto been most commonly found among these minerals.

The process suggested by the circumstances already described seems to furnish an explanation of this apparent discrepancy.

These silicious attendants of the diamond are but recent associates, produced by circumstances which date immeasurably later than the birth of their valued companions. The process of forming the diamond commenced as soon as the abatement of the first ebullition of heat-action under water took place. This heat continued, but less vigorously, to expel the gas, whose destiny it was to be imprisoned in the silt of the superincumbent sea, and then to be reduced by the slow and secret processes of nature, its carbon becoming crystallised in the shapes in which we find diamonds. The molten matter whence this heat proceeded struggled towards the surface; it succeeded in some places in protruding itself into the water; in others its energies became expended before actual contact with the water was effected. At this epoch the pebbles we are considering were not yet formed; the silica of which they are composed had still to be deposited by infiltration into the vesicular cavities of this erupted rock, now cooled and hardened; crystallisation had yet to take place, and then had to be followed by the slow erosive action of water, which released the newly formed pebbles from their rocky mould, and distributed them to become associated for the first time with the brilliant gem.

When we take into account that the rock, in which these pebbles were formed, must have been forced into water and remained under and in contact with it for ages before they could be formed, and for many additional ages before they could have been released and smoothed, we shall see that, wherever the diamond is associated with them, this as a rule is accidental; the water-action, which in wearing away the rock released the pebbles it contained and afterwards rolled and smoothed them, was capable of transporting, and probably did in many instances transport, diamonds and pebbles together to long distances from the spots on which they were formed,

But such places as the Colesburg Kopje seem to have escaped this or any erosion, from their present surface downwards. We find their cavities filled with the ancient silt and clay which formed the sea-bed when these fissures were made, and which began to be washed into them as soon as the first eruption, which caused the opening, was overcome by the gravitation of the water; they are the shafts in which the diamonds were made, and their depth may perhaps never be ascertained. If even the mouths of these funnels were higher than they now are, they have been lowered by water, and the diamonds they contained at that level have been washed away.

If these shafted erupted kopjes, or mounds, are the birth-place of the diamond, the fact seems to explain why gems unearthed at Colesburg Kopje and under similar conditions elsewhere are liable to fracture or flaw on exposure, while those found among pebbles are not. As regards the former, it is their first contact with light and air, and the sudden exposure to these produces the catastrophe; while in the case of the latter, ages have passed away since they were first disturbed, so that all the effects of the first exposure on their more sensitive companions are represented by the fragments into which they fell when they gave way under it.

The value of a true answer to the question "How are diamonds formed?" consists chiefly in its being able to suggest, with more or less accuracy, where search may be successfully made and where it most probably would be labour thrown away. But this must be left to observers on the spot. Examination of the country will determine whether, as a rule, the visible main trap-dykes do or do not coincide, in their general direction, with each other. If they do, it is probable that those which do not crop out on the surface run in corresponding lines; and it seems not impossible that on the line of one or other of these, varied by such minor deviation as the eccentricity of a crack in the earth's crust would lead us to expect, other Colesburg Kopjes may be found.

Perhaps also, if the experiments, on which the theory of the formation of metamorphic rock is founded, were carefully considered with reference to observed conditions in diamond-producing spots, some useful information might be gained.

SUPPLEMENTARY REMARKS ON THE COMMERCIAL ASPECTS AND INFLUENCES OF THE SOUTH AFRICAN DIAMOND AND GOLD FIELDS.

By Robert James Mann, M.D.

(Late Superintendent of Education in the Colony of Natal.)

The paper of Mr. Shepstone has been brought under the notice of the African Section of the Society of Arts on account of its being an original communication on the subject of which it treats from a gentleman long associated with public work in South Africa, and well-known in the region as a person of philosophic mind and exact information. But it has also been used upon this occasion because it may answer the purpose of a peg upon which may be hung some other remarks and suggestions that extend more thoroughly into the considerations that are touched by the South African Section.

The large Orange River, the leading stream of South Africa, runs in one bold course for an extent of nearly 900 miles across the broad stretch of this part of the continent, at a distance of something more than 400 miles from the southern extremity of the land, and forming for the greater portion of its course the frontier of the English territory. Towards the east, or upper part, however, the stream really consists of two large branches, which are topographically recognised as separate rivers, although they are geographically and substantially but tributaries of one and the same stream. The northern branch is distinguished as the Vaal, or Yellow River, and the southern branch as the Orange River above the junction with the Vaal. The tract of territory which is included within this upper fork of the Orange River system is the Orange River Free State, a Republic formed by the Africander descendants of the old Dutch settlers of the Cape. The extremities of the fork strike, in the eastern direction, upon the ledge of the Drakenberg Mountains, here within 200 miles of

the Indian Ocean, and forming the real water-shed crest of the Continent, for from this ledge short rivers run eastward into the ocean, and the large Orange River system runs westward into the Atlantic. The steep sea-board slope of this water-shed crest looks down over the green valleys and hills of the colony of Natal and of the neighbouring Kaffir land. To the north of the Vaal River the hills and plains of the vast upland territory of the Transvaal Republic, also an Africander Dutch Settlement, extend quite to the banks of the Limpopo River, the second river system alluded to by Mr. Shepstone as draining the great elevated basin on the side of the Indian Ocean. The sea-board slope of the Transvaal territory is the land of the Zulu and Amaswasi Kaffir tribes. The lofty highlands beyond the Limpopo, the northern rim of Mr. Shepstone's upraised sea, are only bounded in that direction by the ravines of the Zambesi River, and extend to the north–west well across the Continent until they are grooved and furrowed there by the parent waters of the Congo. It is a curious and notable fact of African geography that the water-shed crest which contain the parent sources of the eastward-flowing Zambesi is almost as near to the Atlantic as the crest which contains the parent sources of the westward-flowing Orange River is near to the Indian Ocean. The raised rim of the Transvaal and Free State basin, that is gapped by the channels of the Orange and Limpopo Rivers, is in reality an offset from the great central highland that culminates between the Limpopo and the Zambesi.

About sixty miles above the confluence of the Vaal and Orange Rivers, in the heart of the region that has thus been geographically described, upon the banks of the Vaal River, looking towards the Bloemfontein district of the free state, and about a full day's drive from the township of the same name, lies the remarkable spot that has now become notorious as the great diamond field of South Africa. The first serious working of this field commenced as recently as the year 1868 or 1869. In the month of December in the year 1871 there were 7,000 diggers in the field, and several thousand diamonds of various sizes had been found. In the following year it was estimated that there was a population of 20,000 miners at the fields. The three nearly-connected mines known as Dutoitspan, Bultfontein, and Colesburg Kopje have since been very assiduously worked —so assiduously, in fact, that the land has been so extensively honeycombed that it is now crumbling and slipping away from the grasp of the searchers, notwithstanding the elaborate devices for propping and shoring that have been adopted. The amount of diamonds that have been found within that period is unquestionably very large; how large in all probability will never be actually known, as the machinery of the Income-tax Commissioners has not yet secured returns in this particular schedule. But it is, at any rate, so vast that a very material diminution has been brought about in the value of the larger gems in the home markets. A certain amount of chill has been temporarily thrown upon the diamond enterprise by the natural oporation of this influence, connected with the increased difficulty and cost of working in deep and exhaustively excavated mines. There are instances on record of men excavating recently ninety feet down, and still realising a find. The report from the Colesburg Kopje division by the recent mails was to the effect that "the repeated land-slips were a source of great anxiety, and that there was scarcely a hundred yards of the Kopje free from cracks and fissures." The aspect, indeed, was considered so serious as to threaten the discontinuation of the working of this particular branch of the field. This state of affairs is quite foreshadowed in a photograph of the working submitted to the meeting, which was, nevertheless, taken some months ago. At the conclusion of the report of this state of affairs there occurs, however, a remark that is not without some measure of consolation as well as of suggestion. It is to this effect:—"The movement from the diamond fields to the gold fields still continues, and the seats in the passenger waggon are secured for three weeks."

It is matter of familiar knowledge that in the year 1868 the German explorer, Karl Mauch, in one of his adventurous journeys in this region of South Africa, came upon traces of old Mashuna workings for gold, and reefs of gold-bearing quartz. His account of what he he had seen led soon afterwards to a further examination of the region by Mr. Thomas Baines and Sir John Swinburne, and samples of gold have been sent down from the spot from time to time, one of which was shown at the meeting of the Royal Geographical Society in March, 1871, in the form of an ingot weighing 28 ounces. This original gold field of South Africa lies in the centre of the great highland already alluded to, which intervenes between the Limpopo and Zambesi rivers. There are workings on the River Tati and neighbouring streams, which flow southwards from the high water-shed, and are affluents of the Limpopo; and there are reefs of still higher promise on the Chingasora, Kangamatimba, and Simbo rivers, which flow in the opposite direction into the Zambesi. There is great probability, indeed, that the main axis of this elevated water-shed is a mass of granite and gneiss, flanked with slate, and intersected with veins of gold-bearing quartz. Specimens of the quartz which have been examined in England yielded from one to eight ounces of gold per ton.

The great drawback of this otherwise promising gold field is its remoteness from the sea-board of the civilised settlements, and the difficulty and high cost of the transport, by which alone it can be reached. The Limpopo slope of the water-shed is more than 800 miles from the port of Natal, and the centre of Karl Mauch's discovery is some days' journey beyond that. The gold is also almost entirely confined to solid rock seams, so that massive machinery is indispensable. There are no alluvial deposits of the precious metal worth notice on the high water-shed. It is propable, however, that there may be in some of the streams that flow further north, into the Luenja branch of the Zambesi, which has been long known to the Portuguese as yielding gold.

The discovery of this remote gold region, however, has had the effect of awakening a restless spirit of enterprise throughout the Cape settlements. Explorers have been washing, and crushing, and assaying, in every direction. Quill-fulls of gold have been gathered, even from the sands of some of the Natal rivers, and now at last, it looks very much indeed as if resolution and perseverance are to have their abundant reward. Within the last few months, alluvial deposits of gold of unquestionable richness have been struck within the Transvaal territory itself. These deposits are about 80 miles from Potchefstroom, the capital of the Republic, close to the Dutch settlement of Lydenburg, on the sea-ward flank of the Drakenberg, and therefore on the outer rim of Mr. Shepstone's elevated basin; and instead of being hundreds of miles in the interior, as is the case with the Mashuna deposits, they are within comparatively easy reach of the sea, and within ten days' drive of the chief towns of Natal, along a well frequented road. The journey from Delagoa Bay to Lydenburg is made on foot in ten days, and the first pioneer's waggon, with 1800 lbs. of merchandise, has just been taken from Delagoa Bay by this route. A party of 63 Kaffir porters travelling on foot had also recently arrived by the same track, laden with grocery supplies. The distance from the capital of Natal is very nearly the same to either the diamond fields on the Vaal River, or to the gold fields of Lydenburg; both are about 450 miles from Maritzburg, or 500 miles from Durban, the port of the colony of Natal, by the nearest route.

There seems now to be no doubt whatever as to the value and availability of the gold field at last opened out on the western frontier of the Transvaal States. When the last advices came from the fields there were about 600 miners at work, and most of them with

fair success. There are several instances spoken of in which from two to three ounces of gold per day had been procured by the individual worker. In one case eighteen ounces seems to have been bagged in the day; in another instance seventeen ounces, comprising a nugget of nine ounces weight; and in another instance the yield was thirteen ounces for three hours work. In this particular case the gold was contained in a crevice of the rock, and comprised nuggets weighing three and four pounds. The genuineness of this find is officially certified by Mr. W. McDonald, acting as gold commissioner at the fields. The average yield for each man at the fields per day was roughly spoken of at this time as being about one ounce, and one ounce per day was estimated as giving a revenue for the miner of something like £1,100 per annum. The precious metal is chiefly procured from the alluvial soil by the ordinary process of washing, but some of the Lydenburg deposits are of the character of softened and decomposed granite, with granular and nuggetty gold mingled with the pulverulent mass. The sample ingot of Lydenburg gold exhibited to the meeting is very kindly contributed by an old friend of the author of this paper, Mr. W. G. Baker, of Maritzburg.

The influence of the opening up of these gold fields within easy reach of the centres of civilised settlements will, of necessity, be very immediate and very large, and will tell with very direct force upon the concurrent state of affairs on the banks of the Vaal River. A considerable portion of the population at the diamond fields will of necessity be drawn away from them by the new attraction. Gold has one great advantage over the diamond, it is infinitely less within reach of easy and rapid depreciation from over abundance. Much of the value of the large diamond has hitherto been due to its comparative rarity. So large an increase of supply as the South African fields have furnished, on this account, very materially diminishes the market price of the gem. From this cause, and from the overworked condition of the most productive portions of the mine, which has been already alluded to, claims that were a few weeks ago worth hundreds of pounds, are at this time valued at tens. But it must, nevertheless, be understood that diamonds are still being turned up in considerable quantity. A diamond from Dutoitspan, of 134 carats, and valued at £1,600, has just been announced as being found by Mr. P. W. Shotly.

The commercial aspect of these very recent developments of South African enterprise and activity has now to be glanced at, and is, indeed, the point to which the preceding remarks have been designed to lead. The influence which the discovery of diamonds and gold in this district has already exerted, is a very considerable and even momentous one; but this is chiefly worthy of note upon this occasion on account of the suggestions with which even these early results are pregnant, both in their bearing upon the civilised and settled portion of the community, and upon the very large native population of dark skin and woolly hair that lie around and beyond. If the object of the white races that have entered at this pleasant Southern door of the great tropical continent of the world be to open up trade, and by its means to diffuse and extend civilisation towards the torrid zone of black barbarism, there cannot be a doubt that diamonds and gold will do more to accomplish their aim in a brief decade than other more slow-paced agencies can effect in a century. That writing is already upon the wall, and may be read without much effort of prophetic insight.

As has been already stated, the first discovery of diamonds in South Africa was within a very few years, and an available and accessible field for the production of gold is still but in the first blush of its earliest promise. A most remarkable stimulus has nevertheless been given to trade through the entire stretch of the English possessions from the Cape to Natal, Port Elizabeth and Algoa Bay having probably reaped the fullest sheaves of the early harvest. In Natal the stagnation and pressure of recent monetary embarrassments and complications have been very materially relieved, and a considerable amount of capital has been distributed through the colony. Poor settlers have found themselves able, in many instances, to purchase property. Mortgages, that had grown to a formidable amount, and that looked even hopeless, have been cleared away; and the banks have been able to reduce responsibilities and losses that have been pressing heavily upon them during the critical period, within narrow and manageable limits. This, no doubt, has also been in the main, the experience both in the eastern and western divisions of the parent colony. A wave of renewed prosperity has spread over the entire range of the South African settlements, and is now overflowing the first outposts of the inner barbarism that hems them round on the landward side.

One of the first consequences of this returned flow of prosperity is a very startling rise in the price of many of the necessaries of life. A large demand is already created in the fields for live stock, agricultural produce, fruit, and building materials. These are all sent up in large quantities from the old settled provinces. This, of course, tells in a two-fold direction. It goes far to destroy the advantage hitherto enjoyed of cheap living in the old settlements; but the quickening influence which it exerts upon industrial enterprise and activity, very far transcends the weight that is thrown into the opposite scale. The balance is on the side of unquestionable gain. The pinch, on the whole, is perhaps most severely and painfully felt in the two particulars of transport and labour. Almost everything that is consumed in the fields is derived from the neighbouring settled territories, and has to be sent up to them by the slow and costly procedure of heavy waggons drawn by oxen. This of necessity falls as a very heavy strain upon the already too limited resources in this particular of lands circumstanced like Natal, where the increase of live stock, and of oxen in particular, is checked periodically by outbursts of epidemic sickness. The remedy is obvious—the early commencement of railway construction of a simple and cheap character. But in the meantime, and pending the arrangements for this, the difficulty presses heavily upon the industrial enterprise of the young community.

The labour supply is a still larger difficulty in settlements where, as in Natal, there are nearly seven thousand acres of land planted with labour-absorbing sugar cane, and nearly four thousand acres with coffee. It is, nevertheless, somewhat surprising to English apprehension that it should be so in the face of the fact that the proportion of the black population of the colony to the white is about as 15 to 1. In the table of African population presented by Mr. Saunders at the meeting of the African Section on February 20th, the people of Natal are set down as amounting to 212,000 individuals on the whole. This, however, is considerably within the truth. The approximate return of the population of Natal for the last year was in excess of 305,000. Now, of this number, only 17,000 were Europeans, 5,000 were introduced Indian coolies, and 283,000 were Kaffirs.

One of the early recommendations of the colony of Natal was the presence of rude and cheap native labour. Quite within the memory of the author of these notes, the cost of a native agricultural labourer or domestic servant in the colony was from 6s. to 8s. a month for wages, and about 10s. a month for rations. Those halcyon days were rapidly passing away before the diamond began to shed its light upon the field, and coolies were in process of introduction from India for service upon the plantations. Now, the Natal Kaffirs engage readily with parties proceeding to the diamond fields and gold fields, I believe, at the rate of £2 and £3 per month; and the wages for native service within the colony are consequently also raised in a very material degree.

Perhaps no more instructive instance of the power of civilised settlements to affect beneficially even the most

stagnant barbarism could be found in the pages of human history than is furnished by the bare statement of what has happened in Natal. When the first English settlers landed on its coast, near the present site of its port, fifty years ago, there was scarcely a native hut or village to be found within a stretch of 200 miles of its territory. The frontier of Zulu despotism and ferocity was at that time fixed a little way beyond the river Tongaat, which is some distance within the bounds of the present colony, and to the south of that line there were no cattle, no gardens, no growing crops. The entire country was a desolate and devastated wilderness with a few half-starved and terrified stragglers lurking in the thickest bush, deriving a precarious and miserable subsistence from wild roots and shell-fish, and wandering fitfully from hiding-place to hiding-place. In some instances the privation was so great that individuals sunk into the practice of cannibalism. Dogs were not uncommonly eaten by Kaffirs, and hyenas continually attacked both men and women, and carried off children. When the author of this paper first made a personal acquaintance with the colony, about seventeen years ago, the wilderness had ceased to be desolate. The peaceful rule of Queen Victoria had superseded the savage Zulu ascendancy, and 120,000 Kaffirs were settled under the shelter of its laws, tending their herds and cultivating their gardens. At the present time there are 283,000; and this number is increasing day by day.

The Kaffir population of Natal is chiefly distributed in certain reserved districts that have been set aside for their occupation. They live there in a sort of clan-ship, under petty chiefs; but these chiefs are under the surveillance and control of the magistrates of the colony, and under the supreme rule of the Lieutenant-Governor, assisted by a veteran secretary for native affairs. The Kaffirs come out from the reserved locations from time to time to enter upon limited terms of service to the white occupiers and planters, and then return home with their earnings, and this, with the frequent intercommunication with civilised habits and civilised men, which it implies, is substantially the way in which the English colonisation operates for their improvement. They first flock into the English territory on account of the welcome protection to life, limb, and property which its government affords; and then, unconsciously, new wants arise, and new cravings are fostered, and industrial habits are slowly formed to satisfy these demands.

During the quarter of a century of English occupation of the colony of Natal, the black native population has been orderly and peaceable, under its own sense of the advantages which it derives from the parental care of the government, almost without a break. The first material exception to this happy rule has just recently occurred; and curiously enough is one of the developments of the diamond influence. The chief products of civilised manufacture which the Kaffirs in this early stage of their industrial history have learned to prize are iron picks or spades, woollen blankets, cotton blankets and fabrics, and glass beads. The value of the yearly importation of cotton, woollen, and iron manufactures from England considerably exceeds £200,000 sterling. But unfortunately, there is one attraction which is stronger over their desires than even these legitimate possessions, but which is forbidden, for reasons of expediency, by the state. Guns and gunpowder are contraband treasures. No gun is allowed to be held by any one in Natal unless it is duly registered and allowed in the office of a magistrate. But in the neighbouring diamond fields this restriction has not been hitherto practically in force, and as Kaffirs will just give anything for a gun, guns have been sold to them there without reserve. In this way the northern frontier clans of the Natal colony have been gradually acquiring possession of fire arms surreptitiously, and one chief of this northern frontier district, named Langabalele, when summoned to give an account of his unlawful possessions before the magistrates, at first refused to obey the summons, and then when he found the matter was being seriously taken up by the authorities, attempted to leave the colony with his live stock and portable Lares. A party of his men armed with the forbidden weapons, and driving a large herd of oxen, were intercepted in one of the natural mountain outlets by a small company of volunteers, who were under orders not to fire upon the Kaffirs unless they were themselves attacked. In an unexpectedly resolute effort to make good their retreat, and so to save their cattle, these fugitives fired upon the volunteers and killed four of the party, of whom three were white colonists, who thus unfortunately became historical as the first Englishmen who have fallen in armed conflict with the native race in this colony. The Kaffirs effected their escape for the time, but they were pursued, and intercepted from the further side by the mounted police of the old colony. The chief, with his leading men, and 7,000 head of cattle have been since seized and brought back to Natal, where the cattle have been forfeited and sold, and the men are now being tried for armed rebellion.

The question of the position and prospects of these native tribes in Natal is a very interesting one; so interesting indeed, and so large, that it can only be glanced at upon this occasion. The problem which has to be solved, is both a difficult and delicate one. It is how to bring pressure upon these naturally easy-going and indolent people, to make them change a life of basking in the sunshine, for a life of persistent and productive toil, without giving them a substantial grievance which might lead to a coherent resistance. This difficulty is one which is continually cropping out in colonial politics, and which, in all probability, will acquire increasing importance; and it very fortunately happens that in its secretary for native affairs, the gentleman to whom we are indebted this evening for the paper on the diamond fields, the colony has the advantage of the services and counsel of an officer of very large experience and sagacity, and who happily has, furthermore, an exceptionably deep insight into the traditions, feelings, and capacities of these Kaffir tribes.

In the entire conviction that commerce and trade are the really efficient civilisers of barbarous humanity beyond all other agencies, and that therefore the opening of a door for the inlet of this influence, such as has been secured by the permanent industrial occupation of Natal by white settlers, is a matter of the largest social moment, I feel that I cannot conclude these remarks without a very brief allusion to commercial aspects within the colony. In the year 1866 the white population of the colony amounted to 16,600 souls; at the end of the last year it amounted to only 17,200 souls. For various reasons, among which the outlet afforded inland and by the Free State and Transvaal territories, and now by the diamond and gold fields, are not the least, the white population has been for some time almost stationary. Not so, however, with the results of these white people's industry. The value of the exports from the colony for the seven years ending with 1872, was, in round numbers, £203,000, £225,000, £271,000, £363,000, £382,000, £562,000, and £622,000. The value of imports for the same years was—£263,000, £269,000, £317,000, £380,000, £429,000, £472,000, and £825,000. These figures speak for themselves. There can be no mistake as to their meaning and promise. With such a fulcrum and such a leverage secured, the opening out of the interior wilds of barbarous Africa in this direction will certainly go on.

One of the immediate results of the discovery of diamonds and gold on the borders of the Transvaal will, no doubt, be the speedy accomplishment of a trunk line of railway through Natal to the Free States frontier; and one of the proximate and early results it is to be hoped will be the utilisation of the coal and iron deposits that lie within the colony. There are large tracts of valuable surface coal in the northern districts, which extend

no one yet knows how far and how deep, and there are valuable deposits of iron in all directions. The author of this paper had recently to bring specimens of excellent iron ore under the notice of Sir Antonio Brady, which yielded upon assay 53 and 48 per cent. of metallic iron, which were pronounced to be of a good kind for reduction, and which came from a deposit of practically inexhaustible extent, comprising a large mountain of mixed specular and magnetic forms of the ore.

DISCUSSION.

Mr. E. T. Cooper said he had been at the diamond diggings for the last three years, and he did not think the diggers agreed with the view put forward by Mr. Shepstone as to diamonds being an aqueous deposit; his own opiuion rather was that they were due to igneous action. And they must not confound the manner in which diamonds were found in the Vaal, and in which they were found in Colsberg Kopje. The bed in which it was formed appeared to be decomposed volcanic substance; in fact he believed the whole district of the Vaal River had been covered by lava, and that diamonds would be found in it from the Drakenberg right to the Atlantic Ocean. The diamonds were on the summits of the kopjes; and why? The whole of the southern portion of the country had been covered by water, and when it flowed off it cleared out the valleys, leaving the eminences where the diamonds had been found. The Colesberg Kopje was in reality a level, but it was so named by the miners in remembrance of a large mountain in the vicinity. It was now excavated to a considerable depth, but originally it was perfectly level at the surface. There was first a depth of 2 feet of red sand, then a white calcareous deposit of about 10 feet, then perhaps 30 or 40 feet of green stuff, and below that an indefinite depth of blue stuff, which was now worked to a depth of from 90 to 120 feet from the surface, and the diamonds were still as plentiful as ever. The Zulus and Kaffirs came from as far as a thousand miles to work at the diamond fields, where they got 10s. a week and their keep; with the first 10s. or 12s. they had they bought a blanket, then they saved up £6 or £6 10s. and bought a gun, and as soon as they had purchased some powder and percussion caps off they started.

Mr. Jonas Bergtheil, after some highly complimentary remarks on Mr. Shepstone and his administration in Natal, said he had the honour of being a member of the Natal Legislature when the law was passed with reference to the carrying of firearms, and the fact was there was no prohibition, but simply an obligation on every person having a gun to go to the nearest magistrate and register it. This chief, however, who had been very well received in the colony when he ran away from his relative and head chief, after a time got rather too proud, and fancying himself as good as a white man, he refused to comply with the law, the result being that several lives had been sacrificed, and he was now in custody awaiting his trial. Such was the consequence of giving these natives guns, all for the sake of getting a few wretched diamonds.

Mr. Cooper said the blame must be attached to the Government if to any one, not the diggers, who paid the native workmen in cash, and had no control over the manner in which they spent it. He did not think, however, that they would come to work at all, if it were not for the sake of purchasing firearms.

Mr. W. Soper showed a piece of blue stone with a diamond embedded in it, which was found at a depth of about 189 feet, and at that depth the diggers were now working. The blue stone when dug out was dried; and as water dissolved it, he thought water must have originally formed part of its composition, and that there must have been heat to have baked it into its present condition. With reference to the commercial part of the subject, they all knew that the test of civilisation of a country was the state of its roads. Cape Colony was by no means deficient in this respect, for the residents had lately made great improvement in the roads; so much so, that now diggers could go from the diamond fields to Cape Town in five days and a half. In the eastern part, also, they had commenced a railway. There had been a railway in existence for some time in the western part. Allusion had been made to the question of labour, which was a vital part of the creation of any commercial industry. The colonists had shown their appreciation of this question by sending home an emigration commissioner, and they were fully alive to all the points which the lecturer had observed upon. There was one thing which civilisation would improve, and that was the state of the climate. Droughts were a great drawback to progress, and hence the gladness with which rains were always spoken of in the colony. A friend of his, just returned from the diamond fields, told him that he had paid at Christmas 25s. for a cabbage, and 2s. 6d. for a lettuce, which proved how important the question of irrigation was. When civilisation advanced, better roads would be made, and the country properly drained, and then the climate would be improved.

Professor Tennant said it was well known that diamonds from the Cape had been described in that room as early as 1867, and a model of the first one received by the agent for the colonies was exhibited at Paris in that year, when he himself lectured upon it to the members of the Society who visited the Paris Exhibition. In a case on the table were some Cape diamonds brought over in 1868, and he saw in the room a gentleman who possessed about the finest collection of diamonds he had ever seen; one of them was worth at least £20,000. But still earlier, viz., in 1852, reference had been made in that room to the probability of finding diamonds at the Cape, the prediction being founded on a statement in a book published in 1812 by Mr. Mawe. This book contained an account of Mr. Mawe's travels in Brazil, and he gave it as his decided opinion that diamonds would be found both in the Cape and in Australia. This had repeatedly been brought before the public; and yet, when the Cape diamonds were brought forward in 1868, they were met with the assertion that stones had been taken out there; The finest diamond brought to England, now in the possession of Earl Dudley, which, two years ago, was exhibited at South Kensington, was said to have been taken out and sowed there; but the idea of taking out a diamond worth £20,000, and putting it there for some stranger to pick up, was rather too improbable. It was remarkable that they had received more large diamonds from the Cape in seven years, than from the Brazils, from Borneo, from India, and other diamond-producing countries in 100 years. Unfortunately there was no doubt, also, that very large numbers of small stones were overlooked. If the Chinese could be induced to go out there, and work over the old ground, as they had done in the gold districts of Australia, he had no doubt they would get a very good living out of the leavings of Europeans.

Mr. Cooper said they laboured under the disadvantage of having no water at the diamond fields. No diamonds under half a carat in weight ever came on the tables, the smaller ones being passed over.

Dr. Mann said Professor Tennant had not quite understood the paper—he had not intended it to be understood that the first diamond was found in 1871, but in that year the first workings were commenced.

Professor Tennant said he had with him a specimen of quartz containing gold, which he should be glad to let any one inspect. He thought it was a mistake to suppose that diamonds had been depreciated in value; it was only when they got a diamond above £10,000

that the purchasers were few and far between; but a diamond worth £1,000 was 50 per cent. dearer now than it was twenty years ago. It was supposed that tinted diamonds only came from the Cape, but that was a mistake—they came from Brazil of all colours.

Mr. Jones had heard it stated that the diamonds from the Cape lost their lustre when polished, and should be glad if Professor Tennant would state whether this was so or not.

Professor Tennant said that was not so, for when a diamond was once polished it would retain its lustre.

Mr. W. Soper said he had received the first diamond from the Cape, and it was upon publishing a statement of it in the *Times* that the gentleman was sent out by Mr. Emanuel to inspect the fields. As to the quality of the diamonds, if they had an influx of a large quantity of secondary value, that very influx increased the value of the pure brilliants; and it was because they had such a large quantity of second-quality stones from the Cape, that they had a great increase in value of the finest and purest water stones.

Mr. Alfred Smart could not but feel that the remarks of Professor Tennant, unless they were much qualified, would mislead those present and the world at large. The colours of the Cape diamonds when first found were quite different from those of the Brazilian diamonds. The Brazilian diamonds were of all colours on the outside, but when cut there was inside a stone or kernel which turned out perfectly white; in fact, some of the best brilliants were cut from this class of stones. But the Cape diamonds were, although not diversified in colour, principally of a yellow description, and he was within bounds when he said that they rarely improved in cutting—if they were yellow in the rough they were yellow when finished. When the stones first came over from the Cape, many of the cutters were deceived on that point, being accustomed to get white stones out of the Brazilian coloured ones, they naturally concluded, the Cape stones being lighter in colour, that they were getting a superior stone to the Brazilian, but they soon found that was not so. He should be glad if Professor Tennant would state if it was not a fact that the stones from Brazil and the stones from the Cape produced a very different class of brilliants. Diamonds were from 60 to 70 per cent. cheaper than they were three years ago, and if the supply continued, as at present it did, he could not see how they could expect a rise in value; but if the diggers left for the gold fields, there would be a considerable diminution in the findings, and then the price, no doubt, would improve. He thought they had got to a point, now, as to the price of diamonds, which would affect a large community, and that they would not see the price any lower; but latterly they had been swamped with quantity.

Dr. Mann, in reply, said he had referred merely to the working of the fields having commenced in 1871, and he did not dispute for one moment the correctness of Mr. Tennant's statements as to diamonds having been found earlier. He might also say that he had not brought forward Mr. Shepstone's paper as containing a satisfactory explanation of the formation of the diamond; but as it was a question on which even scientific men had not yet arrived at anything like an understanding, and as the paper contained some interesting suggestions, he had thought desirable to print it. He begged also to say that he endorsed all that had been said by Mr. Bergtheil as to the high qualities of Mr. Shepstone, and hoped, before long, the former gentleman would have an opportunity of introducing his friend to the Society, as he was coming to England shortly.

The Chairman then proposed a cordial vote of thanks to Dr. Mann, which concluded the proceedings.

FIFTEENTH ORDINARY MEETING.

Wednesday, March 18th, 1874; Lord ALFRED S. CHURCHILL, Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Ballingall, James, jun., 38, Great College-street, Camden-town, N.W.
Broome, Richard Tarrant, 58, Highbury New-park, N.
Deacon, Henry, Widnes.
Fairbairns, William Henry, 2, Crosby-hall-chambers, Bishopsgate-street, E.C.
Gladstone, John Hall, Ph.D., F.R.S., 17, Pembridge-square, W.
Hartnell, Wilson, Rodorough, Stroud.
Johnson, Samuel W., LL.D., Lichfield-house School, Newbury, Berks.
Kaufmann, Adolph, Grove-house, The Grove, Clapham-road, S.W.
Stephenson, Charles, 3, Eastcheap, E.C.
Witherby, Richard, Morden Cliff, Lewisham, S.E.

The following candidates were balloted for and duly elected members of the Society:—

De Luc, Charles Lombard, Forest-hill, S.E.
De Salles, I., 6, Great Winchester-street-buildings, E.C.
Honey, A. J., the Distillery, 25, Holborn, E.C.
Matthiessen, Henry, Raymond-buildings, Gray's-inn, W.C.
McDonnell, Alexander, St. John's Island-bridge, Dublin.
Moll, E. A., Beech Tree-bank, Rectory-lane, Prestwich, Manchester.
Spartali, Démétrius M., the Shrubbery, Clapham-common, S.W.
Stacey, Samuel Lloyd, 300, High Holborn, W.C.
Whitehouse, E. O. Wildman, Roslyn Hill-house, Hampstead, N.W.

The Paper read was:—

ON THE CHANNEL TUNNEL.

By William Hawes, F.G.S.

The subject I propose to bring before the Society this evening is of great interest politically, commercially, and socially.

The establishment of continuous railway communication between England and the Continent must lead to results which will engage the attention of the statesman, the merchant, and the philanthropist; and surely this Society ought to take a deep interest in the construction of a submarine tunnel which will tend to strengthen the bonds which unite two great peoples—will facilitate the interchange of commercial productions between foreign countries—promote Arts, Manufactures, and Commerce, and tend to improve and to give permanence to that respect and friendship between nations which is the best and most secure basis upon which our prosperity can depend. The realisation of such an enterprise must be of immense importance, especially to France and England, and in the words of the report of the French Commission of Enquête on the Channel Tunnel, dated December 30, 1873:—

> "The establishment of a railway which would unite the railway systems of England with those of France, and consequently with the whole Continent, presents advantages for the interests of commerce and for those of civilisation, evidence of which need not be demonstrated. The Commission is therefore of opinion that it should declare of public utility the establishment of a submarine railway between England and France."

Until very recently, although the idea of making a communication across the Channel independently of the sea route has been a subject occupying the attention of a few engineers, it has not excited any interest in the public mind. Various plans for its accomplishment have been suggested—a bridge on piers of a sufficient height to allow the free passage of shipping; an iron tube to be laid on the bed of the ocean, and to be gradually extended until it reached the other side of the strait; a tunnel with a ventilating shaft in the centre of the Channel, forming an obstruction to navigation in mid-channel which, had it existed naturally, would have been removed ere now at any cost; and a tunnel driven at such a depth as would require a longer tunnel on each side, by which to descend to and ascend from that portion of it under the sea, than the distance between Dover and Calais—have all been advocated by their respective promoters. It is not, however, for me to criticise these plans, and I will only remark that all of them have been put aside since the plans which I shall have the pleasure of submitting to you this evening have been brought under public notice.

Improved boats have also been proposed, and one designed by Mr. Bessemer, to whose mechanical genius the public are much indebted, is in course of construction. But however the proposed arrangements may lessen the inconveniences of the sea passage, they will not prevent storms and bad weather, nor remove the inconveniences incidental to the changes from railway to steamboat, and steamboat to railway.

Before I proceed to explain the drawings and plans on the walls, let me call your attention to what has already been done in tunnelling and in driving driftways under the sea.

For many years mining has been carried on under the sea. In Cornwall, in Cumberland, and in Northumberland, lead, silver, and coal have been won from strata under the sea, and in some instances the working has been so near the bottom that the action of the waves could be distinctly heard in the galleries. In Cornwall, at the Botallack and Levant mines, galleries are driven considerable distances from the coast, and with the side galleries form a network some score of miles in length, and in some parts with a very thin stratum of rock between them and the sea.

In Cumberland the galleries of one pit are between five and six thousand yards in length, and extend in a direct line more than 4,000 yards under the sea, yet the manager states that only an inappreciable quantity of sea-water finds its way into the mine.

Then, again, it is 50 years since Sir Isambard Brunel projected the Thames Tunnel, which, constructed for carriage and foot traffic, has recently been converted into a railway tunnel, and trains are now running through it every few minutes daily, and within a very few feet of the bottom of the river, which is here 1,200 feet in width. The soil above the tunnel is of the loosest character, mud, gravel, and sand, and in some parts not twenty feet thick.

This tunnel, the first constructed under a tidal river, and having for a considerable portion of its length 50 feet of water above it, is now as sound and water-tight as any, and more so than many tunnels constructed inland.

Among the various tunnels which have been made for railways, one or two may be mentioned where difficulties arising from an excessive influx of water have been successfully overcome. The Kilsby Tunnel, from which for many weeks 1,800 gals. of water were pumped per minute, by the employment of 1,250 men, and 13 steam engines, was successfully driven at a cost of £145 per yard. The Saltwood and the Bletchingly Tunnels were also driven, in the face of great difficulties, at a cost of £118 per yard, at which rates 22 miles would cost £5,650,000 and £4,568,000 respectively. The Hauenstein Tunnel, in Switzerland, a very difficult work, cost £80 per yard. Ordinary railway tunnels, through chalk and such-like strata, cost from £30 to £50 per yard.

Since the completion of these tunnels, the art of tunnelling has advanced considerably, and with the aid of machinery to facilitate the operations of the workmen, and of arrangements for the supply of fresh air, it appears that no difficulty exists in piercing the hardest rocks and in forcing a way through them of almost any length.

The most interesting instances recently completed are, the tunnel under Mont Cenis, nine miles in length, at a cost of £206 per yard; and the Hoosac Tunnel, in America, nearly six miles in length, at a cost of about £180 per yard, both for the most part through very hard rock; and there are now three in progress, one under the Severn, a deep tidal river, five miles in length, under the direction of Sir John Hawkshaw; another under the Mersey, under Mr. Brunlees' care; and the third under the St. Gothard, ten miles in length, where the rate of progress is much more rapid than was made under Mont Cenis, the most recent return being at a rate of 14·6 ft. per day on the two faces. This increased rate of excavation is due to improvements made in M. Sommeiller's machinery, the result of the experience gained during its use in the Mont Cenis Tunnel. But M. Favre's rate of progress under the St. Gothard will be much exceeded by the use of Major Beaumont's new apparatus, and this rate will again be very much surpassed when working in the grey chalk, which forms the bed of the sea between Dover and Calais, by the use of Mr. Brunton's machine, a model of which is on the table. All these machines are driven by compressed air, which, after driving the machinery, is used for the ventilation of the tunnel.

It has then been established, during the progress of these works, that tunnels of the size required for railways can be driven through strata whether consisting of loose soil or the hardest rocks, and that the powerful machinery employed, driven by compressed air, provides an adequate supply of air for ventilation during construction.

Having thus referred to what has already been done in tunnelling for railway purposes, let me now call your attention to the Submarine Tunnel, proposed to be constructed under the Straits of Dover, but which, while exceeding all others in length, will not, from the nature of the stratum through which it will be excavated, occupy more time or involve greater difficulties than have been overcome in driving the tunnel under the Mont Cenis. The character of the stratum through which the Channel Tunnel is to be driven must determine not only

the cost and the time required for its execution, but its practicability, and has therefore demanded the most serious and careful consideration by Sir John Hawkshaw and Mr. Brunlees, as well as by their French colleagues.

A distinguished member of the Geological Society, the late president, who appears to doubt the feasibility of constructing a tunnel between Dover and Calais, on account of the risk of meeting with fissures in the chalk, recently read a paper before the Institution of Civil Engineers, on "The Geological Conditions Affecting a Submarine Tunnel between England and France." He is satisfied that a tunnel could be safely driven through the Palæozoic rocks which underlie the Channel at more than 1,000 below the surface, the attempt to pierce which would involve the construction of a tunnel to connect it with the existing railways on either side of the Channel, of at least five times the length of the distance between Dover and Calais, thereby increasing the cost, and the difficulties of construction and of ventilation, to such an extent as to deprive the work of any practical value, and to remove it out of the category of works of useful or profitable enterprise. This idea then may be at once dismissed as impracticable; and his second suggestion, to drive the tunnel through the London clay, is hardly less so, for in order to keep in the deepest line of the trough of the clay—without which he does not appear to think this could be done with safety—the tunnel must be at least 80 miles long under the sea, besides the communications with the surface on either side. In illustration of the facility of driving a driftway through clay, he refers to the small boring under the Thames at Tower-hill, whilst the fact that a tunnel large enough for railway purposes has been driven through the alluvial deposits lying above the clay is lost sight of altogether.

It is unnecessary to dwell upon the difficulties of driving a railway tunnel either through the Palæozoic rocks at a great depth, or through the London clay at a lesser depth, but both involving the construction of tunnels of such length as to render them practically useless as the means of establishing a submarine railway communication with the Continent, when there exists in the best possible position a bed of the lower grey chalk, impervious to water, and of a thickness greater than is required for the safe and expeditious completion, in a direct line, of the proposed tunnel.

It may also be stated, as the result of experience in cutting through chalk, that the principal supply of water is generally found in the first 50 or 100 ft. below the level of the valleys of the neighbouring district, and in the beds incumbent on the chalk marl, neither of which conditions apply to the stratum of chalk of great thickness which underlies the Channel, and which is easily accessible for the purpose of constructing a tunnel. This bed of chalk consists on the English side of the Channel of 175 feet of white chalk, and 295 feet of the lower, or grey chalk, and on the French side of 270 feet of white, and 480 of grey chalk, which is quite impervious to water, and from its plastic nature must be free from fissures, through which only in the white chalk could water find its way from the bed of the Channel to the proposed tunnel in the grey or plastic chalk marl.

I need only add, while on this part of my subject, that from the most accurate examination of the strata on both sides of the Channel, commenced in the year 1865 by Sir John Hawkshaw, as well as from a most careful examination of the bottom of the Channel, made from a steamer specially employed for the purpose, and provided with apparatus contrived for the purpose, by means of which the bottom could be pierced and specimens raised for examination,—it has been satisfactorily established that the actual position of the chalk across the channel is very nearly identical with that deduced from previous inquiries, and that its unbroken continuity appears to be beyond doubt. Its thickness, determined by deep borings on both sides, is proved to be above 500 ft. below high water mark, with an ample thickness of the lower, or grey chalk, between the bottom of the sea—which is nowhere more than 180 ft. deep—and the crown of the tunnel, as well as between the bottom of the tunnel and the green sand or water-bearing strata underlying the grey chalk.

The opinion of M. de Souch, Inspector-General of Mines in France, and who was heard before the last meeting of the Commission of Enquête, is very satisfactory on the character of the geologieal formation between Dover and Calais. He first compared the line selected by the engineers of the Channel Tunnel Company with those suggested by other engineers—one from Sangatte to the South Foreland, and the other from Cape Grinez to Folkestone. He showed that the ground near Cape Grinez presents a series of very thin beds, having their outcrop in the sea—subject to breaks and faults—and he does not believe in the possibility of making a tunnel through alternate permeable and impermeable beds, all having their outcrop in the sea. In M. de Souch's opinion, the line proposed by the Channel Tunnel Company is the only one which presents chances of success, and is the only rational one; and in 1868, when examined by the General Council of Mines, he expressed his opinion that it was realisable, and that on higher than pecuniary grounds, he thought the enterprise ought to be encouraged.

Having thus shown the continuity and thickness of the strata of white and grey chalk, the only difficulty likely to interfere with the construction of the works would be the existence of fissures extending from the bottom of the sea at its deepest part through the 200 feet of white and grey chalk between the crown of the tunnel and the bottom of the sea, through which an irruption of sea water might take place. In relation to this part of my subject, the following extracts from various papers are interesting.

The probability of this country having been an isthmus, and of the land connecting it with the continent being washed away by the action of the sea, was carefully considered by Verstigan, so long since as 1673, in a pamphlet dedicated to King James. He compared the identity of the strata, the composition of the cliffs, the similarity of their lengths, and arrived at the opinion that the surface had been gradually worn away by the action of the sea, and not by disruption. In the following century, M. Desmarest wrote an essay on the

same subject, arriving at the same conclusion, and in 1818 the question was philosophically treated by Richard Phillips, F.R.S., in an elaborate essay which he read before the Geological Society. Mr. Phillips states that the thickness of the chalk appears to be well ascertained on both sides of the Channel.

At Dover it consists of—

1. 350 feet of white chalk with flints.
2. 130 feet with few flints.
3. 140 feet without flints.
4. 200 feet of grey chalk.

On the French coast the same deposits exist as those which constitute the long range of coast between Deal and Folkestone, except that the upper part of the chalk with flints is not visible in the former.

The dip of the strata Mr. Phillips states to be the same on both sides of the Channel, and in reviewing the many remarkable points of agreement between the cliffs on each side of the Straits of Dover, it seems to him to be a supposition too reasonable to be ranked among mere hypotheses, that they were once united, and that they have been separated at some very remote period by an irruption of the sea, which in all probability washed away the connecting mass; for the unreasonableness of the popular notion that the two countries were rent asunder by sudden convulsion will become apparent when the thickness of the various strata are carefully and accurately compared.

Again Mr. Phillips states—

"That on the summit of the cliff near Dover, wherever any considerable opening appears in the chalk, deep indentations or gullies are visible which are filled with clay, and which have, as it appears to me, with great probability been attributed to the action of water on its surface."

Mr. Prestwich, in his work on the water supply of London, says:—

"In descending below the surface of the ground, the crevissed condition of the chalk diminishes, the vertical fissures becomes rarer, until in the deep-seated beds beneath the tertiary series the passage of water takes place almost entirely along the planes of stratification, which are generally marked by layers of flint."

And also, "that chalk is porous and will imbibe a large quantity of water is certain, but its texture is too fine and close to allow it to pass freely through it;" in proof of which Mr. Prestwich adds:—

"I have found by experiment that a piece of chalk 2 inches thick, and containing 63 cubic inches, was fully saturated with 26 inches of water in fifteen minutes. Nevertheless, when left to drain, it yielded only one-tenth of a cubic inch of water in twelve hours, and transmitted water so slowly that, with its surface covered with water, only six-tenths of an inch filtered through it in twelve hours."

And again—

"I believe that large fissures very rarely exist in the deep seated beds of chalk. In the first place, the mass has not been sufficiently disrupted, and the flow of water through it has been excessively slow; but in the hills of a chalk district, on which the effects of disturbances have had full play, I can readily conceive the existence of large open fissures, although even there they appear to be by no means common."

Admitting, however improbable, that there may be fissures in the white chalk at the depth at which the tunnel is to be driven, they must be filled with chalk or other earthy matter, which for thousands of years has been subject to the pressure of a column of water varying from 100 to 200 feet in height, and as the Channel has been gradually worn away and deepened by the action of the sea, these fissures must be reduced in width in proportion to the thickness of the chalk washed away. Then, passing through the white chalk, the least consideration must satisfy any one that no opening or fissure can exist in a bed of grey or plastic chalk under the pressure, not only of a high column of water, but also exposed as it is to the weight of the superincumbent bed of white chalk. In fact, any interference with the safe progress of the work from fissures may be safely dismissed from our calculations. But it may be said there will be infiltration of water through the 200 feet of upper and lower chalk. All experiments and evidence on the subject show this to be almost impossible. Without saying there will be no infiltration, it may be safely stated there will not be any worthy of notice, or that cannot be easily carried away by the drains and pumping machinery to be provided for that purpose.

It appears, then, to be generally acknowledged that the only place where a submarine tunnel can be made, with a due regard to safety and economy, is through the grey chalk which stretches across the straits between Dover and Calais, and this being admitted, it only remains to show the cost of, and the time required for, the construction of a tunnel of such dimensions and length as to be practically available for general traffic.

First, as to time. The application of the machine for tunnelling through chalk or any soft strata, invented by Mr. Brunton, a model of which is on the table, will so reduce the time required for the excavation of the tunnel between Dover and Calais, that the period for the completion of the 22 miles may be determined almost to a certainty. At Snodland, near Maidstone, where it has been tried, a heading of 7 feet in diameter was driven at the rate of one yard per hour. This rate, supposing the work to be begun on both sides of the Channel, would require only two years to drive a driftway from 7 to 9 feet in diameter across the Channel, but allowing for the delays and casualties which always occur in works of such magnitude, we may safely say it would be easily completed in 2½ years.

Mr. Brunton will set the model machine at work and explain its operation. I will only add that the large machine has been fairly tested, and that the simplicity of its arrangement affords the best guarantee of its successful application to working through a soft, plastic material like the lower or grey chalk. The action of the machine is twofold. It chips away the material from the face of the chalk by an unceasing operation, and it collects the debris produced, deposits it on a band, and finally delivers it into the waggons which are to convey it away. The manner in which this is done will be understood by reference to the diagrams, &c., on the wall and by the examination of the working model on the table.

With such a machine the cost of the excavation of the driftway may be accurately estimated. The cost of the tunnelling machines, the air-pumps and pumping engines for drainage and for raising the chalk as excavated, can be easily determined. The hand labour to be employed is also capable of accurate estimate, and would be limited in

amount, as the tunnelling machinery would be worked by compressed air, which, whilst driving the machine, would also ventilate the driftway; and the charge for interest on capital and for management during construction can be fixed and limited.

The driftway being completed, the cost and time required for its enlargement to the size of a railway tunnel could also be as easily estimated; and it may be assumed that should the driftway be driven successfully one or two miles under the sea, the enlargement might be begun without waiting for its completion across the Channel.

If this course be pursued, the entire work may be completed in five or six years, and at a cost of from eight or ten millions of money; but until the driftway be carried a certain distance under the sea, it is almost impossible to give more than a general idea of the time which would be occupied in completing the work, or the expenditure it would involve.

A diagram on the wall will give a better idea of the tunnel than any description. The shafts on each shore will be sunk to the depth of 450 feet below high water mark. From the bottom of the shaft driftways will be driven for the drainage of the works whilst in progress, and for its permanent drainage after completion.

The tunnel will commence 200 feet above this driftway, and will be driven at an inclination of 1 foot in 80 to the junction with the drainage driftway, and then at a gradient of 1 to 2,640 to the centre of the straits, where the tunnel from the English shore will meet that driven exactly in the same manner from the French shore, and being united with it, will complete the submarine railway under the Channel. The drainage will be from the centre of the tunnel to either end.

At present, I have only referred to ventilation during construction, respecting which so long as the excavating power is obtained by the use of compressed air, there is no difficulty. The results obtained during the construction of the Mont Cenis and St. Gothard Tunnels are conclusive on this point. But for the ventilation after completion I will confine myself to the statement of our distinguished engineers, that there can be no difficulty in obtaining by mechanical means a steady current of air through the tunnel at all times, quite sufficient to maintain the purity of the atmosphere. The exact method by which this will be accomplished need not be stated at present, it is sufficient to know that there is a general agreement of opinion by the English and French engineers as to the facility with which perfect ventilation can be maintained.

Having thus shown the period of time which would most probably be required to complete this great work, I must next consider the income likely to be derived from the investment of £10,00,0000 of capital—the maximum estimate—in the construction of this submarine communication between England and the Continent. It must, however, be remembered that this estimate is the very highest possible.

The basis of any calculation must be the present traffic of passengers and merchandise. This being established, we must add the normal increase which invariably follows the substitution of railway accommodation for any other mode of locomotion, and then estimate that to be attracted by the rapidity, certainty, cheapness, and comfort which this line of railway will afford over all other routes of communication between England and Europe.

The existing traffic is very large. It increases annuallyat the rate of about 5 per cent. From Dover and Calais, Folkestone and Boulogne, Southampton and Havre, Newhaven and Dieppe, and from London to Boulogne, it may be safely estimated that 450,000 persons pass annually to and from the Continent and England.

To this must be added a large number who will use this submarine line, now travelling to and fro between England and Ostend, Dunkirk, Antwerp, and Rotterdam, but who would be brought by the existing railways, viâ the Channel Tunnel, direct to London without change of carriage, and with a great saving of time and fatigue. The present traffic by these routes, the greater part of which will probably pass through the tunnel, would raise the traffic to at least 500,000 persons per annum.

This number may be further increased by the annual addition which always takes place when increased facilities—economy of time and money, with greatly reduced fatigue—are afforded for travelling.

It cannot be an over-estimate to assume that there would be an immediate and very large increase of traffic under such circumstances. But what would be the amount of this increase were there no sea passage, no sea sickness, no delays from bad weather, by which an ordinary voyage of $1\frac{3}{4}$ or 2 hours is not unfrequently extended to 3 or 4 hours, or even a longer time—no waiting for tides, none of the trouble, expense, and annoyance occasioned by the trans-shipment of luggage, and its not unfrequent temporary loss and injury in its trans-shipment, first from the railway to the boat, and then from the steamboat to the railway, and especially if—that which perhaps makes this sea passage more obnoxious than anything else to ladies—the want of comfort and reasonable accommodation on board the boats employed in conveying passengers across the Channel—were all exchanged for a comfortable railway carriage, in which passengers would be carried from London to Paris in almost as short a time as they now reach Calais or Boulogne.

It is well known that the establishment of railway communication, even where the traffic has previously been carried in well-appointed coaches, has enormously increased the number of passengers. Perhaps the most striking illustration of this is to be found in the records of the first establishment of the Liverpool and Manchester Railway, or more recently the increase of traffic between London and Brighton. The coaches running were among the best-appointed and fastest in the kingdom, but directly these railways were opened, the passenger traffic trebled, and in a few years the numbers in both instances were to be counted by millions rather than by thousands.

Again, look at the 600,000,000 of passengers now carried annually by the railways, and compare this number with any estimate which can be formed of the comparatively few who travelled by coaches. Apply, then, the result of this experience to the

Channel Tunnel, and we have not only the increase of speed to induce travelling—the railway against the coach—but comfortable, luxurious, and economical travelling to place against the present system, which can only be designated as the most uncomfortable possible, uncertain in its duration, and very expensive; and besides this, we have the population of Europe rapidly advancing in wealth at one end of the tunnel, and the greatest and richest country in the world at the other, the intercourse between them being materially restricted by the inconveniences to which travellers are obliged to submit in crossing the Straits of Dover. In view, then, of the substitution of railway accommodation as against the discomfort of steamboats, drawing to it as it would, a large proportion of the passengers from more distant ports, the increase in the course of a very short period of time upon the present traffic cannot be estimated at less than that which has taken place everywhere when improved means of locomotion have been introduced, or three-fold on the existing traffic.

This will give an aggregate number of 2,000,000 of 1st, 2nd, and 3rd class passengers who will pass direct between London, the central point to which all the great railways of England converge, and the great cities of the Continent, with the minimum amount of inconvenience, for the carriages will run to and from England to the European cities and centres of attraction without any change. But even these advantages, great as they will be to the public, are comparatively of little importance compared with the advantages which will be afforded for the transmission of valuable merchandise between England and the Continent. The time occupied in its carriage from London to Boulogne, Dieppe, and Havre, and from thence to Paris and Brussels, cannot be estimated at less than eight or nine days. By far the greater portion of this valuable merchandise is subject to injury, and it is frequently delayed and injured by bad weather. By the Channel Tunnel route, merchandise may be loaded in Manchester or other manufacturing towns and arrive in the same truck at its destination within 24 hours of departure, free from risk of damage and all the charges incidental to the numerous changes in the mode of conveyance to which it is now necessarily exposed. The quantity of merchandise shipped is shown by the large amount of tonnage—1,918,280 tons—employed between France and our southern ports, Ramsgate, Deal, Dover, Folkestone, Newhaven, Shoreham, Littlehampton, Southampton, and London.

The imports from France are £41,780,000, and the exports to France £28,290,000 annually, a very large proportion of which consists of valuable raw materials and manufactures, in the transit of which time, safety, and freedom from injury are of greater importance than the difference between the lower cost of sea transit and the higher railway rates.

This is practically proved by the greater proportion which the goods traffic on our trunk railways bears to the passenger traffic, 41·87 per cent. of the total receipts being derived from passengers and 54·50 per cent. from goods, most of which were formerly carried by sea or canal, and it is not at all too much to estimate that the same proportion will hold good in the traffic through the tunnel, as the advantages offered for the transit of merchandise will be proportionably greater, and the risks of every kind materially less, than by the present routes.

Believing, then, that the data I have given afford a fair means of estimating the revenue to be derived from the Channel Tunnel Railway, I will endeavour to reduce them to figures, and to show the result with reference to the capital required.

First, from passengers of all kinds, 1st, 2nd, and 3rd, at, say 2,000,000, or four times the present number, at an average fare of 8s. 6d. each, every passsenger being carried the entire length of the railway ..	£850,000
Next, merchandise—assuming the quantity now shipped to and from Calais to be half of that which will pass by the tunnel instead of being shipped from the various Channel shipping ports of either country, or 1,200,000 tons at 2d. per ton per mile for 30 miles, or 5s. per ton, the receipts will be	300,000
Mails, parcels, telegraphs, &c.	50,000
Total	£1,200,000
Less 40 per cent. working expenses. There will be no stations or junctions in the 30 miles, no exposure to weather, and very reduced wear and tear, &c...............	468,000
Net revenue	£732,000

Or on £10,000,000—$7\frac{1}{3}$ per cent.

It is difficult to make a sufficiently large estimate of the passenger traffic. The traffic passing from north to south over our trunk lines, great as it is, forms no basis upon which to make an accurate calculation. We know that 500,000 persons cross the Channel annually from the nearest ports only, but what would be the increase of this traffic were the sea voyage dispensed with it is impossible to do more than guess. The effect on foreigners, who are more susceptible to the "*Mal de mer*" than we are, would be very great; there would be a rush of them to visit England, and to a very important extent our pleasure seekers abroad would be materially increased could they enter a carriage at Cannon-street, Charing-cross, or Victoria, and be sure of arriving in Paris or Brussels in six hours without sea sickness. The extent to which this operates is shown by the larger number of passengers that prefer the Dover and Calais route to that from Folkestone and Boulogne; the shorter sea passage and the longer and more expensive railway journey being preferred in the proportion of 15 to 11 to the longer sea passage and the shorter and cheaper railway journey. From this it is fair to suppose that a still shorter journey, without any change of carriage, or the disagreeable sea passage, would be preferred by almost everyone. An accurate estimate of the effect of such altered and novel conditions upon travellers, whether for business or pleasure, is almost impossible. Everyone must form his own opinion upon it, which will, no doubt, be influenced by his personal sensations in crossing. Independently of the saving of time and inconvenience, the diminished cost of the journey will be very considerable. All the minor charges at the places of embarkation and debarkation, on board the boats, refreshments, and the conveyance of luggage to and from the railway

and steamboats, will be saved, and these now form a large addition to the steamboat fare of 8s. 6d.

These views are strongly entertained in France, where the interest taken in the progress of this great international work is more clearly demonstrated than in England. Subscriptions are being raised, and a small company is being formed to commence the excavation of the experimental driftway near Calais, and complaints are made of the slow progress we are making on this side of the water.

The project of the submarine connection between the two countries was approved by the late Emperor, and the plans of the English committee were referred by him in 1868 to a Commission appointed "to examine a project for a submarine communication between France and England." This commission reported:—

1st. That there was every reason to believe that the chalk formation extends under the Channel between Dover and Calais, and that—

"The thickness of the grey chalk gives a certain latitude for the maintenance of the tunnel in the same direction, even where the level of the bed of the sea may be subject to some undulation; and they believe that the existence of any great fracture in the chalk is very improbable."

2nd. As to ventilation, it was admitted that there was no difficulty during construction, and the Commissioners state that—

"The execution of the preparatory works, as set forth in the project of the committee, does not appear to be liable to greater difficulties than those which are ordinarily incurred in underground work." And they add—"respecting the ventilation of the permanent work, that it is evident it will present no special difficulty, but on the contrary it will be benefitted by the experiments of the trial works."

3rd. As to whether the advantages of the development of the traffic and its economical and political interests were sufficient to justify the cost of construction, the Commissioners report that the estimated cost was considered, but in the absence of precise information, the Commission adopted as sufficient the estimates of the English engineers. The report then continues—

"That England is by far the best customer of France, that the produce of the French soil contributes largely to feed her people, and that the establishment of a direct communication between the French and English railways would give a new impulse to our exportations and stimulate our agriculture."

And further—

"That, putting an end to the *ennui*, fatigue, and delay inseparable from crossing the sea would considerably increase the number of travellers across the straits, and would lead passengers going to England to come by way of the North of France, from Italy, Switzerland, Germany, Belgium, and even Holland."

To these considerations they added those of another kind, viz., the advantages

"Of strengthening the bond which unite us to an industrious, Conservative, and wise people, whose alliance with France constitutes a valuable pledge for the peace of the world."

The revolution in France stopped for a time any public action on the part of the Commission, particularly as M. Thiers was not at all friendly to the undertaking. Little, therefore, was done until quite recently, when an Enquête, composed of the Prefect of the Department, several deputies, and others interested in the commerce of Calais and Boulogne, was appointed to meet in the department of the Pas de Calais, to enquire into the feasibility of the plans proposed, and the utility of the project, and the Commission, after hearing evidence from various parties, reported that—

"Considering the establishment of a railway which would unite the railway systems of England with those of France, and consequently with the whole continent, presents advantages for the interests of commerce, and for those of civilisation, evidence of which need not be demonstrated:—The Commission is of opinion it should declare of public utility the establishment of a submarine railway between England and France."

It is, then, most satisfactory to find that the plans of Sir John Hawkshaw and Mr. Brunlees, and the site they selected for the tunnel, adopted as it has been by their distinguished colleagues, M. Talabot, M. Chevalier, and M. Thomè de Gamon, were approved by the Commission of French engineers appointed by the late Emperor to enquire into its utility and feasibility; and also by the members of the Enquête, nominated by the present government, all of whom, interested in the commercial prosperity of the department of the Pas de Calais, desire to promote the success of the undertaking.

At the same time as the Commission for the Enquête in the Pas de Calais was issued, the Chambers of Commerce in France were requested to report their opinions to the Minister upon the desirability of the construction of a submarine communication between France and England. I regret I am not able to give a summary of these reports, but I believe I am correct in stating that, with one exception, they were decidedly in favour of the prosecution of the work on mercantile and national grounds.

Let us now proceed to consider how this great work can be accomplished.

There are two distinct steps to be taken. The first, to raise sufficient capital to make the driftway, to test the practicability of the greater work, and the second, when this is proved to be practicable, both on the score of expense and the time required for its completion, to find capital for the enlargement of the driftway into a Submarine Railway Tunnel.

To accomplish the first, or preliminary portion of the work, £160,000 must be raised. Half of this should be found by France and other European states, the other half in England.

So confident do I feel that this great national work will be accomplished, that it is impossible for me to doubt if a proper appeal be made to the public, based upon an appropriation of a certain preferential interest in the larger capital when raised, say—by securing to the first contributors four shares in the larger company for each share subscribed towards the £160,000 required for the preliminary works, that the whole sum will soon be provided.

To remove the great national obstacle which restricts the intercourse of this country with Europe —which imposes a heavy charge upon every passenger and ton of goods—which causes delays and difficulties almost innumerable in every transaction, must be a sufficient inducement to secure the subscription of the first £160,000 for the trial works. And when we think of the large amount of capital —nearly £650,000,000—invested in railways in England, and that above 450,000,000 of passengers and 180,000,000 tons of goods are carried by them annually, is it possible to doubt that when you

provide the same facilities for travelling between the 30,000,000 of the English population and the 150,000,000 of continental population, the traffic will be limited to two or three hundred thousand people and a few thousand tons of goods and merchandise annually?

If, then, £650,000,000 have been raised for railways without any assistance from Government, because the population have required the conveniences and facilities its expenditure affords, is it being too sanguine to expect that £8,000,000, or even £10,000,000 will be forthcoming to perfect the present mode of transit across the Channel?

These figures apply only to this country; the same results have attended the establishment of improved facilities for locomotion abroad—indeed, everywhere; let the ordinary mode of travelling be improved, quickened, and cheapened, made punctual, and more comfortable, and the number of persons travelling rapidly increases beyond the expectations of everyone.

It is proposed, then, to establish in France and England companies to raise £160,000, and to begin the works on both sides at once; and so soon as the driftway is bored a sufficient distance under the sea to prove the accuracy of the calculations of the English and French engineers, and the practicability of the work, to take measures to bring this great undertaking before the various governments and capitals interested it its success, with a view to the ultimate provision of capital for its completion. The following contributions were made towards the St. Gotbard Tunnel:— Italy subscribed 45,000,000 francs, Switerland 20,000,000, and Germany 20,000,000, leaving 115,000,000 for general subscription.

Only one further portion of the subject remains to be considered, viz., the objections which may be raised by rival schemes and on national and political grounds. Upon the merits of rival plans I will not enter, but to those who think our national prosperity can be affected by any measure which will remove obstacles that impede the communication between Europe and this country, and to those who think our national safety can be lessened by the construction of a submarine tunnel between Dover and Calais, which can be closed on either side in a few minutes, I can offer no arguments which will induce them to change their opinions, and here in the great room of the Society of Arts I will not stop to consider their prejudices or their ignorance.

There may be differences of opinion as to the commercial result of the enterprise, but those who have lived to see prejudices and prophecies of failure dispelled, and political, social, and commercial successes displace them, whether in free trade, ocean steam navigation, electric telegraphy, or penny postage, will not be influenced by such anticipations; they will rely on great principles, the application of which invariably shows that everything which increases our facilities of communication with the world beyond these islands, tends to England's prosperity and greatness, and that all that is required to secure their adoption, is the fullest and freest inquiry into their merits.

I trust then, that the members of the Society of Arts will not fail to see the national importance of this great undertaking, the details of which I have endeavoured this evening to place before them.

Description of Mr. J. D. Brunton's Tunnelling Machine.*

Fig. 1 is a side elevation of the machine, partly in section; Fig. 2 is a corresponding end view of the same, also partly in section, representing the working or cutting end of the machine and part of the driving gear; Fig. 3 is a view of the opposite end of the machine; Fig. 4 is a general plan; and Fig. 4A is a detail face view of one of the cutter chucks, with one of the sockets or holders. *a* is a hollow shaft resting on and revolving in the bearing *c*, *c*, of the carriage C, on which the entire machine is supported, and upon which it is carried forward; *b* is the crosshead cast or keyed upon the shaft *a*. At its extremities the crosshead carries the arbors *d*, *d*, upon which revolve the cutter chucks, *e*, *e*. That portion of the arbor on which the chuck rotates is eccentric with the portion which is contained in the crosshead; *f*, *f*, are worm wheels fixed upon the arbors *d*, *d*; and *g*, *g*, are worms working into them. By means of the worms and wheels, and the eccentricity in the arbor as already described, the chuck can be moved a small distance outward or inward, so as to compensate for any wear of the cutters, by which the diameter of the pit, tunnel, or gallery formed might be diminished. The axis of the shaft *a* may be called the "central axis," and the axes of those parts of the arbors *d*, *d*, on which the chucks rotate are designated the "planetary axes," and are equidistant from the central axis. The chuck *e* and the toothed wheel *h* are cast in one piece. *i*, *i* are the cutters, of which six are attached to each chuck; *j*, *j* are the pivots or journals on which they are at liberty freely to rotate; *k*, *k* are the bolts holding them upon the pivots and in the sockets, k^1, k^1. These sockets are pieces distinct from the cutter chucks, and are fixed to them by bolts and nuts or screws, and are formed with slots to allow of the sockets being placed more distant from the centre as the diameters of the cutters are reduced by wear.

The angle at which the cutters are set with the plane of the surface of the rock or other substance to be cut may be varied, and should be such as to enable the cutters most effectively to act. The central spur wheel *l* gears into the wheels cast upon the back of the cutter chucks *e*, *e*, and is keyed upon a central shaft *m*, concentric with and passing along the interior of the hollow shaft *a*. The shaft *m* revolves in proper bearings provided at each end of the shaft *a*, and upon its outer extremity there is keyed a bevel wheel *n*, into which gears another bevel wheel *o*, which receives its motion from the prime mover by a wire rope and pulley *p*, or direct from the engine, if compressed air is used as the motive power. Upon the hollow shaft *a* is keyed a worm wheel *q*, into which gears a worm *r*, which causes the wheel *q* and the shaft *a* to revolve by means of the pulley *s*, and the bevel wheel and pinion T, *t*. The pulley *s* is driven by a belt from the pulley o^1 upon the shaft O. It will be seen that the "planetary motion" of the cutters is effected by the revolution of the shaft *m*, and that the motion of the planetary axes round the central axis (or "orbital motion") is caused by the revolution of the shaft *a*. The relative speed of these shafts will regulate the "feed" supplied to each cutter, or in other words the advance which each cutter makes beyond that which preceded it.

Upon the external circumference of the hollow shaft *a* is formed a screw, upon which is placed a nut, having a toothed wheel w^1 cast upon it; the outer circumference of the nut is turned to receive a collar. The nut and collar W can be held together by means of a key, so that the one cannot revolve without the other. Upon W are cast two or more lugs, *z*, *z*, which carry arms, Z; the outer ends of these arms are furnished with a screw and foot-plate. By means of the screws these plates are brought into contact with the internal surface of the tunnel or gallery; and the effect of the screw on the shaft *a* when the machine is in operation is to jam firmly the arms Z, Z, in the tunnel or gallery, and so to constitute the nut, with its collar W, a fulcrum or fixed point from which the whole machine is forced forward against the face of the tunnel by the revolution of the shaft *a*. When *a* has been screwed through the nut to the end of the thread upon it, the machine is stopped, the key is slackened, and by means of handles, and the pinions working into the wheel w^1 on the nut, the nut is screwed forward again to the inner end of the thread upon the shaft *a*, carrying with it the collar W, and arms Z, Z. A set screw working in a groove in the circumference of the nut prevents the collar W from

* See accompanying diagrams.

slipping off the nut, at the same time that (in the slackened state of the key) it allows the nut to revolve without carrying the collar and its arms round with it. The combined orbital and planetary motions, as described, together with the forward motion produced by the screw acting against the fixed nut, cause the cutters to cut the face of the tunnel or gallery into a spiral form, having its pitch or angle of progress equal to the pitch of the thread upon the shaft a.

The cutters i, i, are discs of steel or other suitable substance, and may be from 10 in. to 20 in. diameter, and from $\frac{1}{2}$ in. to 1 in. thick, according to the size of the machine and nature of the rock or ground operated upon. The whole circumference of their periphery is formed into a cutting edge, and they are placed at right angles to their planes upon the pivots or journals j, j, which, with the cutters, rotate freely in the socket or holders k^1, k^1. The radius of the circle described by the edge of the cutters in their action upon the rock should be about one-half of the radius of the cylindrical tunnel or gallery to be formed, so that in every orbital revolution the cutters shall pass over and cut from the entire, or almost the entire, face of the end.

C, C¹ indicate the carriage, which consists of the fore part C, the back part C¹, and the sidebeams D, D, connecting the fore and back parts; E, E, are double-flanged wheels, rolling on two pairs of rails F, F. Uprights on the fore and back carriage support rollers G, G, which are set firmly against the roof of the tunnel or gallery, and contribute to keep the machine steadily in a central position.

By the divergence of the centre lines of the arbors d, d, from the plane of the central axis, provision is made for the clearance of the cutters from the face of the rock during that part of their revolution in which they are not cutting.

For the purpose of removing the debris a circular drum A, Figs. 5, 6, with diagonal scrapes is mounted on the shaft a, between the fore carriage and the crosshead b, and is made to revolve by gearing not shown in the Figures. These scrapers move close against a vertical plate C, which prevents the stuff collected by them from escaping till it is carried up to the point of overfall b, when it falls over the edge of the plate down the shoot D on to the delivery band B, Figs. 5, 6, 7, which is driven by a belt a from the clip pulley shaft. By this the stuff is received, carried to the rear of the Machine, and there tipped into the wagons. This band is supported by rollers in a frame of wood F; it is made of strong painted canvas, with lags or slats of wood on its under side to give lateral rigidity.

DISCUSSION.

Sir John Hawkshaw, F.R.S., said he did not think, as an engineer, he could add much to the paper that had been read. Mr. Hawes had stated the commercial views, and he had had something to do with the commercial aspect of great undertakings. With regard to this project, it might be well to state that the cost, which had been put at 10 millions, for the construction of the railway beneath the Channel, though it appeared a large sum, really embraced about 10 miles of railway on each side. In order to get to the tunnel, the railway would have to be commenced in the town of Dover, where a very large station would have to be made, and to run from point to point along the coast till it turned down near to the South Foreland. When it emerged on the other side on the French coast, several miles of railway would also have to be made, to join it with the Northern of France line, so as to be able to get to Paris and Belgium. In fact, the capital of 10 millions would be for about 31 miles of railway in all. That would make the railway cost £300,000 per mile, about one-third the cost of the Metropolitan Railway, and about one-sixth the cost of the railway from Charing-cross to Cannon-street and London Bridge, which he had himself constructed, so that it was not so formidable as it at first sight appeared. He did not believe when people were fully convinced of the practicability of the scheme, supposing they came to the conclusion to construct the railway, that the question of expense would stop it. The attempt to put in figures the profits to be derived by connecting all the European lines with all the railway system in this country up to John o' Groat's would be like all railway questions—whatever figures were put down, the calculation would be greatly exceeded. Whatever mistakes had been made with regard to railways in this country, there had never as yet been any mistake as to the traffic, for it had always exceeded the most sanguine calculations and it was still increasing in amount upon English railways. With reference to the engineering point of view, although it would no doubt surprise many present, he believed the greatest difficulty in constructing the railway would be, not under the tunnel, but in the white chalk just under the shore. He had had some experience of the formation of this chalk, as he was at the present time completing a tunnel five miles in length at Brighton, which ran along the shore to Portobello about 20 feet underneath the level of the sea at one end, and five feet at the other, and the higher they got in the chalk the more difficult it was. If the tunnel could be sunk lower it would be perfectly immaterial what was above it. Some of their geological friends, Mr. Prestwich in particular, said if they could go down to the Palæozoic rocks they would be perfectly safe, and he quite agreed the lower they went the safer they would be; but if they went lower, they would have further to go before they could come up, and this must be taken into consideration. The tunnel would be nowhere deeper than 200 feet under the bottom of the sea, which would be quite sufficient for all purposes. With regard to percolation through homogeneous chalk, that was perfectly immaterial for engineering purposes, because no engineer who knew anything of it would trouble about that. With regard to permeation through slight fissures, they might be filled up with a material more porous than homogeneous chalk, in which case they would get a small quantity of water, as he did at Brighton, but it need not stop the works. Nothing would interfere with the works unless a fisssure were met with, extending 200 feet down, such as he did not believe existed, for if such fissures had ever existed they were probably filled up long ago. He thought there was a reasonable prospect of the tunnel being undertaken. It was proposed to sink two driftways in order to give confidence to people who doubted the practicability of the scheme. There would be no difficulty in providing artificial ventilation, if necessary, which he thought it would be, at a very moderate cost. The tunnel would be lined with brickwork and cement, three feet six inches in thickness, and there would be a double line of railway.

Mr. J. F. Bateman, F.R.S., said he was quite aware it might be supposed he was an interested party in objecting to the scheme, but such was not the case. It was true that, some years ago, he proposed a mode of crossing the Channel, which he believed was the only reasonable and feasible mode by which it could be done, but at the present price of iron, and at his time of life, he did not intend to prosecute his scheme. He was quite ready to concur in almost everything which had been said as to the commercial aspect, and the probable large profits which would be derived from connecting England with the Continent, by a safe, easy, and comfortable mode of crossing the Straits of Dover, and that it would be of the greatest possible benefit to England and the Continent; but as an engineer and a geologist he saw many difficulties in the way of carrying out the project. The section on the wall of the proposed tunnel showed two bore holes—one on the English side and the other on the French—and a horizontal line right across; but who could say there was a horizontal stratum for a distance of twenty-four miles without a single dislocation? And if one were met with, no engineering skill or contrivance could overcome it. He was quite sure there was no such horizontal line in a part of the world which had been subject to so many dislocations. He had no wish to oppose the making of a trial drift, and certainly this ought to be done before anything on a large scale was attempted. He should be glad to see the scheme succeed; but such a project was much too large, and in-

volved questions of too great magnitude, both of money and risk to human life, to be undertaken unless there was always a certainty that it would be carried through successfully. He noticed that Mr. Hawes spoke of Mr. Prestwich by name when he referred to him as supporting this scheme, but only as late president of the Geological Society, when he said something to the contrary effect, which was rather curious. There was certainly no one better fitted to form a correct opinion in this question of the geological stratification than Mr. Prestwich, and a paper which he read not long ago before the Institution of Civil Engineers was a master piece of inferential reasoning, but it did not amount to more, and though that might do very well for geologists, engineers wanted something more certain before commencing opperations. The fact that rocks rose to the surface of the mid-channel bed showed it was almost impossible that the strata were not in an unconformable position, as might be expected, and that there had been great dislocations over which the water now flowed. These straits flowed between England and the Continent with a maximum depth of 200 feet, the average depth being 100 feet, and all observant geologists knew that almost every valley in this country was merely the longitudinal dislocation of strata, over which water had flowed and scooped out the superincumbent soil, and that nearly all rivers in the same way followed the line of geological faults. Inferentially, therefore, it would appear that these straits, which were merely a large river, also followed a dislocation of strata; and it would necessarily follow that the proposed tunnel would very likely meet with fissures of such a character that no engineering skill could surmount. Mr. Hawes had exhibited a piece of chalk which had been five days under water, but there was no pressure there; if there had been, he ventured to say the whole of the water would have been forced through the chalk. With regard to the mines in Cumberland, the greatest distance they had travelled under the sea was four miles, and the least depth below the sea bed 660 feet. At the Botallack mines also they had not gone very far, bnt still they continually had to plug out the sea; an operation which would be rather difficult in a large railway tunnel, under a pressure of 400 feet of water. In the Botallack mine also they had a silurian or other hard rock, which was very different to the grey soluble chalk. If anything occurred in the middle of the tunnel, it would be 10 or 11 miles from the shaft, or 15 from the end of the tunnel. Altogether, therefore, he thought there was too much uncertainty about it to justify the undertaking of a work of such magnitude at present. He should be very glad if, as Captain Tyler had suggested, it were possible to go from London to Calcutta dryshod, crossing the Channel by a tunnel, the Bosphorus by a bridge, and the rest of the journey by land, but he feared the time had not yet arrived for it. He honoured gentlemen who came forward and were willing to risk their money and reputation in such an undertaking, but he had more hopes for the improvement of the steam vessels to ameliorate the miseries of the Channel passage. He had had great experience in tunnelling, in which there was no difficulty of any kind but that arising from water, but where that occurred, or material which could be carried by water, such as running sand or chalk, the difficulties were sometimes found to be insurmountable. In conclusion, he repeated that his great objection was the probable presence of fissures and dislocations, and therefore, while he should be willing to contribute to an experimental drift being made, he would not venture to go farther.

Mr. R. Rawlinson, C.B., said he had had something to do with engineering and something to do with geology, and might therefore say a word on this important subject. The map on the wall was a mere office copy or diagram made to show the proposed tunnel, and not the geology of the Channel or the fissures which no doubt existed. With regard to the condition of the stratification of the bed of the sea, he did not believe England had been forcibly disrupted from the Continent, but thought the intervening channel was owing to a denudation of the chalk, which had been at one time continuous and washed by the currents of the ocean, that the top and loose portion had long since gone, and that the remaining portion, whether white or grey, had been then exposed to the superincumbent pressure of the ocean, and had become consolidated incalculable ages ago. With regard to the difficulty of working in the white chalk below the water line, the whole land received the soft water evaporated from the ocean, and if it were liable to fissures, like millstone grit, mountain lime stone, and some of the beds of oolite, the water percolating down would get into the white chalk, and coming in contact with the lime, melt it, and carry it it down to the ocean; this caused fissures, but that fissuring process did not go on very much below the level of the ocean, as there was not room for the flowing action of the water. He anticipated there would be some trouble in keeping out the water, but not more than Sir John Hawkshaw was aware of, or so much probably as in the Brighton culvert, which ran parallel to the sea, whilst this would be running in a cross section. Supposing there were originally a few fissures, he was quite satisfied they were sealed up long ago, and therefore that there was no danger of any influx of water more than the engineers would be able to manage. In making the Thames Tunnel, Mr. Brunel had found that he had to make good the work behind him as he advanced, which he did by means of a shield. He recollected visiting the tunnel after they had passed the worst portion, and if he recollected, they had driven the tunnel by means of this shield through thirty or forty feet of liquid mud, the tunnel being made good in single brick lengths, without any tubings, as the work advanced. If fissures were met with in the Channel, a shield might be run forward, and so the difficulty would be overcome. With regard to the questions of time, construction, ventilation, and pecuniary returns, he would not enter into them, but he believed the ventilation might easily be accomplished, especially if means were taken to utilise the motion of the trains in passing through the tunnel to create a constant current of air, which he had no doubt might be done. When the tunnel was completed, he believed the wonder would be that there was so small a quantity of water to pump out.

Mr. Lawrence said it had occurred to him that it would be well if preliminary trials could be made of the geological formation of the Channel throughout its whole length, by making 24 or 25 borings a mile apart, so as to see what the actual section was. If that were satisfactory, it would be an encouragement to further proceedings.

Mr. T. Eyton Jones, though not an engineer, had taken a great deal of interest in this subject. and some years ago obtained, through Sir W. W. Wynn, an introduction to the Emperor of the French for a gentleman who had a plan for making a tunnel under the Channel. The consequence was that an inquiry was ordered into the subject, Sir J. Hawkshaw's assistance being obtained; but the grand question at that time seemed to be as to ventilation. They were told, however, on high authority, that ventilation could easily be secured. The only tunnel in which this had to be dealt with on a large scale was the Mont Cenis, and although that was 3,800 feet above the level of the sea, it appeared, from a paper recently read by Mr. Sopwith before the Institute of Mining Engineers, that the ventilation was far from satisfactory, and though not bad enough to stop the traffic, it rendered the work of watchmen and plate-layers at times almost intolerable. In order to remedy this, a pipe 8 inches in diameter was being introduced, and force pumps at the Italian end. This occurred notwithstanding the measures which had been taken for securing ventilation, and Major Beaumont, who

took part in the discussion following Mr. Sopwith's paper, said he had been through the tunnel on an engine, and though the driver said it was a remarkably fine day, he was much distressed at times on account of the impure air. He thought stop-cocks would obviate the difficulty, though they would not answer if there were constant traffic. Now, it appeared to him that if a large tunnel were made beneath the Channel, it ought to be so ventilated that trains could pass constantly. Major Beaumont suggested that the difficulty could be got over in a long tunnel by dividing it vertically, so that trains might constantly run in one direction in each division, and then artificial ventilation could easily be added if required. Another engineer at the same meeting stated that ventilation was much more difficult, and a much stronger current was required when trains passed each way. Now here was a tunnel four times the length of the Mont Cenis, and without the advantages of its altitude, and looking to all the circumstances, he thought it highly necessary that this ventilation question should be thoroughly and satisfactorily settled before any steps were taken. The plan proposed by Mr. Low, of Wrexham, the gentleman to whom he had before alluded, was to sink two shafts, 12 feet in diameter, and 200 feet in depth, and 100 feet or less apart, in the line of the proposed tunnels, and ventilate by an up and down shaft, as in the case of a colliery, with large fires, and steam-engines of 700 horse-power, to keep a current of air going through the tunnel at the rate of ten miles an hour. He also suggested that the tunnel should rise 3 ft. per mile to a point in the middle, so that if any leakage took place the water would run back to the ends, where it might be pumped out. An eminent French engineer, who inquired into this scheme, was quite satisfied with it, and brought it before a Commission, many of the members of which expressed themselves very warmly in its favour. The idea was that it would be better to have a double driftway than one large tunnel, but with means of communication between the two; then, in case of accident to one, the traffic could be continued by means of the other. He thought it only fair, as Mr. Low had worked at this subject so long ago, that his name should be mentioned in connection with it.

Mr. J. Aird remarked that the main question to be decided was in his opinion the practicability of the scheme, not who had first proposed it. He did not think Mr. Lawrence's suggestion to put down borings at all a good one, for in the first place it would be exceedingly difficult to do, and secondly, the borings must not be too near the line of the proposed tunnel, or they would be very detrimental to it. With regard to the possibility of driving a tunnel, his experience, which entitled him to speak with some authority on such a question, led him to believe that it could be accomplished, not without difficulty, certainly with no more difficulties than could readily be overcome if reasonable precautions were taken. The greatest difficulty he had no doubt would be the white chalk, or where it overlapped the grey; but his experience led him to believe that the water which was often found in chalk came there from the land, and if you went to a greater depth, as was here proposed, there would be no water beyond a little simple percolation, which could readily be got rid of. As to the cutting machinery, though he would not say he disapproved of it, he thought it required some hesitation before using it in a work of this description, where if any mishap occurred the great thing was to be able to deal with it immediately, and not to have anything like obstruction in your way, and to keep a borer pushed forward a little way a-head, so that you might not be taken by surprise. He feared that it might lead to serious disaster in the case of an accident to have the tunnel blocked up by machinery. In conclusion, he thought Mr. Hawes in his calculation had left out some important items of advantage to be gained by such a tunnel, viz., the enormous increase in the value of railway property both on this side and in France. That would probably go a great way towards the expense even of a work of this magnitude.

Mr. Brunton thought some error might arise from what had been said with regard to the pressure of the water at great depths; the fact was that at great depths, either in a mine or tunnel, where the water found its way by filtration, there was no statical pressure. With a vertical tube 200 ft. in height, filled with water, there would be a considerable statical pressure, but if the tube were filled with powdered chalk, pretty closely rammed together, and the water had to percolate through it, there would be no pressure at all; much less would there be any on the under surface of a bed of chalk which had been consolidated for thousands of years. Unless, therefore, the crevices were very large—and if there were any they would probably be filled up—there would be no statical pressure in the tunnel. With regard to the machine there was a borer attached to the front of it which cut a hole of two or three inches diameter some ten feet ahead of the machine; to that extent, therefore, warning would be given of any water which might be reached.

Mr. Nathanael R. Griffith said he had had some experience as a mining engineer, and had paid great attention to this question. He wished first to correct some doubtless unintentional mistakes of Mr. Bateman with regard to the under-sea collieries at Whitehaven, which he knew very well. The depth beneath the sea was not 660 feet, as had been stated, but 40 fathoms or 240 feet. In the next place, Mr. Bateman seemed to suppose that if any obstructions were met with in the strata, there must of necessity be a large influx of water; now in the Whitehaven collieries they often met with considerable faults, 40 or 50 feet sometimes, but they did not find more water come through there than at other places. The question of ventilation was doubtless a very important one, but he had under his daily charge a length of driftways, much greater than that of the proposed tunnel, and kept them free from the products of respiration, smoke, &c., and also from inflammable gases, under great penalties in case of failure. There was no difficulty with the proper appliances in ventilating for more than 20 miles, but if he were to attempt to drive a single gallery, he could not go 100 yards without firing the mine. They invariably had two driftways parallel to each other connected by "cut-throughs," or "thrillings," so that the fresh air was brought up one driftway to the face, and back along the other; when the drift got a little farther, a new communication was opened, and the former one filled up. This appeared to be Mr. Low's plan, and he thought it the only feasible one for a tunnel of such length. The double driftway could easily be enlarged into a double tunnel, the trains in each tunnel only going in one direction, and thus creating and keeping up a current of air in that direction. If the trains went both ways in the same tunnel, the benefit of the air currents caused by them would be entirely neutralised.

The Chairman, in proposing a vote of thanks to Mr. Hawes for his able paper, said that though he was neither an engineer nor a geologist, he could not avoid the opinion that in pre-Adamite times England and the Continent were united together, and that the idea that the severance was caused simply by the action of water was a most rational one. This idea was strengthened by the position of the tides; at the present moment, the tide from the North Sea and that coming up the English Channel now met near Dungeness, but very probably in earlier times the place of meeting was much nearer the site of the proposed tunnel, and by the constant action of the double tides, the Channel had been worn down to its present dimensions. He did not think any greater difficulties would be encountered now than were met with when the Thames Tunnel was made, which, though only 20 feet below the bed of the river, and made through a very loose soil, had, with the exception of one accident, which was soon repaired, been thoroughly

successful. He believed the three feet of brick in cement, with which it was proposed to line the tunnel, would be amply sufficient to prevent any leakage which might occur through the chalk, and thought the only real difficulty in the enterprise would be the one of money.

The vote of thanks having been carried unanimously,

Mr. Hawes, in reply, said it was very gratifying to find that there was only one friend present who had really taken exception to his plans; and he did not expect to hear from so distinguished an engineer as Mr. Bateman that the only ground of his opposition really resolved itself into one of fear. He was afraid of dislocations, afraid of water, afraid of ventilation; and he did not suggest any means of overcoming the difficulties, but thought these fears would prevent the raising of money. He (Mr. Hawes) thought the word "impossible" had been erased from the dictionary of engineers. He had been connected with this scheme for a long time, and did not believe that any objections were likely to arise which the skill of the professional gentlemen on both sides of the Channel would be unable to overcome. Dislocated chalk was one thing, and solid chalk was another thing altogether; but they believed the tunnel would pass through a bed of solid chalk, with few dislocations, if any.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Roya Albert Hall (east side), Upper Kensington-gore, London W., Major-General Scott, C.B., secretary.]

The Committee for Sanitary Apparatus and Construction held their seventh meeting on Tuesday, the 10th inst., at the Royal Albert-hall, Mr. George Godwin in the chair. There were also present—Mr. Gatliff, Dr. Hardwick, and Dr. George Ross. Captain Clayton, R.E., attended the Committee. The goods received were inspected, and the Committee adjourned until the 24th inst.

The eighth meeting of the Committee for Building Contrivances and Materials was held on the 11th inst., Mr. H. Grissell in the chair. There were also present—Messrs. Bird, Elger, Kirkaldy, and Wyatt. Captain Clayton, R.E., attended the Committee. After inspecting the goods received, the Committee adjourned until the 25th inst.

The ninth meeting of the Ethnological and Geographical Committee was held at the Royal Albert Hall on Friday, the 13th inst., at which Mr. E. Thomas (in the chair), Mr. H. Cole, C.B., Dr. Mouat, Col. Harley, C.B., Major Donnelly, Mr. E. W. Braybrooke, and Mr. G. S. Saunders, secretary, were present. It was agreed that at the next meeting a Sub-Committee should be formed, to superintend the arrangements of objects, and that steps should be taken to procure for exhibition, if possible, the umbrella and arm chair lately received by Her Majesty and the Prince of Wales, from Ashantee.

Most of the foreign paintings have arrived. The collections from Belgium and Munich are specially strong and representative. This year the greater part of the galleries will be occupied by foreign works of art.

The fifth meeting of the Sub-Committee for Civil and Mechanical Engineering was held at the Royal Albert Hall on the 16th inst., Sir John Coode in the chair. There were also present—Messrs. J. F. Bateman, J. Douglass, R. Moreland, Colonel Pasley, R.E., Dr. C. W. Siemens, and Mr. E. Woods. Captain E. G. Clayton, R.E., attended the Commitee. After inspecting the goods received up to date, the Committee adjourned until the 30th March.

It is stated that 25,000 samples of all the Portuguese wines will be exhibited in the vaults of the Albert Hall, in the Foreign Wines Department.

EXHIBITIONS.

THE PROPOSED FRENCH INTERNATIONAL EXHIBITION FOR 1875.

It has been already announced that it is proposed to attempt an International at Paris next year, which originates in private enterprise. Authority has been obtained to form a series of annexes to the Palais de l'Industrie, which would cover the Cour de la Reine and the adjacent avenues.

The *Revue Industrielle*, while supporting the project in the belief that it will have a certain degree of success, regrets to see spreading about secondary exhibitions, too closely approaching each other, in which labours are wasted that might be advantageously utilised when the moment arrives for renewing a great International Exhibition. Public attention, and especially the efforts of exhibitors, are wearied by multiplying these industial expositions. The progress made in the various branches of mechanical construction, and especially in the manufacture of furniture, of clothing, of sugar, paper, &c., proceed, it is true, but much too slowly to give to successive exhibitors their principal element of success—novelty. It requires an interval of ten or fifteen years to bring about important improvements in any industry. In fine arts and sericiculture, on the contrary, frequent exhibitions are an absolute necessity; but in France, the annual salons and the *concours regionaux* or local shows, supply this want.

And what is the time chosen for making an appeal to producers and manufacturers for this new industrial manifestation? Work is suspended in a great number of factories, business is dull, and agriculture has seriously suffered during the last two years. Is it hoped to inspire confidence in the markets and increase orders? Experience has proved that exhibitions facilitate transactions in the time of full activity, but that they have not the power of animating commerce when it is languishing. The managers of this new exhibition should reflect on the disastrous results of the exhibitions of Lyons and Vienna before commencing their problematic operation, to which, however, notwithstanding our misgivings, the *Revue* wishes all success. These are the remarks of the French journalist, who might at least be expected to be favourably disposed towards the project.

HARVESTING CORN IN WET WEATHER.

It may be remembered that six years ago, in 1868, the Society's Gold Medal and a prize of fifty guineas were awarded to Mr. W. A. Gibbs for his essay on a method of "Harvesting Corn in Hot Weather." In that essay the author described an invention of his own for drying hay, straw, &c., by means of a hot blast driven over or through the mass of wet stuff. Since its first introduction to public notice through the aid of the Society, the plan has been extensively tried and experimented upon, and it may be considered a cause of justifiable satisfaction to the members of the Society that yet another addition has been made to the long list of practical appliances brought into general use by its help.

The machine, as first constructed by Mr. Gibbs, and as described in the essay above referred to, was of a very

simple character. A hot blast was driven by a fan through a chamber below the floor of a drying kiln or shed. The upper side of this chamber formed the floor of the shed, and it was perforated with numerous holes, in each of which fitted a short vertical tube or cone. On these tubes stooks of straw might be spitted, or about them the loose hay, &c., strewn. The shed was filled with the wet stuff to a sufficient height, and it was then left to dry, the stuff being occasionally forked over by hand labour. This apparatus has undergone severe tests, and Mr. Gibbs states that it has elicited strong expressions of praise from a great number of practical agriculturists. Still the inventor felt that it was not perfect. The action was discontinuous, and while the shed was being emptied and refilled, the heat was practically wasted. This drawback was to some extent got rid of by dividing the shed into two compartments, one of which was at work drying while the other was being emptied or filled, but still there was a great loss of heat. Then the labour was of a very trying character, conducted as it was in a hot, damp, sulphurous atmosphere. Thirdly, a considerable amount of labour was required. Fourthly, the apparatus was a fixture. Mr. Gibbs consequently set to work to devise an apparatus in which these four defects should be remedied. As the result of a fresh series of experiments, he has produced a working model of a machine which is entirely automatic, only requiring the wet stuff to be fed in at one end, for it to be delivered dry at the other continuously, the whole being easily portable.

Up to the present, no working machine on a large scale has been constructed, but Mr. Gibbs considers the results obtained from the small models sufficiently satisfactory to justify him in expecting great improvement on the work of his former machine. The construction of the apparatus is as follows:—On a framework, to which wheels can be fitted so that it can be moved from place to place, is mounted a long reciprocating table, to which a to-and-fro motion is given by a cam or crank shaft. This table can be set at any incline by means of a rack and pinion, and its upper end is naturally of such a height that the stuff to be treated can easily be pitched on it from a cart. Along the centre of this table is a gable-shaped tube, from openings at the lower edges of which the heated air, driven into the tube from a fan, passes. Along each side of the table, parallel with the air passage, are two shafts, one above the other, the lower one carrying several cranks, on each of which is loosely pivotted a sort of hay-fork; on the upper shaft tappets are fixed, and these strike the ends of the hay forks as they are carried round by the cranks. The result of this is that a sort of lifting and tossing motion is imparted to the ends of the forks. Hay or other stuff placed on the upper end of the table is by its reciprocating action, aided by the action of the forks, carried slowly along its length and subjected to the current of hot air as it goes. Should it not be thoroughly dried by one passage through the machine, it can be sent through again and again till the process is complete. The above mechanism is, it is hardly necessary to mention, worked by gearing from the shaft which actuates the reciprocating table, and this is driven from the engine that works the fan.

So successful has been the growth of the different varieties of the Bombay mango in Jamaica, that it is expected very soon to become an article of export to New York.

In the official report for Jamaica it is stated that chocolate now meets with very little attention. The cacoa plant is peculiarly well suited to many places in the island, and with a view to re-establish its culture, a small plantation has now been devoted to its growth.

The postal system of India appears to be steadily developing. According to statistics contained in the *Indian Civil and Military Gazette*, two hundred new post-offices were opened during 1873, bringing the total number up to three thousand, with two thousand letter-boxes in addition.

THE AMERICAN POTATO-BEETLE.

With reference to Mr. Shirley Hibberd's paper on the potato disease, the following description of this insect may be interesting. The account is extracted from a recent number of the *Globe*:—

The American potato-beetle, or the Colorado potato-bug, as it is commonly called in the States, is an insect about half an inch long, of an oval form, of a yellowish cream-colour, with the head and thorax orange-brown with black marks, and five black lines running down each of its wing-cases. From the last-mentioned character it has received the name of *Doryphora decemlineata*. It was originally described by Professor Thomas Say as long ago as the year 1823, but at that time it was confined to its wild localities in the Far West, where it is said to feed upon a species of wild potato. The gradual western extension of agriculture brought the cultivated potato within its reach, and probably finding this more palatable than its natural food, the insect at once seized upon the new pasture offered to it; and, in consequence of the abundance of suitable nourishment secured by the labours of the unfortunate agriculturists, multiplied exceedingly. It seems to have been first noticed as an insect injurious to the potato crops about the year 1861, and its subsequent progress has been very rapid, so much so, indeed, that according to one authority it has advanced eastwards about 360 miles in 6 years, or at the rate of 60 miles a year, which appears almost incredible. Its powers of multiplication are so great that we need not wonder at the amount of injury it inflicts. Each female is said to lay from 700 to 1,200 eggs, and there are three broods in the course of the year, so that, as estimated by a writer in the *Canadian Entomologist*, the progeny of a single pair would in the course of one season (if left entirely unmolested) amount to about 60 millions. Of course insectivorous birds, and predacious and parasitic insects, prevent anything like this increase from taking place. The natural history of the insect is as follows:—The eggs are attached in clusters of from one to two dozen to the underside of the young leaves of the potato, and the larvæ, which are the perpetrators of the mischief, are hatched in a few days, and feed on the leaves for from 17 to 20 days. They then descend into the ground and change to *pupæ*, in which condition the insects remain for 10 or 12 days, after which they emerge as perfect beetles, and deposit a fresh supply of eggs for a second generation. In Canada the whole process is said to occupy about 50 days. The *pupæ* of the last generation of the season remain quiescent in the ground through the winter, and the perfect insects emerge in the spring to recommence operations on the young potato plants. The *Times* stated the other day that an application had been made to Government to prevent the importation from America of seed potatos, which might introduce a terrible scourge into our fields, and that the authorities, from the known natural history of the insect, consider that there is no likelihood of its being introduced. This is very true; but at the same time we know that unlikely things sometimes come to pass, and, from the fact that the *pupæ* of the final generation of the season are in the ground at the time when the ripe potatoes are dug, it is just possible a few might accidentally get themselves attached to or mixed up with seed potatoes. Of course even then the chances of their establishing themselves in this country would be very small, but it would not be a useless precaution for every farmer who uses American seed potatoes to watch his fields carefully, and, in case any of the plants show signs of injury, to examine their leaves for a reddish brown grub with a black head, a ring of black on the first segment of its body, and two rows of black spots on each side. The remedy recommended by Professor Verrill is dusting the plants with Paris green, mixed from 8 to 12 times its weight of wheat flour, or 3 times its weight of wood ashes.

CORRESPONDENCE.

CHANNEL TUNNEL.

Sir,—I was present last evening at the meeting of the Society during the reading of Mr. Hawes' interesting paper on the Channel Tunnel, and I fully intended making some observations relative to this project, but was prevented owing to the lateness of the hour. With your permission, therefore, I will submit a few facts connected with this scheme.

I have before me a printed circular which was issued by the committee early in 1868, for the purpose of obtaining signatures to an address which was afterwards presented to the late Emperor Napoleon. This circular explains the nature of the project as it was then understood, and is signed by the members of the Committee at that time, Lord Richard Grosvenor's name heading the list. The following is extracted from it:—"The nature of the proposed plan is to make a double submarine tunnel (each tunnel for one line of rails) from shore to shore, without any intermediate air-shafts, in the Channel, and with cross passages connecting the tunnels. Our engineers, Messrs. Hawkshaw, Brunlees, Thorné de Gamond, and William Low, having long studied the question, have assured us of the practicability of executing the work. The first step in the project is the driving of a small double gallery or driftway under the Straits from shore to shore. This will cost one million sterling, and we seek from the French and English governments a guarantee of interest on that amount."

Now, sir, this was the project laid before Lord Richard Grosvenor, in 1867, by Mr. William Low, and it was he who christened it the "Channel Tunnel Railway." It would take up too much space to follow the history of this project from that time up to the present day. It will be sufficient to say that this project was approved of by Mr. Brunlees, who associated himself with it, and afterwards by Sir John Hawkshaw, who, by the interposition of Captain Tyler, was brought in as one of the engineers, and that from the month of June, 1868, until June, 1872, the names of Messrs. Hawkshaw, Brunlees, and Low were associated together as the engineers of this the only feasible project for connecting the railway systems of England and France. In 1872, a difference of opinion having arisen between Mr. Hawkshaw and Mr. Low, the latter gentleman was sacrificed in deference to Mr. Hawkshaw's wishes.

We heard from Mr. Hawes last evening, that the plan now proposed to be adopted is that of a single tunnel with two lines of railway, and that the preliminary work will consist of a single driftway, which is to be ventilated by a conduit carried under the roadway. Now we have to consider how this alteration from the original plan will meet the exigencies and requirements of the case.

In a memorandum presented by Mr. Low to the Commission of Inquiry at Paris, in December last, these difficulties are fully set forth, and also the advantages of his own system, viz., that of a double driftway, and the Commissioners so fully approved of Mr. Low's plans that they especially mention them in their report to the French Government, of which I enclose a correct translation, while they state that no details had been offered by the engineers of the single driftway system. In consequence of Mr. Low's separation from what may be called Mr. Hawkshaw's system or project, he was compelled to seek fresh supporters, and to register a new company. This has been done, and it is known as the Anglo-French Submarine Railway Company. A provisional committee of gentlemen of high standing has been formed, a certain amount of capital has been subscribed, and the land on the English side has been purchased for the purpose of sinking the shafts and proceeding with the preliminary driftways. Mr. Low's plan is approved of by some of the most eminent mining engineers, both in England and France; one of the latter, who was present at the reading of Mr. Low's memorandum to the French Commission, rose at its completion and stated that this plan was in his opinion the only practicable solution of the question. The great question of ventilation was altogether left out in Mr. Hawes' paper, and this is in reality the most delicate side of the question. Mr. Low's plans and details were all fully matured in 1866; hitherto we have seen no details in connection with the single drifting system. I must apologise for taking up so much of your valuable space; if time permitted I could say much more.—I am, &c. George Thomas.

8, King-street, Wrexham, March 18th, 1874.

Report of the Commission of Inquiry.

(Translation.)

The Commission of Inquiry, in view of the preliminary scheme which was submitted by an Anglo-French Committee, for making a submarine railroad between France and England.

In view of the records of the inquiry to which this preliminary scheme was submitted and the documents annexed.

In view of the reports of the Chambers of Commerce of the Department, and the Consulting Senate of Arts and Grades of St. Pierre.

In view of the different petitions, especially that of the memorandum of Mr. Low, and the statement in support and explanation, addressed to the Commission with a view of laying before it methods of execution differing from those deposited with the Commission of Inquiry, for carrying out or to be employed in boring the galleries.

Considering that the Commission is called solely for the purpose of giving its opinion on the project which was the object of the appointment of the Commission of Inquiry, and on the public utility of the enterprise.

Considering that it is not called upon to decide upon the details of execution of the work, which indeed are not set out in the endorsement, or specification.

Considering that all which is important or which concerns the scheme or project laid before the Inquiry, is that the concession is asked for without seeking for pecuniary aid or guarantee of interest.

Considering that it is understood, from the explanations given by the members of the Committee, that this concession would be made subject to the ordinary conditions of railway enterprises.

Considering that the ascertained facts in science, and the high social standing and honourable position of the petitioners for a concession forbid any doubt as to the *bona-fides* of the undertaking.

Considering that the formation of a railway, which would not only put the English and French system of railways in communication, but also the whole of the Continent, presents such self-evident advantages for commerce and civilisation.

The Commission reports that there is every ground for declaring that the formation of a submarine railway between France and England would be a signal step in the direction of public utility,

Besides which the Commission, considering that the towns on the seaboard have vested interests which must be respected, and considering that it is only right to place the navigation connected with these seaports in a position to meet the competition which hereafter the submarine railway will raise against them, expresses a strong wish that the State will carry out, with all practicable dispatch, such works as are necessary to make the ports of Boulogne and Calais accessible at all times of the tide to vessels of large burden or tonnage.

THE PARAFFINE INDUSTRY.

SIR,—As Mr. Field's able lecture on paraffine industry may be supposed to give the history of the commercial introduction of paraffine into this country, allow me to point out an omission in it. I believe the first considerable source of paraffine to have been Rangoon petroleum. This Rangoon "Tar" (butter would have been a more characteristic name) had been known long before, but was neglected, until the scientific researches of Mr. Warren De La Rue showed it to contain many useful bodies easily separable, among them paraffine, in a much larger proportion than it existed in, or was yielded by, the oils from shale, schist, or Boghead coal. Mr. De La Rue patented his discoveries, and his patented processes were adopted and developed by Price's Patent Candle Company, on a commercial scale, in 1857. To confirm my memory I have inquired at the works, and find that the Company manufactured from Rangoon petroleum more than 25 tons of paraffine candles in 1857. Little as this may seem, it was thought great in 1857. After this time I well remember the great chemist Dr. Hoffman's exclamation of pleased surprise at seeing a ton of paraffine.

Owing probably to the Rangoon tar having been exposed in its formation to a less high temperature than any of its kindred bodies then known, its constituents were comparatively easily purified, and consequently in 1857, when the refining processes were less perfect than at present, beautiful transparent candles were manufactured; these, though almost pure paraffine, were called Belmontine, after the name of the works, a name legally securable, and contrasted favourably with other paraffine candles, especially those from Bonn, which were, I believe, the earliest manufactured.—I am, &c.,

G. F. WILSON.

March 16, 1874.

THE SOCIETY'S MEETINGS.

SIR,—I suppose anyone who attends our meetings will heartily endorse the strictures of your correspondent. I have long thought it was high time that some check were given to habitual talkers, who occupy our time unprofitably, being sometimes nearly unintelligible, and either lengthen our meetings inconveniently or prevent practical men, who have usually something to say, finding time to say it.—I am, &c.,

ANOTHER OLD MEMBER.

London, March 12th, 1874.

GENERAL NOTES.

Channel Passage.—A general meeting of the Bessemer Saloon Steamboat Company was recently held, when explanations were given by Mr. E. J. Reed, M.P., and by Mr. Bessemer, as to the progress of the first ship and engines. It was stated that in working out the details of the invention the expectations formed at the time the company was established had been greatly strengthened, and that the success of the undertaking might be relied upon as absolutely certain. The ship will be launched with engines and saloon on board all complete, and be ready for active service in the early summer.

The Cost of our Coal.—The following figures give the quantities of coal raised in Great Britain, with the loss of life which took place for each year, from 1868 to 1872:—

Date.	Tons of coal raised.	Deaths.	Tons of coal raised per death.
1868	104,566,959	1,011	103,429
1869	108,003,482	1,116	96,777
1870	112,875,525	991	113,900
1871	117,439,251	1,075	109,246
1872	123,393,853	1,060	116,400

Heating Apparatus for Domestic Purposes.—A new form of heating apparatus, intended to warm comparatively small quantities of water at a time, has recently been patented by Mr. Strode. A vertical chimney is arranged over a set of Bunsen burners. This chimney consists of an inner and outer cylinder, and in the jacket thus formed a current of water is allowed to flow, taking up the heat as it goes from the heated surface of the inner cylinder. The water is admitted cold at the bottom, and discharged at the top heated. The invention is intended for use in positions where a complete heating apparatus for hot water supply with cisterns, &c., cannot be constructed.

Deterioration of Coals.—That coals lose considerably in value by exposure to the weather is well-known, but few, probably, are aware of the extent of the damage. Dr. Varrentrass has ascertained a loss of more than one-third in the weight of a sample of coal exposed for some time to the air, and he states that the quality of the coal had undergone a still greater deterioration. The loss is set down as due to a slow combustion of the volatile elements of the coal, which gradually diminish in amount, whilst the proportion of carbon, ash, and sulphur are increased. In some experiments made the gas furnished diminished 45 per cent., and the heating power 47 per cent., in a coal which had been exposed, and the same coal under shelter lost only 25 per cent. as a gas generator, and 10 per cent. as a heat producer. Anthracite, as might be expected, suffers least from exposure to the atmosphere, and the bituminous coals are those which lose most.

The Sweetmeat Trade in France.—The manfacture of bon-bons is carried on all over France, and in Paris alone there are upwards of 200 shops, employing over 1,000 hands that are engaged in this industry. The men earn from 1·50 to 8frs. per day, and the women from 1 to 4 frs. The manner in which liqueur bon-bons are made is extremely simple. The sugar preparation, reduced to a fine powder, is spread over a tray, and upon this single drops of the liqueur are allowed to fall; the tray is then shaken, and the pulverised sugar forms a coating round the several drops of fluid, which can be increased at will to any thickness. The amount of indirect industry is enormous. The last published statistics show that the sweetmeat trade of France exceeds 12 million francs. Perhaps the greatest marvel is to find that the country itself expends 10 millions of this sum.

NOTICES.

THE LIBRARY.

The following works have been presented to the Library:—

Archæologia; or Miscellaneous Tracts relating to Antiquity. Published by the Society of Antiquaries of London. Vols. xliii. and xliv. Presented by the Society.

Annual Reports of the Board of State Charities of Massachusetts; 1867 to 1873. Presented by Dr. E. Jarvis.

33rd, 34th, and 36th Annual Reports of the Board of Education.

Report on Measures adopted for Sanitary Improvements in India from June, 1872, to June, 1873.

Sociedad Económica Matritense. Resúmen de sus Actas y de sus Taréas en el Año 1873, parte documental. Presented by his Excellency José Merino Ballesteros, G.C.I.C.

Tijdschrift uitgegeven door de Nederlandsche Maatschappij ter Bevordering van Nijverheid 1873. Presented by the Society.

The following have been presented by his Excellency the Governor General of India in Council:—

Memoirs of the Geological Survey of India. Vol. x., part 1.

Memoirs of the Geological Survey of India (Palæon-

tologia Indica). Parts 3 and 4 of vol. iv., sec. 8; and part 1, vol. i., sec. 9.

Records of the Geological Survey of India. Vol. vi., parts 1 to 4 (1873).

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

The following arrangements for Wednesday evenings have been made:—

March 25.—"On the London International Exhibition of 1874." By Henry Hardy Cole, Esq., Lieut. R.E. On this evening the Right Hon. Lyon Playfair, C.B., F.R.S., will preside.

April 1.—*No meeting.*

April 8.—"On the Importance of a Special Organisation for the Diffusion of Sanitary Knowledge." By Major-General Synge.

April 15.—"On the Proportion which Investments in the Purchase of Objects of Fine and Industrial Art ought to bear to the National Income and Expenditure." By Henry Cole, Esq., C.B.

April 22.—"On Progress recently made in Ornamental Processes connected with Metallic and other Industries." By W. C. Aitken, Esq.

April 29.—"On some Recent Inventions and Applications of Lambeth Stoneware, Terra Cotta, and other Pottery for Internal and External Decorations." By John Sparkes, Esq., Head Master of the Lambeth School of Art, and of the Arts Department of Dulwich College.

May 6.—"On Timber Houses." By Frank E. Thicke, Esq.

Indian Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

April 17.—"On the Indian Famine, with Especial Reference to the Means which should be Adopted for Preventing or Alleviating Famine." By General Sir Arthur Cotton, K.C.S.I.

African Section.

These meetings are arranged for Tuesday evenings, at 8 o'clock, and the following arrangements have been made:—

April 14.—"On Trade in Western Africa with and without British Protection." By Andrew Swanzy, Esq.

Chemical Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

March 20.—"On Anthracene and Alizarine." By Dr. Versmann.

April 10.—"On some Recent Processes for the Manufacture of Soda." By C. W. Vincent, Esq., F.C.S.

April 24.—"On Pyrites, as a source of Sulphur, Copper, and Iron." By Dr. C. R. A. Wright, F.C.S.

May 8.—"On Sugar Refining, with special reference to Finzel's Sugar Crystals." By Dr. Griffin.

May 22.—"On the Manufacture of Chlorine." By W. Weldon, Esq., F.C.S.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Mon. ...Royal Geographical, 1, Savile-row, W., 8½ p.m. Mr. R. G. Watson, "On a Journey in the Island of Yezo, and on the Progress of Geography in Japan."
British Architects, 9, Conduit-street, W., 8 p.m.
Medical, 11, Chandos-street, W., 8 p.m.
London Institution, Finsbury-circus, E.C., 4 p.m.

Tues. ...Royal Institution, Albemarle-street, W., 3 p.m. Professor Tyndall, "On the Physical Properties of Liquids and Gases."
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Continued discussion on Mr. George W. Rendel's paper, "On Gun Carriages and Mechanical Appliances for Working Heavy Ordnance."
Anthropological Inst., 4, St. Martin's-place, W.C., 8 p.m. 1. Rev. Dunbar I. Heath, "On the Origin and Development of the Mental Function in Man." 2. Mr. W. L. Distant, "On the Mental Differences between the Sexes." 3. By the President, "Notes on an Ashanti Skull."
Royal Colonial, 15, Strand, W.C., 8 p.m. (At the House of the Society of Arts.) Mr. Leonard Wray, "On Settlements on the Straits of Malacca."

Wed. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Lieut. Henry Hardy Cole, "On the London International Exhibition of 1874."
London Institution, Finsbury-circus, E.C., 7 p.m.
Geological, Somerset-house, W.C., 8 p.m. 1. By Principal Dawson, LL.D., "On the Upper Coal Formation of Eastern Nova Scotia and Prince Edward Island, in its relation to the Permiam." 2. Mr. J. G. Goodchild, "Note on the Carboniferous Conglomerates of the Eastern Part of the Basin of Eden." Communicated by H. W. Bristow. 3. Mr. R. Mortimer, "An Account of a Well-section in the Chalk at the North end of Driffield, East Yorkshire." Communicated by Mr. W. Whitaker.
Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m.
Archæological Association, 32, Sackville-street, W., 8 p.m.

Thur. ...Institute of Naval Architects. (At the House of the Society of Arts.) Morning Meeting, at 12 noon. Annual Report of the Council. Address by the President. 1. Mr. Nathaniel Barnaby, "Recent Designs of Ships of War for the British Navy." 2. Mr. H. Boulby Willson, "High-speed Channel Steamers." 3. Mr. William Froude, "Experiments with H.M.S. *Greyhound*. Evening Meeting at 7 p.m. 1. Mr. Wm. John, "On the Strength of Iron Ships." 2. Mr. Chas. H. Jordan, "On the Strength of Classed Ships." 3. Mr. Philip Watts, "The Effects of Change of Trim upon the Transverse Stability of Ships." 4. Herr Victor Lutschaunig, "Notes on Stability."
Royal, Burlington House, W., 8½ p.m.
Antiquaries, Somerset House, W.C., 8½ p.m.
Society for the Encouragement of Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. T. H. Thomas, "Art Criticism."
Royal Institution, Albemarle-street, W., 3 p.m. Professor W. C. Williamson, "On Cryptogamic Vegetation—Ferns and Mosses."
Philosophical Club, Willis's Rooms, St. James's, S.W., 6 p.m.

Fri. ...Institute of Naval Architects. (At the House of the Society of Arts.) Morning Meeting at 12 noon. 1. Mr. Benjamin Martell, "On Freeboard." 2. Mr. W. W. Rundell, "The Load-draught of Steamers." 3. Mr. William Froude, "Useful Displacement as Limited by Weight of Structure and of Propulsion Power." 4. Mr. G. B. Rennie, "On Three-throw Crank Engines of the Compound System; H.M.S. *Boadicea* and *Bacchante*. 5. Mr. T. A. Hearson, "Strophometer or Speed Indicator." Evening Meeting at 7 p.m. 1. Mr. Robert Griffiths, "On Screw Propulsion and Screw Ships." 2. Mr. Thos. Moy, "A New Form of Steam Engine." 3. Mr. John McFarlane Gray, "On Clearance and Compression in Steam Cylinders." 4. Mr. Spencer Deverell, "Ocean Wave Power."
Royal United Service Institution, Whitehall-yard, 3 p.m. Lieut.-Colonel George Chesney, "The English Genius, and Army Organisation."
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting; 9 p.m. Professor A. C. Ramsay, "The Physical History of the Rhine."
Quekett Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.

Sat. ...Institute of Naval Architects. (At the House of the Society of Arts). Morning Meeting at 12 noon. 1. Rev. W. R. Jolley, "The Ark Saloon, or Utilisation of Deckhouses for Saving Life in Shipwreck." 2. Herr Gustav A. Mitzlaff, "A Steam Lifeboat." 3. Mr. A. Folkard, "Improvements in Apparatus for Lowering, Hoisting, Engaging, and Freeing Ships' Boats." 4. "Description of the Dromoscope invented by Dr. Taugger, of Trieste." Communicated by Herr Victor Lutschaunig.
Royal Institution, Albemarle-street, W., 3 p.m. Mr. C. T. Newton, "On Mr. Wood's Discoveries at Ephesus."
Royal Botanic, Inner Circle, Regent's-park, N.W. 3¾ p.m.

[The Editor will be glad to receive notices of papers for insertion in the above list.]

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,114. VOL. XXII.

FRIDAY, MARCH 27, 1874.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1874, early in May next. This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of tho Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Mons. Michel Eugène Chevreul, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

The Council invite members of the Society to forward to the Secretary, on or before the 11th of April, the names of such men of high distinction as they may think worthy of this honour.

INTERNATIONAL EXHIBITION OF 1874.

The Council have resolved to offer the Society's Gold and Silver Medals in connection with the International Exhibition of 1874

A gold and a silver medal is offered in each class, and these medals will be given for any object exhibited which, in the opinion of the Council, shows paramount or very great excellence, whether in respect of the final result, the machinery, method of production, or novelty.

VISIT TO THE BRIGHTON AQUARIUM.

Arrangements are now being made for a visit of the Members of the Society of Arts and their children to the Brighton Aquarium, under the guidance of Mr. Frank Buckland, M.A., Her Majesty's Inspector of Salmon Fisheries, who will then deliver his Fourth Juvenile Lecture. Friday, the 10th of April, during the Easter Holidays, is selected for the visit, and a ticket can be had for 10s. 6d., entitling the bearer to travel first-class by special train to Brighton and back, with admission to the Aquarium and luncheon. A sufficient number of names has now been received to justify the Council in definitely carrying out the proposed arrangements, and the issue of tickets has consequently commenced. Members desirous of securing to themselves and friends the privilege of obtaining these tickets, are requested to send in their names at once to the Secretary of the Society of Arts, with remittance, and stating the number of tickets they will require.

PROCEEDINGS OF THE SOCIETY.

CHEMICAL SECTION.

A meeting of this Section was held on Friday, March 20th, Mr. F. A. ABEL, F.R.S., in the chair.

The Chairman, in introducing Dr. Versmann, said the subject which he was about to treat constituted one of the most recent, and also one of the most important instances of the application of purely scientific results to practical purposes. The Great Exhibition of 1851 afforded no indication that a revolution in the industry of colouring matters and dyes was imminent, though the two beautiful colouring matters which excited so much interest in the Exhibition of 1862 had long been familiar to scientific chemists as the ephemeral colouring matters produced in the laboratory by the distillation of coal,

and in other more circuitous processes. The production in 1856 of mauve, or aniline violet, and in 1859 of magenta, or aniline red, as permanent colouring matters, obtainable with comparative ease and in considerable abundance, constituted almost the greatest achievement of applied chemistry between 1851 and 1862. It was not necessary to remind his audience that the thirty-five or more products obtainable by the distillation of coal tar gradually became the sources of colour, or that magenta soon became the parent of a marvellous offspring of beautiful colours. Thus coal tar, which had long occupied the unenviable position of a very disagreeable waste product, rose to a high position amongst the results of manufacturing industry; a position which during the last three years had been further raised by the artificial production of alizarine from the product now obtained in abundance from coal tar. Dr. Playfair, in an interesting series of lectures on the results of the Exhibition of 1851, pointed out that one of the most remarkable achievements of modern science was the utilisation of the refuse from madder, by means of acid, the spent madder being thus made to yield fully one-third as much colouring matter as it originally furnished. It would be only forestalling the lecturer to give even an outline of the processes by which alizarine as a colouring matter was artificially produced, but he might venture to predict that it would be difficult to find a more important or interesting illustration of the manner in which the results of pure scientific research might be made susceptible of application to industrial purposes.

The Paper read was :—

ON ANTHRACENE AND ALIZARINE.

By Frederick Versmann, Ph.D.

In accepting the invitation to lecture before you on one of the most important and most interesting recent chemical discoveries, I had to consider whether I should treat my subject in preference from a practical or from a scientific point of view.

Looking at the object for which this series of chemical lectures has been arranged by the Council, and believing it to be decidedly of a practical nature, I have thought it best to confine myself as much as possible to the practical side of my subject, and to consider the theoretical part only so much as may be necessary for a general understanding. I have done so all the more readily, because I shall thereby be best enabled to point out the great advantage and the absolute necessity of constant scientific investigation of apparently very simple manufacturing processes, and also because I am anxious to invite a discussion on several practical points, which are surrounded by much uncertainty; and I should be much pleased if such discussion should assist in clearing away some of the uncertainty and dissatisfaction at present attached to the true value of an article which suddenly has assumed such vast importance.

I may at once remark that although my paper is "On Anthracene and Alizarine," I have found it impossible to do full justice to both subjects in one evening. I shall therefore limit myself to-night chiefly to the consideration of anthracene, and I shall touch but lightly upon its conversion into colouring matter; but I hope I may have at some future time an opportunity given me to fully discuss the various processes which produce these chemical changes, and result in such splendid and beautiful compounds.

In tracing the history of anthracene, we find that the two great French chemists, Dumas and Laurent, in 1832, first obtained it from the last fractions of the distillation of coal tar; they exposed the oily matter to extreme cold, when a crystalline deposit separated, which was pressed and washed with alcohol; the residue was further purified by re-distillation, crystallisation, and sublimation, and was then submitted to chemical investigation. Dumas and Laurent assigned to the compound thus obtained the formula $C_{15}H_{12}$, and as this is half as much again as naphthalene $C_{10}H_8$, they named the new substance paranaphthalene. But this chemical composition and the low melting point, which was found to be 180°C, convincingly prove that the substance must have been a mixture of several hydro-carbons, and not a definite chemical compound.

Laurent afterwards submitted the substance to fresh investigations, and obtained several interesting derivatives, but as Professor Kapp suggests, in his exhaustive historical memoir on "Anthracene and its Derivatives," published in the *Moniteur Scientifique*, Laurent evidently had at his disposal only small quantities of the impure hydro-carbon; he therefore could not determine the true composition of the substance, which he now named anthracene.

At present it is generally acknowledged that the compound these two chemists investigated was not pure, and that their formula is not correct; it is therefore the more surprising that Girard and Delaire, in their "Traité des Dérivés de la Houille," published only last year, repeat with strange tenacity Dumas and Laurent's antiquated statements; they treat paranaphthalene as an existing definite compound of the formula $C_{15}H_{12}$, although they have nothing new to add in support of their isolated opinion; on the contrary, they confess that the substance is little known, that the investigations are very old, and made very likely not with a pure compound, but with a mixture of paranaphthalene and anthracene.

Fritsche described, in 1857, a hydro-carbon, obtained from coal tar, which he found in many respects closely to resemble Laurent's anthracene, but which had a melting point of 210°C. to 212°C., and the formula of which he found to be $C_{14}H_{10}$

Anderson published, in 1862, a most searching investigation of the higher hydro-carbons from coal tar; he separated anthracene in great purity, obtained many of its most important derivatives, prominent amongst which stands his oxanthracene, or anthrachinon, which, however, had already been obtained by Laurent. Anderson retained Laurent's name of anthracene, but confirmed Fritsche's formula and melting point.

So far, then, the hydro-carbon had been separated from coal tar only, but in 1866, Limprecht demonstrated its formation, resulting from the decomposition of chloride of benzyl by water in a closed vessel, at 180° C.; and in the same year Berthelot commenced the publication of his masterly researches of the action of heat upon the hydro-carbons, their origin, character, and composition; he pointed out the circumstances under which anthracene is formed by the action of heat upon the several more simple hydro-carbons; he found that toluol alone, or a mixture of styrol and benzol, or of benzol and ethylene, passed through a red-hot tube, furnished anthracene.

Berthelot's and Limprecht's results are so far

exclusively of theoretical interest, at present at least, there does not appear any chance of their investigations being capable of practical application. Berthelot also described the extraction of anthracene from coal tar, its purification, and its characters, and he confirmed Anderson's results. So far, all these investigations were of a purely scientific character, but in 1868, two German chemists, Graebe and Liebermann, succeeded in reducing alizarine, extracted from madder, and in obtaining therefrom a hydro-carbon, which corresponds in all its properties to Anderson's anthracene.

This, then, is the starting-point of one of the greatest revolutions in chemical industry, because, after having obtained anthracene from alizarine, it was comparatively easy to convert anthracene into alizarine, and thus the possbility was given of producing, by artificial means, ione of the most important and most ancient natural colouring matters.

Several German manufacturers of aniline dyes at once commenced the solution of this problem, with more or less rapid success, and although scarcely five years have elapsed since the first laboratory experiment was made, to-day we see a number of large works producing vast quantities of the artificial colour. The first and most important question became, of course, the sufficient supply of anthracene.

It is difficult to realise the idea that an article which was but yesterday unknown and useless, and of no commercial value whatever, should to-day be most eagerly sought after, and should command a high price. Such, however, is the case with anthracene, which has suddenly risen to greater importance than any of the other products of the distillation of coal tar. True, the application of benzol and its homologues imparted to this series of hydro-carbons an importance previously unknown, but it becomes almost insignificant if compared with the position anthracene has so suddenly, and no doubt permanently, assumed.

Before attempting to give a description of the manufacture of anthracene, I may be allowed for a moment to go a step further back, to draw your attention to the formation of tar, from which anthracene is obtained.

I need scarcely say that tar is one of the bye-products in the manufacture of illuminating gas. Coal heated in a closed, red-hot retort, as shown in the diagram, is split up into a series of volatile and non-volatile compounds; the last remain in the retort as coke, while the volatile compounds are carried away by means of an exhauster; they pass through the ascension pipe at one end of the retort into the hydraulic main, and then into the condensers. These are large upright syphons, and as the volatile compounds are made to pass through a whole series, they are cooled. The permanent gases pass on to be further purified and to be stored in the gas-holders, while other products, carried away so far in the form of hot vapour, are condensed in the liquid form, and accumulate at the bottom. These liquid products consist chiefly of tar and water, which separate on standing; the tar is run off into the tar wells, and is ready for further treatment.

In drawing your attention to the following table, in which I have endeavoured to illustrate and to follow up the ultimate separation of anthracene from tar, but starting with coal and its convertion into gas and its by-products, I need scarcely remark that I could not have intended to give a complete representation of all the different compounds obtained in the operation, but that I have simply grouped them together in as few divisions as possible:—

Products of Destructive Distillation of Coal.

COAL

Gas. Liquid. Solid coke.

Tar. Ammonical liquor..

Light oil. Heavy oil. Pitch.

Oil. Solid hydrocarbons. Oil. Solid hydrocarbons. Coke.

Naphthalene, Chrycene, &c. Anthracene. Naphthalene, Anthracene. Chrycene, &c.

We have already seen that coal submitted to destructive distillation yields gaseous, liquid, and solid products. Passing over the gas and the solid, we separate the liquid into tar and into water, containing much ammonia, and which is therefore called ammoniacal liquor. The tar submitted to fractional distillations yields light oil, heavy oil, and pitch. These, I repeat, are only broad divisions, as obtained by the first distillation of tar. The oils contain several series of liquid hydro-carbons, the most important of which is the benzol series; a series of bases containing nitrogen, of which aniline is the type; a series of acids, foremost amongst which is carbolic acid; and lastly, a whole series of hydro-carbons, most prominent amongst which we find anthracene.

Perhaps I ought to have given a complete list of all these compounds, with some of their characteristic physical properties, but as their number is very considerable, more than sixty at least, I have limited myself to the solid hydro-carbons, as the only ones bearing directly upon our subject. These we shall have to consider later on, when speaking of the impurities which accompany anthracene.

In looking at the diagram you will observe that the pitch resulting from tar is further divided, ultimately yielding again anthracene. This is a process I shall have to speak of separately.

The manufacture of anthracene appears at the first moment to be extremely simple, an impression which, unfortunately, has taken hold of many tar distillers, and which accounts for the low quality of very large quantities of anthracene sold.

The well-known process of tar distilling, so the formula runs, is carried out as usual, and the last 10 or 15 per cent. of the products of the distillation are set aside and allowed to stand for some weeks, when a crystalline deposit of solid hydrocarbons separates; this is freed as much as possible from the adherent oil by filtration, pressing, or other mechanical means, when the residue, more or less dry and more or less impure, is ready for sale.

This, no doubt, is the necessary beginning of the process, which, however, should be further followed up, and ultimately result in an article of such purity that it might at once be converted into colouring matter, *i.e.*, an article containing at least 75 or 80 per cent. of pure anthracene.

True, in the early days of anthracene—and that

is but four years ago—the alizarine makers were well contented to get anthracene of any quality, however low in percentage, because the success and very life of the new dye depended upon the possibility of getting large quantities of a hitherto unknown article. At that time the alizarine maker bought what he could get, often perhaps not knowing himself the value of the articles bought; but it is evident he did so unwillingly and only of necessity, as is clearly shown by some remarks of Dr. Gessort's, one of the earliest and most successful manufacturers of alizarine, who wrote about three years ago as follows:—

"It is to be regretted that the tar distillers are not more careful in the manufacture of commercial anthracene. The manufacturer of alizarine has not at his disposal the necessary plant required for the purification of crude anthracene; at all events, he loses much time, and has no use for the oily residues resulting from the purification.

"The tar distillers, on the other hand, can always use these by-products along with their other oils. They ought to take the greatest care in the pressing of the well-filtered and drained anthracene, by using powerful hydraulic presses and by pressing, first cold and then hot, as strongly as possible. Such crude, well-pressed anthracene is readily powdered and passed through a sieve, and in this state of fine division it may be treated with petroleum spirit, boiling between 70° and 90° C., and after sufficient washing it may again be submitted to strong pressure.

The price of crude anthracene of good quality is sufficiently high and remunerative to induce the tar distiller well to study the rational manufacture of the article, and to devote all his care to it."

Every word of these remarks, written three years ago, holds good even to-day, because only very few distillers are aware of the profit to be derived from purifying their crude product and thus obtaining a high-class article. It is also true that, now that the question of producing large quantities of anthracene has been settled, the alizarine manufacturer buys but unwillingly a low per cent. article, and we see a new class of manufacturers spring up, which stand between the two former ones, viz., anthracene purifiers, who buy the crude anthracene and supply the consumer with an article of the desired purity. Of these anthracene purifiers there are several in Germany and at least one in England; and nothing could speak more strongly in favour of my argument, that the first manufacturer should also be the purifier, than the fact that other people find it profitable to take up the purification as a separate business.

Of course, I do not for a moment under-estimate the difficulties connected with the subject; on the contrary, I am anxious to point them out, and to express my strong opinion that the whole manufacture must be looked upon, not so much as a mechanical, but rather as a chemical operation, that it requires a chemist's constant care and scientific investigation, without which only partially satisfactory results can be ascertained; because after first having obtained the crude product, what is the question to be solved? Is it not the separation of one substance from a number of other substances extremely similar in their physical properties; and can such separation be successfully carried out, especially on the manufacturing scale, without an intimate acquaintance with all these substances? Certainly not; and moreover, the production of the first article ought to be based upon scientific principles as well; because we must assume, and there is little doubt of this view being correct, that the greatest part of these solid hydro-carbons does not exist ready formed in the tar, is during the distillation not simply vaporised and afterwards again condensed, but that it is the product of decomposition by heat of more simple compounds; and if this be so, will not the study of the effects of heat under varying circumstances become of the utmost importance, and lead to most valuable results. I do not lose sight of the fact that, for the tar distiller, the mechanical part of his business is of the greatest importance, such as the suitable arrangement of his plant, the economical carriage from one part of the works to the other of the bulky raw material and its products, etc.; but in order to derive full benefit from his operations he should be guided and assisted by experience derived from investigation.

Anthracene having become of such great commercial importance, its most exhaustive scientific examination became a matter of course; and the last few years have brought us, especially from Germany, a number of most valuable investigations on nearly all the solid hydro-carbons. Berthelot had previously separated and described many of them, but perhaps he had not sufficiently large or sufficiently pure quantities to work upon; at all events more recent publications, the results chiefly of Graebe's and Liebermann's researches, have somewhat modified several of Berthelot's conclusions. In the following table I have given a list of these solid hydro-carbons, their formulas, melting point, and boiling point, as far as they are known at present:—

Solid Hydro-carbons.

Name.	Formula.	Melting Point.	Boiling Point.
		Deg. C.	Deg. C.
Naphthalene	$C_{10}H_8$	79	220
Acenaphthene	$C_{12}H_{10}$	100	285
Fluorene..........	..	113	305
Phenanthren	$C_{14}H_{10}$	110	340
Anthracene	$C_{14}H_{10}$	213	360
Pyrene	$C_{16}H_{10}$	180	..
Chrysene	$C_{18}H_{12}$	248	360
Retene............	$C_{18}H_{18}$	95	400
Benzerythrene	..	..	..

Variable quantities of all these compounds are found in commercial anthracene, and their complete separation becomes extremely difficult. In treating the commercial article it will always be best to remove the oil as completely as possible before attempting any further separation, and for this reason; the oil itself is almost the best solvent of all the solid hydro-carbons, including anthracene, which is shown by the fact that after the settlement of the crystalline deposits in the oil, a considerable quantity is often re-dissolved with a slight increase in temperature of the air; if therefore, a sample, containing much oil, is treated with a solvent, the combined actions of oil and such solvent removes considerably more anthracene than the solvent alone. This remark holds good with alcohol and bisulphide of carbon analyses; a soft sample containing much oil always shows a lower percentage than the same sample previously pressed and separated from the oil.

The attempt to give a separate and distinct account of the characteristics of these solid hydro-carbons would be useless for practical purposes, because, with the exception of the first and last, they are extremely similar to one another, and a quantitative separation becomes a matter of great difficulty. The difference in the action of alcohol, ether, bisulphide of carbon, benzol, petroleum, and other solvents is merely a matter of degree. Nitric acid and sulphuric acid, chlorine, and bromine, produce similar compounds of addition or substitution. A solution of picric acid, mixed with a solution of the hydro-carbons, forms a series of compounds varying in colour from yellow and light orange, to dark blood-red, but which are so little stable that even an excess of the solvent, alcohol for instance, separates the acid again. Even similar products of oxidation are obtained from most of them, at least as far as they have been studied. Naphthalene may pretty easily be separated; all solvents take it up most freely; the low melting and boiling point is very marked; even water vapour carries it off, and it may thus be purified. It is formed during the manufacture of gas, and is partly carried off and held in suspension by the gas. With a fall in temperature it often solidifies in the gas pipes, so as almost to choke them up, and thus often becomes a great nuisance to the gas manufacturer, especially as by its abstraction from the gas the illuminating power of the last is sensibly decreased.

Benzerythrene, the last substance on our list, is very little known, and has scarcely yet been studied. It is the very last product in distilling pitch, and may thus be separated without difficulty. It is of a resinous character. After nearly all the oil with the hydro-carbons has passed over, this last product appears in the form of a bright red powdery vapour. It soon loses its fine colour on exposure to light, and assumes a dull brown colour.

Another substance has been separated from crude anthracene by Graebe and Caro, which they have named *Acridine* $C_{12}H_9N$, and which is therefore a base containing nitrogen. This is remarkable for its intensely irritating action upon the skin and mucous membrane. The least particle of the dust inhaled produces most violent sneezing, Although it is present only in very minute quantities, it often is the cause of great annoyance to the workmen.

I now return to that point of my first diagram where the tar is separated into oil and pitch. Finding that the anthracene passes over just at the last moment of the distillation, it was natural to assume that more might be left behind which could be separated on continuing or renewing the distillation. Many suggestions have been made to carry out this idea of obtaining anthracene in such manner, but without destroying the pitch or without coking it, and they all appear to have been made without being verified by practical experiment.

Professor Kopp, whose contributions to the history of anthracene I have already mentioned, was perhaps the first to propose to melt pitch in a suitable vessel and to carry off the anthracene vapours by introducing surperheated steam or air. Now it is well-known what will happen in either ease; the least trace of water is the great trouble in distilling tar or pitch, because it makes the whole mass froth up and run over into the condensing pipes, and this will surely happen on blowing superheated steam into the molten pitch. So also with introducing a current of air into the hot mass, which will result in another slight inconvenience—it is sure to set fire to the contents of the still and to cause an explosion. This, Professor Kopp seems to have foreseen himself, because he recommends us to deprive the air of its oxygen by passing it through red hot iron tubes filled with charcoal.

But the object of these operations is to save the pitch which shall remain sufficiently fluid to run out of the still at the end of the operation.

The late Professor Calvert, who most successfully pursued scientific investigation and its practical application, and who I believe was the first to speak of the very subject of my paper in this room, in one of his Cantor lectures, expressed his opinion in the following words at Manchester :—

"I am aware that it has been proposed to distil soft pitch so as to obtain the volatile products that are given off in coking, but the expense, difficulty, and danger of such operation are such that I doubt if they can be overcome so as to produce anthracene of comparative purity on a commercial scale."

These remarks, I think, must refer to Professor Kopp's suggestions, and in that respect they are no doubt most applicable.

The records of the Patent-office bear witness to a good deal of activity in this direction. The first patent was taken out by Broenner and Gutzkow. The principal claim of this patent is the process of converting anthracene into alizarine, but they also claim the production of anthracene from pitch by the very process I have just described, viz., by passing steam into the still.

The next patent was taken out by Mr. Henry Fenner and myself, and we were the first to distinctly claim the production of anthracene from coal-tar pitch, either as a continuous process of the tar distillation, or a separate operation, but in all cases we continue the distillation to the complete coking of the pitch; we also were the first to practically carry out this process, and to obtain thereby anthracene on a large scale. This patent, like every other patent which is worth anything, has been made the subject of a good deal of discussion. First, it was asserted that everybody had done exactly the same thing long before; then it became quite evident the thing could not be done at all; lastly, it might possibly be done, but to no purpose.

Looking at the difference in distilling tar and pitch, it will readily be understood that the result must be somewhat different; in the first case the impurities are chiefly those hydro-carbons which pass over before the anthracene, and which have a lower melting point, while in the second case the higher hydro-carbons form the principle impurities. At first a great dislike, not to say prejudice, was created against the anthracene made from pitch, and with apparent reason, very likely because the buyers did not recognise the difference in the impurities, which of course necessitated a different treatment in the purification, and consequently the consumers did not succeed to their satisfaction in converting it into anthrachinon. However, all these difficulties have gradually been overcome; it has been satisfactorily demon-

strated that this kind of anthracene, properly purified, is identical with that obtained from tar, that it can just as easily be converted into anthrachinon and alizarine, of both of which I have samples on the table, and the highly purified products of the Anthracene Company (Limited), who works our patent, is beginning to find universal favour with the intelligent alizarine makers.

The separation of anthracene from pitch is most important, because the yield is thereby greatly increased; tar alone gives about a half per cent. of pure anthracene, while tar and pitch give at least two per cent.

The crude anthracene obtained from pitch is treated somewhat similarly to the taranthracene. The oil is allowed to stand for some time, it is then filtered, pressed, hydraulic pressed, and treated with suitable solvents to remove most of the impurities, and there is no difficulty whatever in thus obtaining an article containing 70 per eent. and more of pure anthracene.

The residue in the retort is a valuable coke, which is free from sulphur and phosphorus, and nearly free from mineral substances, containing about 99 per cent. of carbon, and having an intense heating power; I need scarcely say it is vastly superior to the ordinary gas eoke, which contains all the mineral impurities of the eoal in a concentrated form. There are several other patents in reference to the manufacture and purification of anthracene—Clark, Lucas, Caspers, and others—which I need not further notice.

None of the natural piteh or bitumen deposits seems to yield anthracene. I have myself tried Val de Travers, Trinidad, and several other of these deposits, without getting any hydro-carbon of this series. We must at present, therefore, look to the coal tar as our only starting point.

The yield of anthracene depends somewhat upon the quality of coal, and certainly also upon the degree of heat to which the coal has been exposed in the gas manufacture. Thus it is generally assumed that Scotch coals yield little anthracene, while South Staffordshire coal is rich in anthraeene.

Pure anthracene crystallises in rhomboidal plates, which melt at 213° C. to a clear colourless liquid; it distils at about 360° C. Nearly pure anthracene may be obtained by melting a partially purified sample in a retort, and passing a strong current of air through it, when the anthracene is carried off, and may be collected in the shape of brilliant flakes, or it may also be purified by sublimation.

I have determined the solubility of pure anthracene in alcohol of different specific gravity, and also in some other solvents, and the result is as follows:—

	Per cent. Anthracene at 15° C.			Per cent. Anthracene at 15° C.	
	By volume.	By weight.		By volume.	By weight.
Alcohol ...800	·472	·591	Ether	·858	1·175
" 825	·424	·574	Chloroform ...	2·587	1·736
" 830	·408	·491	Bisulphide of Carbon ...	1·180	1·478
" 835	·397	·475	Glacial Acetic Acid	·472	·444
" 840	·387	·460	Benzol	1·470	1·661
" 850	·360	·423	Petroleum	·291	·394

Having thus obtained the anthracene by one method or the other in a saleable form, we may next consider the method of determining its marketable value, and here I come to the most unsatisfactory part of the whole subject, a part which I am anxious to thoroughly ventilate.

In other eommercial analyses the results obtained by the ehemist, in almost all cases, is expressed in percentage of a definite, pure, chemical eompound, from which, by simple ealculation, the real and exact value of the merchandise is ascertained; no room is left for manipulating the analysis or for introducing modifications, by whieh the result is affected. This is unfortunately not the case with the anthracene tests. I have already drawn attention to the difficulty the manufacturer has to contend with in separating the one hydro-earbon from the whole series, and if this is the case on the large scale, the difficulties no doubt increase with a laboratory experiment, and the chance of really trustworthy quantitative determination becomes almost hopeless. I repeat, the impurities which influence the value of the article are in all their physical properties so similar to anthracene itself, that it is impossible to effect a complete separation, either by solution, sublimation, or other meehanical means; nor do we know as yet of a eonvenient and entirely satisfactory process by which anthracene might be eonverted into a definite and distinct chemical eompound, different from analogous products obtained from the impurities.

A short account of the usual anthracene tests will bear out my opinion. The first few parcels of anthraeene were sold without any analysis whatever, and perhaps neither buyer nor seller knew what kind of bargain he had made, but soon the German alizarine makers looked up the tar distillers all over the country, and it became necessary to adopt some kind of test for determining the quality and value of this new product.

Dr. Gessert, of Elberfeld, in first introducing the alcohol test, was guided by the just opinion that the commercial value of a sample might be ascertained with sufficient accuracy by determining the percentage of hydro-carbons insoluble in alcohol, together with its melting and solidifying point. The details of the test are as follows:—

Alcohol Test.

Take 20 grammes of the well-mixed sample, heat it in a beaker glass with 150 per cent. of alcohol, sp. gr. 825, till it gently boils; then cool it to 15° C. (59° F.), bring it on a filter, and wash with so much alcohol that the filtrate measures 400 per cent. Dry the filter and residue in a water bath, detach the residue from the filter and weigh; the weight multiplied by 5 gives the percentage. Mix the weighed residue well in a mortar, and introduce a small quantity into a narrow glass tube, about four inches long and one-sixteenth internal diameter, and drawn to a point at one end; fix the tube and a delicate thermometer into a small paraffine or ozokorite bath, which heat gently and gradually. Note the moment the anthracene becomes liquid, *i.e.*, when the first drop collects at the end of the tube, this is the melting point. Now increase the temperature to about 220° C., remove the flame, and note the moment the liquid becomes solid again, this is the solidifying point, which with good samples should be nearly the same as the melting point; the mean of the two is the final point.

Now, we know pure anthraeene melts and solidifies at 213°C., and in order to make the test really accurate, the percentage of insoluble should be of such quality as to melt exactly at that temperature; but even then it might not be pure

anthracene, because some of the impurities have a lower and others a higher melting point, and a mixture of the two might melt at 213° C. This, however, is a question which need not be considered, because such a mixture would show a wide difference in the melting and the solidifying point, while with a pure, definite compound they should be very nearly the same. The determination of the melting point altogether is an operation demanding great attention. First of all, a very delicate thermometer is required, and none should be used without previous comparison with a standard thermometer; very few instruments are so exact as not to require a correction, sometimes of several degrees, both in the rise and fall of the mercury. Then, again, the melting point of these hydro-carbons, especially in small quantities, often varies in like manner as that of sulphur, consequent to a change in the condition they have assumed by previous melting, more or less strong heating, or more or less rapid cooling.

But, nevertheless, although the alcohol test cannot claim anything like analytical accuracy, it may form a guide in fixing the approximate value of the article, provided the details of the test always remain the same.

The true melting point of 213° C. was never insisted upon, but its maximum was first fixed at 200° C. Competition soon lowered it to 195° C., and ultimately to 190° C., at which it now stands, *i.e.*, the present alcohol test means the determination of per cent. of insoluble in alcohol, having a melting point of at least 190° C.

Of course, everybody knows that is not pure anthracene; still the test might be sufficiently accurate for comparative experiment, if always carried out in the same manner.

But now mercantile speculation and cleverness steps in and suggests trifling modifications for its own benefit. Knowing that the less anhydrous the alcohol is, the less it will dissolve, or, in other words, the higher the percentage of insoluble will be, several ingenious people have their test made with alcohol of 830 or 835, or sometimes even of 840 sp. gr.

Again, an impure sample may have a melting point much below 190° C. Then the chemist is often expected to take, not the actual proportion of alcohol, but an indefinite quantity, sufficient to bring up the melting point to 190° C.

In such cases the analyst is, of course, helpless; he has simply to follow the instructions he may receive, and any protest of his would perhaps have no other effect than the loss of a client.

The reason for using alcohol of half-a-dozen different specific gravities is obvious; the percentage of insoluble may thereby be increased or decreased. But such tricks and manipulations should not be tolerated; they throw doubt and confusion upon all transactions, and undermine the value of chemical analysis altogether.

Some time after the alcohol test had been adopted, the bisulphide of carbon test was introduced, which is as follows:—

Bisulphide of Carbon Test.

Take 10 grammes of the well-mixed sample, place it in a wide mouth stoppered bottle, together with 30 c.c. of bisulphide of carbon, shake up well and allow to stand for one hour at a temperature of 15° C. (59° F.); then bring the mixture on a filter, wash with 30 c.c. more bisulphide of carbon, and gently press the filter so as to dry it as much as possible; then dry completely in a water-bath, detach the residue from filter and weigh; the weight multiplied by 10 gives the percentage. The melting and solidifying points are taken as above.

The principle of this test is so far the same as that of the alcohol test, viz., that the impurities are more soluble in the liquid than anthracene, and may thereby, partly at least, be removed. We find bisulphide of carbon much more active than alcohol, and on treating one and the same sample with both tests, alcohol invariably yields a higher percentage of insoluble with a lower melting point, while bisulphide gives a lower percentage with a higher melting point. There is no fixed relation between the two results. The product of the bisulphide test seldom has a melting point below 200° C., while with alcohol very few samples indeed show so high a melting point. The result of the bisulphide test is therefore much purer, and ought to fetch a higher price; but as no definite rule can be adopted, the constant mixing up of the two tests is another source of confusion.

I have tabulated a number of experiments with genuine commercial samples of various makers from different parts of the country; they are the result of 400 alcohol tests and of 250 bisulphide of carbon tests, and the deductions drawn from these figures strikingly show the difference of the two tests, and also the low quality of the product sold at present:—

Alcohol Test of 400 Commercial Samples.

Melting Points.	Below 10 per cent.	10 to 20 per cent.	20 to 30 per cent.	30 to 40 per cent.	40 to 50 per cent.	50 to 60 per cent.	60 to 70 per cent.	70 to 80 per cent.	80 to 90 per cent.
Deg. Cent.									
Below 160	..	1	..	1	..	1	..	..	..
160—170..	..	..	1	..	1	1	..	..	..
170—180..	..	2	4	3	3	..	..	..	..
180—185..	..	1	11	16	3	2	1	..	..
185—190..	..	7	21	30	20	18	5	..	..
190—195..	..	24	35	48	51	21	13	2	..
195—200..	2	9	6	10	5	6	5	2	1
Above 200	..	1	1	1	..	1	1	2	..
Total	2	45	79	109	83	50	25	6	1

Bisulphide of Carbon Test of 250 Commercial Samples.

Melting Points.	Below 10 per cent.	10 to 20 per cent.	20 to 30 per cent.	30 to 40 per cent.	40 to 50 per cent.	50 to 60 per cent.	60 to 70 per cent.	70 to 80 per cent.
Deg. Cent.								
195—200	..	2	1	..	..	2	..	..
200—205	4	13	16	12	9	4	..	..
205—210	5	24	47	35	6	..	4	..
210—215	2	11	32	8	4	..	..	..
215—218	5	..	..	..	2	..	..	2
Total	16	50	96	55	21	6	4	2

In summarising these figures, we find with the alcohol test, out of 400 samples:—

47, or about	12 per cent.	contain	less than	20 per cent.	insoluble.
79, ,,	20 ,,	,,	from	20 to 30 ,,	,,
109, ,,	27 ,,	,,	,,	30 ,, 40 ,,	,,
83, ,,	21 ,,	,,	,,	40 ,, 50 ,,	,,
50, ,,	12½ ,,	,,	,,	50 ,, 60 ,,	,,
32, ,,	8 ,,	,,	above	60 ,,	,,

Again, as to the melting point, we find:—

153, or about	38 per cent.	melt below	190 deg. C.
194, ,,	48 ,,	,, between	190 to 195 deg. C.
46, ,,	12 ,,	,, ,,	195 ,, 200 ,,
7, ,,	2 ,,	,, above	200 ,,

Looking at the bisulphide of carbon test, we find equally satisfactory results, viz., out of 250 samples—

16, or about	6 per cent.	contain	less than	10 per cent.	insoluble.
50, ,,	20 ,,	,,	from	10 to 20 ,,	,,
96, ,,	38 ,,	,,	,,	20 ,, 30 ,,	,,
55, ,,	22 ,,	,,	,,	30 ,, 40 ,,	,,
21, ,,	8 ,,	,,	,,	40 ,, 50 ,,	,,
12, ,,	5 ,,	,,	above	50 ,,	,,

Again, as to the melting point, we find:—

5, or about	2 per cent.	melt between	195 to 200 deg. C.
58, ,,	23 ,,	,, ,,	200 ,, 205 ,,
121, ,,	48 ,,	,, ,,	204 ,, 210 ,,
57, ,,	23 ,,	,, ,,	210 ,, 215 ,,
9, ,,	4 ,,	,, ,,	215 ,, 218 ,,

I am indebted for these figures to my friend Mr. Manning, in whose laboratory these analyses have all been made in the course of last year; they fairly represent the quality of anthracene met with in the market at that time, and I do not think any sensible improvement has taken place since. Surely the manufacturer must soon find it to his own advantage to supply a higher class article.

With the alcohol test we have 80 per cent. containing less than 50 per cent. of insoluble, but only 2 per cent. of more than 70 per cent. of insoluble, which is the lowest quality the alizarine maker could use. Taking the melting point, we have 38 per cent. below 190° C., the lowest melting point at which the article is at all saleable, and only 2 per cent. above 200° C., which is not even the true melting point.

With the bisulphide of carbon test we have 94 per cent., with less than 50 per cent. of insoluble, and only 5 per cent. above that, while the melting point in all samples is much better, only 2 per cent. below 200° C., and 94 per cent. between 200° and 215° C.

To show the comparative value of the two tests, it was necessary to make a series of experiments with both alcohol and bisulphide, and the following list gives a few of such experiments. I have purposely selected a great variety, from the lowest to the highest quality, which will bring out several points most prominently. I have given the results in round numbers, omitting the decimals, both in percentage and temperatures (see next column).

These thirty experiments represent samples varying with the alcohol test from 20 to over 70 per cent., with a melting point running from 154° to 211° C., while the bisulphide of carbon test varies from 5 to over 70 per cent., with a melting point of from 201° to 218° C.

The relative proportion between the two tests fluctuates with bewildering variety. With the low percentage the difference is as much as 4 to 1, with a vast difference in the melting point; but the higher the percentage the more uniform it becomes; nay with the last sample the alcohol is actually lower than the bisulphide with nearly the same melting point, namely 72·50 per cent. 211° C., against 74 per cent., 213° C.

Comparative Results of Alcohol and Bisulphide of Carbon Tests.

Alcohol.		Bisulphide of Carbon.	
Per cent.	Melting point. Degs. C.	Per cent.	Melting point. Degs. C.
20	154	5	212
20	184	5	204
22	165	5	218
25	177	13	209
27	187	18	207
27	183	15	208
28	181	13	209
30	184	10	208
32	184	21	205
35	183	21	209
36	181	18	202
38	180	22	203
41	184	27	208
42	188	28	211
43	191	31	204
44	189	32	207
46	192	31	209
47	188	32	207
50	192	36	207
51	198	42	212
53	194	36	209
54	157	10	204
56	185	40	201
57	189	43	205
58	183	41	201
59	190	42	203
61	198	50	211
64	200	61	208
69	201	64	208
72·5	211	74	213

Looking at the melting point only in all these tables, the bisulphide of carbon series are the most reliable as approaching the quality of pure anthracene; the last table of alcohol test gives only one-third melting above 190° C., whilst the previous table gives about two-thirds, the rest being only indifferent.

If we want to compare the two tests, we can take only those alcohol samples which melt at or above 190° C. We then find the average proportion to be about 3 to 2, but as we know that the one product is much purer than the other, it must be clearly understood that it is so much more valuable. and no attempt should be made to simply substitute the one test for the other. However, under all circumstances, it will be desirable to improve the quality generally and to increase the percentage, especially by separating the oil as much as possible. But as long as this is not done, I would propose to wash the samples to be tested with light petroleum spirit. and to press and to dry them before using either alcohol or bisulphide; thus a more correct result will be obtained, and in case this should be adopted, more uniformity in the analysis would be insured. But, after all, these tests only give approximate results, and the want of a truly scientific treatment has long been felt. Now in producing alizarine from anthracene, the first step is to convert it into anthrachinon, and this reaction appears to be capable of adoption for analytical purposes.

Mr. Luck, a chemist at Meister, Lucius and Co's., published, some months ago, in the

"Berichteder Deutchen Chemishen Gesellschaft," the following details of an

Anthrachinon Test.

Heat in a flask 1 gramme of anthracene together with 45 c.c. of glacial acetic acid till it gently boils; add gradually, and at intervals of 5 to 10 minutes, a solution of 10 grammes of chromic acid in 5 c.c. of glacial acetic acid and 5 c.c. of water. To prevent any loss of acetic acid during boiling, the flask is mounted with a condenser, which allows the acid constantly to flow back. About two hours' gentle boiling in most cases completes the decomposition, after which allow to cool, add 150 c.c. of water, and let stand for a couple of hours. Light yellow needles of anthrachinon separate from the green liquid. Bring the whole on a filter, wash the crystalline residue first with water, then with a very dilute, hot solution of potash, until the liquid runs off perfectly colourless; and, lastly, again with water, to remove traces of alkali. Now dry the filter in a water bath, and when perfectly dry detach the anthrachinon with a spatula, and weigh. This last direction is given in preference to weighing the residue and filter, because it has been found that the dilute chromic and acetic acid dissolve part of the filter, the original weight of which would thereby be altered.

Before calculating the anthracene from the anthrachinon obtained, a correction must be made; it has been found that 50 c.c. of acetic acid and 150 c.c. of water, as used above, dissolve 0·010 grammes of anthrachinon, which must be added to the weight actually found.

If the anthracene contains sand, or other impurities insoluble in acetic acid, a previous filtration through a small filter becomes necessary; very oily samples have to be pressed first between blotting-paper. Now, this test is based upon the argument that, chemically pure anthracene yields the theoretical quantity of chemically pure anthrachinon, and that the other hydro-carbons are either destroyed by oxidation, or are converted into compounds readily soluble in diluted alkali.

I think, as far as the experiment with pure anthracene goes, the result may be satisfactory, and after having ascertained that the quantity of acid and water used dissolved anthrachinon which corresponds exactly to one per cent. of the sample, the above correction may possibly be admitted, although it is rather a novel addition to analytical chemistry; but as soon as we have to do with a mixture, the conditions are changed, and such correction would make the analysis worthless. Another drawback is the necessity of detaching the anthrachinon from the filter, which is simply impossible without scraping off some paper and losing some crystals.

But a still more serious objection is the fact that some of the other hydro-carbons are acted upon in precisely the same manner as anthracene, and their products are as little soluble in dilute alkali as anthrachinon itself.

Phenanthren dissolved in acetic acid is very slowly oxidised by chromic acid, so that after six or eight hours' boiling much is left unaltered; the phenanthrachinon forms needles of an orange colour, which melt at 205° C., and may thereby be distinguished from anthrachinon, which melts at 273° C., but phenanthrachinon is further decomposed in biphenic acid $C_{14} H_{10} 0_4$; but this is a later reaction.

Chrysene, treated in a similar manner, yields also a chinon, in orange-yellow needles, insoluble in alkali.

Thus we see two at least of the impurities, and perhaps the two most important ones, form similar compounds to the one which should stand out alone in the whole series; the attempted separation is not complete, and the test is highly unsatisfactory. On the one hand the results are too low, and on the other hand they may be too high.

I had hoped to find in picric acid a means of separating the different hydro-carbons, but, as I have pointed out before, although the whole series forms picrates, the compounds are so little stable, and we cannot separate them with sufficient accuracy, that an analytical method is not likely to result from the use of this acid.

At present, then, we must confess the want of an absolutely true quantitative laboratory test, and I am not very sanguine of complete success in this direction. I may compare the difficulties we have to encounter with those met with in the determination of the alkaloids in cinchona bark; here also we have a whole series of compounds, extremely similar to each other in their chemical and physical behaviour; here also we have one member of the series, the quinine, prominently standing out; and although the subject has been studied for many years, and although several methods have been proposed and are followed out, we must confess none of these methods gives entirely satisfactory and reliable results.

But if chemical science is at fault here, let the manufacturer make use of it, when it can assist him, in the improvement of his crude material; let him produce an article of high percentage, and he will thereby best assist himself in removing the difficulties in the valuation of his product.

In arriving at the second part of my paper, the convertion of anthracene into alizarine, I am almost afraid of touching it, because the few remaining minutes will only suffice to treat the subject in the most superficial manner, and because I must say a few words on madder and its preparations, the very life and existence of which are seriously threatened by this new industry.

In the East the madder plant has been known since the earliest times; from there it came to Greece and Italy, thence to the South of France, Alsace, Holland, and Germany. In Holland it has been cultivated more than 300 years; in France it has risen to great importance since the middle of last century, especially in Avignon, which now produces about one-half of all the madder consumed, to the value of about £750,000 per annum. Turkey and South Russia also supply considerable quantities of high quality. Some experiments in cultivating madder in this country have been made in Derbyshire, some years ago, but with indifferent results. The soil, the climate, and the weather have the most decided influence upon the growth of the plant, and the subsequent development of the colouring principle. The Dutch madder will dye red, but not purple, and the colour is not fast. Naples madder dyes good red and purple, but the colours are not fast; that of Turkey dyes good red and purple, and is very fast. France supplies the market with two qualities, called "rosées," from their dyeing beautiful reds and pinks, and "paluds," which gives a good purple, besides fine reds, and is the best French quality. The last name is derived from the fact that the plants are grown on marshy land.

The cultivation of the plant and the ultimate separation of the colouring principles is a matter of much time and uncertainty. The root must remain in the ground for a long time—in France two or three years, in Turkey five and seven years—and after having been dried and coarsely powdered, it must be kept another year or two to develop the colouring principles which are not ready formed in the root.

For many centuries, and until the beginning of the present one, the root was used direct, and no attempt was made to separate the colouring matters or to apply them in a concentrated and pure form, but with the development of technical industry and scientific investigation the concentration or separation of the valuable constituents gradually commenced. The first step was the manufacture of "fleur de garance," madder deprived of all substances, soluble in water, and then dried again, which reduced the bulk to about 60 per cent. The washings contain a considerable amount of sugar, which by some French manufacturers is converted into alcohol. A ton of madder gives about 15 gallons of alcohol, of rather unpleasant flavour, but well adapted for technical purposes.

Garancine is madder further treated with sulphuric acid, which destroys part of the ligneous fibre, yielding about 25 per cent., in the form of a fine powder of light brown colour.

Alizarine verte and purpurine are the results of treating madder with sulphurous acid, which dissolves both; after adding sulphuric acid to the solution and heating to 40° C., purpurine separates about half or three-quarters per cent., and on further heating to 100° C., alizarine verte separates about 3 per cent.

Yellow alizarine is obtained by further purifying this alizarine verte.

Extracts of madder are mostly obtained by treating the root with boiling water, collecting the precipitates which separate on cooling, mixing them with gum or starch, and adding acetate of alumina or iron. This is, in fact, a mixture of colouring matter and a mordant, which may be used for printing direct. These are the principal madder preparations, many of which are manufactured in this country.

In speaking now of the artificial alizarine and its manufacture from anthracene, the three principal links in this process are seemingly :—

Anthracene................	$C_{14}\,H_{10}$
Anthrachinon..............	$C_{14}\,H_8\,O_2$
Alizarine..................	$C_{14}\,H_8\,O_4$

The conversion of anthracene into anthrachinon does not offer any difficulty. It has been studied by Anderson long before any practical application ever was thought of.

Chromic acid or nitric acid readily effects the change, but chromic acid is preferable, inasmuch as nitric acid also gives rise to the formation of some nitro compounds. The crude product is readily purified by sublimation, when the anthrachinon is obtained in fine yellow needles, which melt at 275° C.

Anthrachinon strongly resists the action of any oxidising agent, and although Wartha succeeded in converting small quantities into alizarine by heating it with an alcoholic potash solution, still this direct oxidation is practically not possible; it therefore became necessary to further convert anthrachinon into a compound which, when treated with potash, would yield alizarine.

The methods of converting anthracene, not only into anthrachinon, but into a further substitution compound, form the principal subject of different patents, a short review of which will at once give the history of the rapid development of this new industry.

Graebe and Liebermann, the original discoverers, claim in their first patent the treatment of anthrachinon with bromine or chlorine, thereby obtaining bibrom or bichlor anthrachinon, which, fused with caustic potash, yields alizarate of potash, and this in its turn decomposed by hydrochloric or any other acid leaves alizarine. They also obtain the bromine or chlorine compound without the formation of anthrachinon by acting upon anthracene direct with bromine or chlorine, thus obtaining the tetrabrom anthracene or corresponding chlorine compound; this boiled with nitric acid gives bibrom anthrachinon.

$C_{14}\,H_{10}$	$C_{14}\,H_{10}$
$C_{14}\,H_8\,O_2$	$C_{14}\,H_6\,Br_4$
$C_{14}\,H_6\,Br_2\,O_2$	$C_{14}\,H_6\,Br_2\,O_2$
$C_{14}\,H_6\,K_2\,O_4$	
$C_{14}\,H_8\,O_4$	

Broenner and Guzhow's patent, the next one, is so confused that it is difficult to clearly understand it; but it seems evident, among a great mass of irrelevant matter they point out, that the above treatment with bromine and chlorine may be substituted by the action of sulphuric or nitric acid. They claim to produce not only alizarine, but also purpurine.

Caro, Graebe, and Liebermann, in another patent, claim the production of the sulpho acid of anthrachinon by treating anthrachinon with sulphuric acid, removing excess of sulphuric acid by carbonate of lime, then adding carbonate of soda, evaporating the solution of the soda salt to dryness, and fusing it with caustic soda or potash. They also avoid the introduction of anthrachinon by treating anthracene direct with sulphuric acid, and obtain the bisulpho acid of anthracene, which is converted into bisulpho acid of anthrachinon by means of oxidising agents, such as peroxide of manganese.

$C_{14}\,H_{10}$	$C_{14}\,H_{10}$
$C_{14}\,H_8\,O_2$	$C_{14}\,H_8\,(H\,So_3)_2$
$C_{14}\,H_6\,(H\,So_3)_2\,O_2$	$C_{14}\,H_6\,(H\,So_3)_2\,O_2$

The first part of the last patent, viz., the formation of the bisulpho acid of anthrachinon, is also claimed by Perkin, in a patent dated one day after Caro, Graebe, and Liebermann's.

Perkin holds also the next patent in which anthrachinon is again avoided. Bromine or chlorine compounds of anthracene are acted upon by sulphuric acid, and the result oxidised by peroxide of manganese. Dale and Schorlemmer have further simplified the re-action; they boil anthracene with sulphuric acid, remove excess of acid by carbonate of lime, and treat the solution with caustic potash and nitrate or chlorate of potash. The last patent has been obtained by Meister, Lucius, and Bruening; this embodies the treatment of anthrachinon with fuming nitric acid and production of mononitro anthrachinon.

I can do nothing but give the reactions which are intended to be produced, without attempting to allude to the great delicacy of the operations. I need scarcely say that at every step the most attentive care is required, because almost every reaction may either be not carried far enough, or may be carried too far, and in either case total or partial failure in the manufacture must be the inevitable consequence.

I have merely given the seven patents because they will best show the tendency to simplify the original elaborate and costly processes, and that this has been effectually done is shown by the large quantity of alizarine produced, and by the great reduction in price.

The artificial product is mostly sold as paste, which is better applicable than a dry powder, which would not mix so well and uniformly. Of course this paste is not chemically pure, but whereas two years ago many samples did not contain more than 5 per cent. of alizarine, the quality has now vastly improved.

Pure alizarine may readily be obtained by evaporating the paste, and then extracting the colouring matter, or by sublimation, as shown by different specimens.

Great doubts were first expressed as to the quality of the dye compared with that of madder preparations, but they seem not to exist any longer; it has been convincingly proved by Bolley, Kopp, Schunck, Perkin, and others, that the natural and artificial alizarine are identically the same, and the same results are produced.

The question of price has also been settled, whereas not two years ago the difference was greatly in favour of madder, it is now about the same, in consequence of the greatly increased production.

There is now one factory in this country, founded by Perkin, one in France, and more than a dozen in Germany and Switzerland. Some idea of the extent of this manufacture may be formed from the fact that last year more than 1,000 tons of 10 per cent. paste were produced, in value of £500,000, and it is stated that one German firm are preparing to make 500 tons a year.

The effect upon madder cultivation has naturally been most serious, and especially at Avignon the question is most anxiously discussed whether the artificial alizarine will ultimately drive the madder out of the market altogether. The vitality of the new product is more than secured, but although it must very seriously injure the madder interest, it need not necessarily kill the natural product altogether. There may be room for both, and an increased production may, and undoubtedly will, insure a vastly increased consumption.

Such effect we have seen with the introduction of the aniline dyes; a whole series of new compounds of formerly unknown shades have sprung up, of a total value of about £2,000,000 a year, and have they thrown any of the old dyes, madder, or indigo, out of the market? No; new applications have been found, more coloured articles of every description are used; and so it will be the same with alizarine—the more it is manufactured, the more it will be used.

No doubt the madder growers will have to struggle hard in the competition, and of this they seem to be aware already. Only the other day the Agricultural Society at Avignon inquired of the Industrial Society at Mulhausen what they had to fear of artificial alizarine. The answer was, that to successfully compete, they must improve their product; they must not only sell the raw material, containing but a few per cent. of valuable matter, but they must call in the assistance of science; they must manufacture the extracts of such quality as is made in Paris and England; but that it was impossible to drive the artificial product out of the market again. In such manner the artificial alizarine will have the merit of improving the quality of its ancient rival.

But even supposing madder cultivation were destined to die out, would the ultimate general advantage not more than compensate the individual loss? Many thousands of acres of land would be set free, and would with other crops give a better return than now, when the root must remain for years in the ground. Seldom, if ever, have such splendid results been obtained in so short a time. Here we see a most unpleasant and perfectly useless greasy substance suddenly turned into one of the most beautiful colouring matters; a new application for immense quantities of various chemicals is found, a number of important manufactures is started, the effect of which is felt more deeply than we can be aware of. And science itself, in accomplishing this revolution, largely profits by it, because the investigation of all the connecting links has of late years given us an insight into the internal arrangement and constitution of these chemical compounds, hitherto unknown.

To England especially the practical part of the question is of the greatest importance, because after all, England is the great tar-producing country, and the principal supply of anthracene must always come from here. The nine London gas works alone convert about 1½ million tons of coal into gas, and produce about 12 million gallons or 60,000 tons of tar a year. The gas companies have not been slow in profiting by this invention; the price of tar has already been more than doubled, an increase almost sufficient to reduce the price of gas a penny or twopence per 1,000 feet.

And finally, must alizarine be the only colour derived from the solid hydro-carbons? It is not very likely that others will be produced from anthracene and its homologues.

Boettger has already separated an anthracene orange of great dyeing power; Springmuhl has succeeded in obtaining a most beautiful blue, the only drawback in the manufacture of which is at present that it would cost about £600 a pound; but one might almost say this is the least difficulty, because the compound once obtained, an easy and economical process of manufacture is almost sure to follow. But while we are thus waiting for further triumphs in this and similar directions, let us not forget to honour and to admire the perseverance, energy, and industry of those scientific minds who, whatever their nationality, have contributed in solving the great problem of imitating and outrivalling nature's silent working, and who have succeeded in producing on scientific principles one of the most lovely natural colouring matters.

DISCUSSION.

Mr. Manning said the point to which he wished to refer was the anthrachinon test. In estimating the value of any test for commercial purposes, it was necessary to have regard to the purpose for which the analysis was required. Now, in the first place, it was an essential point that the result should be constant; and secondly, that it should fairly represent the colour producing power; in both these respects the anthrachinon test fairly answered the requirements. It was difficult in a few words to give precise information as to the reliability of any test, but as a rule the comparative results did not differ more than a half per cent. from any slight difference in manipulation, such as would go to destroy any of the old methods of testing. One experiment he made was to take four different samples, and modify the process by boiling them for 2 hours, $2\frac{1}{2}$ hours, 3 hours, and $3\frac{1}{2}$ hours respectively; but the results all corresponded, the widest difference between the four not being greater than a half per cent. The same sample was examined in another laboratory quite independently, and the results closely corresponded, there not being more than a quarter per cent. difference. The question was often asked what was the relation between the anthrachinon, the bi-sulphide, and the alcohol tests. So far as his experience went, and it extended over between 100 and 200 experiments, he found no relation between the three. The greatest difference was between the alcohol and the anthrachinon, namely, 25 per cent, *e. g.*, a sample which by the alcohol test yielded a definite percentage, when tested by the antrachinon method would give a 25 per cent. lower value, whereas the nearest approach between the two showed a difference of 10 per cent. The difference between the bi-sulphide test and the anthrachinon was not so great, the largest difference being about 10 per cent., and the smallest being from 1 to 3 per cent. on either side. With regard to the bodies mentioned in the last table by Dr. Versmann, he had not been able to procure all of them, but those which he had obtained he had experimented on in the same way, and found them all convertible with caustic potash, though no doubt the Phenanthren was the least readily oxidiable. Possibly, however, this difficulty might be got over, and the colouring power was very intense, showing itself at once, if there was the least trace of phenanthren on the filter, by a strong orange colour which could not be mistaken. With regard to the other bodies, chrysene and benzerythrene, he did not find that they remained on the filter, but were all separated from the anthrachinon, and it was therefore fair to infer that that which was left on the filter in the ordinary process gave very fair and reliable results.

Mr. E. Brooke desired to thank Mr. Manning for the manner in which he had spoken of the anthrachinon test. What was wanted evidently was a test which would be equally good for the seller and the buyer, but it seemed to him that the tests which had been hitherto adopted, such as the alcohol test, were in favour of the seller, and not the buyer. Now, in order to do business successfully, the interests of the buyer and the seller should be identical, and therefore if they could discover a test which would be satisfactory to both parties, it would be a great advantage to all concerned.

Mr. Manning said one great point in favour of the anthrachinon test was, that it was constant in its results. Unless you could do away with the discrepancies which must always arise from the adoption of such methods as had been hitherto in use, which depended wholly on the solvent power of different re-agents, it was obvious that slight differences must very materially modify the result.

The Chairman remarked that there were many suggestive points in the paper, which he had hoped would be taken up by gentlemen who had given their attention to the subject. For instance, there was the question of the distillation of pitch, and the proportion of anthracene said to be obtained from coal tar and from pitch, on which much difference of opinion existed. He had been rather surprised to hear of so large an amount being derived from pitch, having been under the impression that the principal portion of anthracene was obtained in the fractional distillation of tar, or the more volatile portions, and that the higher hydro-carbons, such as chrysene, came in larger proportions from the pitch.

Mr. Dickenson believed that the produce of the distillation of pitch was anthracene of a low fusing point, about 75°, a large quantity of which was now coming into the market. His idea was that the larger quantity of anthracene was obtained in the earlier part of the process, so that if you had 40 gals. in the still, you would get the best quality from the first 30 gals. which passed over, and not much from the last ten. Some time since he had the misfortune to have a boiler burn out, and he found the anthracene resulting was of such a greasy sticky nature, that even when mixed with better qualities it had a very low fusing point, and had to be put aside. He should like to know if this body of low fusing point, obtained from pitch, was really a colouring body. It was soluble by the bisulphide of carbon test, but not by the spirit test. The amount of chrysene obtained from the distillation of tar was very trifling, according to his experience.

Mr. Woodall, speaking as a gas engineer, as gas making was their principal business, and tar making only a secondary matter, wished to know if he had correctly understood Dr. Versmann that the yield of anthracene depended in great measure on the temperature at which the tar was distilled, and if so, whether this statement was based on actual analyses. He understood that the tar distilled from coal at a low temperature was richer in benzole than that distilled at a high temperature, and as the greater part of the anthracene seemed to be obtained from the pitch at the end of the distillation of the tar, it seemed as though the temperature in the gas retort did not have much influence on the quantity of anthracene present in the tar so obtained.

Mr. Spiller said, with regard to the mode of attacking the anthracene in the process of conversion, Dr. Versmann had spoken of two processes of different characters; first, by the direct action of sulphuric acid on the anthracene, and secondly, that by which the anthracene was first chlorinated, and then by treatment with concentrated sulphuric acid oxidised, and so converted into alizarine. In studying the action of these agents, he had noticed very manifest advantages in the chlorinating system, because it appeared to so far separate the molecules of the hydro-carbon, that the hydrated acid could afterwards effect a more rapid and thorough conversion, and, in fact, you thus accomplished what was done in many different branches of manufacture, in working with a variety of aniline colours by the aid of hydro-chlorides, obtaining certain colouring bases which you could not obtain by the direct action of sulphuric acid itself. With all deference, therefore, he thought there was an advantage in the use of that which Mr. Perkin himself had introduced, the chlorinating process, which appeared to render the hydro-carbon more readily available in the after process.

Dr. Versmann, in replying to the various observations which had been made, said he was glad to hear that Mr. Manning was so well satisfied with the anthrachinon test, because he knew that gentleman had had as much experience in the matter as anyone, and it gave satisfactory results for commercial analyses; that was all that could be looked for at present. Still there were difficulties, as he had already pointed out, and some, he believed, were rather serious; at least the anthrachinon test could not claim the merit of strict analytical accuracy, as there might be circumstances under which the

results would be affected one way or the other. First of all, the necessary loss of 1 per cent. in the result was of serious moment, and, as far as he remembered, was unparalleled in analytical chemistry, except in the case given by Fresenius for solubility of magnesia compounds in water, and there the loss was very trifling—nothing like 1 per cent. Then again, there was the difficulty of separating any impurities, but that applied to the bisulphide test as well. It was impossible to avoid carrying over a little coal-dust or coke, which went right through, and was weighed as anthrachinon. Again, if as was proposed, the anthracene, before being submitted to the action of the chromic acid, was dissolved in acetic acid, then added to a concentrated solution of strong glacial acetic acid, and lastly filtered, without subsequent wasting, there must of necessity be a serious amount of anthracene left in the filter. Another difficulty was connected with the filter itself; but he understood that Mr. Manning had hit upon a very ingenious plan for overcoming it. It was impossible to scrape off the whole of the anthracene from the filter if it was dried on the filter, and as the dilute chromic acid and acetic acid dissolved part of the filter, it was impossible to arrive at a correct result by deducting for the gross weight the previous weight of the filter. It had to be dried and carefully scraped off, and it was impossible to avoid taking off some of the paper and leaving some of the crystals. Mr. Manning overcame that difficulty in a very ingenious way, by using two filters together, one of which filtered the anthrachinon, and the other did not, but otherwise was treated in exactly the same way, then by setting one against the other he was able to obtain the exact weight of anthrachinon present. It was sometimes necessary, moreover, to use further precautions, for he recollected one sample being sent from Germany which he was told afterwards contained 6 per cent. of brick dust, and of course if such an article could be sold to any extent at 3s. or 4s. a lb., it would be a very good speculation. If this sort of thing occurred, it would be necessary to begin by dissolving out all the soluble hydrocarbons, to see how much insoluble residue there might be. As to the different percentage of anthracene obtained from tar and pitch, it was very difficult to speak positively, because neither pitch nor tar was a definite compound. If you took the pitch obtained from very soft tar you got very little oil and comparatively little anthracene, but if you drove the distillation as hard as you could without burning the bottom out of the boiler, so that the pitch was only just soft enough to run out in a liquid state, the proportion was much greater. Broadly speaking, he believed the proportions were as 1 to 3; in other words, the proportions of anthracene in tar seldom came up to 1 per cent., and from pitch it was very often 3 per cent. Practical experience had shown that some coals yielded more anthracene than others. He had experimented with the pitch obtained from English, French, American, and German coal, and sometimes found the difference very great indeed, but the result was no doubt chiefly owing to the manner in which the tar had been obtained, whether the coal had been exposed to a very strong heat or not. It was generally found, however, that the tar which gave most benzole also gave most anthracene, whilst that which gave more of the liquid hydro-carbons of a higher boiling point gave less anthracene. Very likely in the production of the tar, the toluol was partly converted into anthracene, just as Berthelot succeeded in obtaining anthracene from toluol. With regard to Mr. Spiller's remarks on the value of the processes introduced by Mr. Perkin, he must repeat what he had said before, that he had not time to go into the different processes for the production of alizarine, and therefore confined himself to a simple enumeration of them; but he quite agreed that to no one more than Mr. Perkin were they indebted for improvements in these processes.

The Chairman, in proposing a vote of thanks to Dr. Versmann, said that although the development of this industry within the last three years was marvellous, it was evident that much still remained to be done, and the concluding remarks of Dr. Versmann clearly pointed to this, that the wider development of this anthracene industry, the more one might hope to see it rival that which had resulted from the manufacture of other coal tar colours. Just as the magenta red aniline dye had given rise to a large family of colours, and to distinct industries, one might also hope in obtaining alizarine so pure and in such large quantities, to see new colours arise, and if it did not entirely replace madder it might lead to a different utilisation of the large tracts of land which were now devoted to this somewhat wasteful cultivation. They were all much indebted to Dr. Versmann for bringing forward this subject, on which there were some points evidently not yet cleared up, but such discussions as these afforded the best opportunity of doing so, and he hoped on future occasions to find them taken still more advantage of for giving and receiving information on practical points.

SIXTEENTH ORDINARY MEETING.

Wednesday, March 25th, 1874; the Right Hon. Lyon Playfair, C.B., M.P., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Allen, Alfred H., F.C.S., 1, Surrey-street, Sheffield.
Armbruster, Charles, F.C.S., the Grove, Hammersmith, W.
Charles, Peter, Church-street, Stoke Newington, N.
Cockey, Henry, Iron Works, Frome, Selwood.
Cookson, Faithful, F.R.G.S., Teddington-hall, Teddington, Middlesex.
Field, Charles, Hither Green-lodge, Lewisham.
Gibbs, Thomas, Bede Metal and Chemical Company (Limited), Jarrow-on-Tyne.
Glover, Hugh C., the Gothic, Highgate-road, N.
Glover, John, 214, St. John-street, Clerkenwell, E.C.
Glover, Richard Thomas, the Gothic, Highgate-road, N.
Johnstone, John Brown, Hall Bank, Ladbroke-terrace, Kensington-park, W.
Knight, Frederick, 14, Rood-lane, E.C.
Knight, Jasper, 2, Great St. Helen's, Bishopsgate-street, E.C.
Langley, Leonard, J.P., Well Hall, Eltham, Kent.
Lloyd, E. R., Albion Tube Works, Birmingham.
Wagner, Henry, M.A., F.R.G.S., 16, King-street, St. James's, S.W.

The following candidates were balloted for and duly elected members of the Society:—

Bartholomew, Alfred J., 5, Newcastle-place, Clerkenwell, E.C.
Coussmaker, Captain George, Westwood, Guildford.
Eschwege, Hermann, 6 and 7, Coleman-street, E.C.
Heath, Burr, 19, Carter-lane, E.C.
Higgins, P., 15, Bury-street, E.C.
Holliday, John, Meyrick-house, Hill-top, West Bromwich.
Hörstmann, F. Oden, Messrs. H. Hörstmann and Sons, Philadelphia, U.S., America.
Lawford, William, 1, Westminster-chambers, S.W.
Looker, Benjamin, Kingston-on-Thames.
Lotz, William Frederick, 19, Carter-lane, E.C.
Murton, James, 8, Argyle-square, W.C.
Robertson, David J. U., 174, Chatham-street, Liverpool.
Stark, W. Emery, 23, Bedford-street, W.C.
Weinmann, Dr. F. L., 5, Wykeham-villas, Wandsworth-common, S.W.

The Paper read was:—

ON THE LONDON INTERNATIONAL EXHIBITION OF 1874.

By Henry Hardy Cole, Lieut. R.E.

It is said that the idea of International Exhibitions is worn out, and that the public is tired of them. There is some truth in this remark as applied to the Great International Exhibitions since 1851, each of which has rivalled its predecessors in size and cost, and—excepting the London Exhibition of 1862—in pecuniary loss.

If these exhibitions are regarded simply as great fairs, no doubt the novelty and fashion of them have declined.

It is the perception of this fact which has led to the establishment of the International Exhibitions at Kensington. These do not aspire to be merely great fairs. Their aim is to show the progress of fine and industrial art from an educational point of view.

A long experience, extending over many years, in fine art, agricultural, and horticultural shows, proves that when exhibitions are limited to precise classes of objects their interest increases as well as their utility.

In 1760 the Society of Arts lent their rooms to the artists of London for purposes of exhibition, and thus originated the exhibitions of the Royal Academy. The extent and attractions, however, of that exhibition were small compared with the exhibition which now takes place in Burlington-house; the Royal Academy exhibitions have led to those of the Old Water Colour Society, of the Society of British Artists in Suffolk-street, of the Institute of Water Colours, of the Dudley Gallery, &c., besides annual picture exhibitions in Manchester, Liverpool, Birmingham, &c. So with agricultural exhibitions. These commenced in a humble way, and now they are so grown that they cannot contain all the different kinds of machinery, and it is found necessary to divide the classes of machinery, and to spread them over a period of years. Modest imitations of these exhibitions, as well as those of horticulture, take place yearly in many parts of the kingdom.

If I might venture to prophesy, I would say that hereafter it will probably be found necessary to lessen the number of industrial classes in each year, and to extend the period for the series.

The establishment of this series at Kensington originated with the Royal Commission for the Exhibition of 1851, incorporated by charter to dispose of the surplus arising from that exhibition in the promotion of science and art.

Since 1851 many other exhibitions have taken place in this and other countries, and her Majesty's Commissioners took advantage of the information which the different organisations afforded in determining the principles on which the present series should be based. It was observed that hitherto the tendency was to encourage undue increase in size, to admit objects not distinguished for peculiar merit, and to throw heavy expenses on exhibitors.

The immense size of the shows and the variety of objects displayed, confused, distracted, and wearied the visitor, whilst expense and uncertain reward fell to the share of the exhibitor, and produced dissatisfaction in his case also.

It has, however, now been found possible to organise exhibitions which shall be generally beneficial, but to do so it was necessary to confine them to a few branches of industry. The general scheme established is to admit every year fine art and new scientific inventions, to illustrate two or three industries, to admit such objects only as meet with the approval of a competent committee of selection, and to save to exhibitors, as far as possible, cost and trouble, by providing space free of rent, glass cases, stands, steam power, and other appliances for the proper exhibition of their objects.

The first three exhibitions of the series of ten have been attended with considerable success to the industries represented.

In 1871, when the industrial classes were confined to pottery, woollen and worsted fabrics, and educational appliances, much interest was excited by the complete show of all kinds of china and earthenware, and by the collection of every kind of common peasant and characteristic pottery made and still in daily use in all parts of the world. Visitors were afforded the opportunity of studying the manufacture of woollens, from the rearing of sheep and goats to the weaving and finishing of the fabric; and her Majesty's Commissioners provided the first example of a real technical "wool-carding school," long needed in the North of England and Scotland.

In 1872, when the industries were jewellery, paper, printing, stationery, cotton fabrics, and musical instruments, there was the most perfect collection of characteristic peasant jewellery from all countries ever shown; and the opportunity was afforded of seeing the "Walter" printing press print off the *Times* newspaper, certainly the greatest advance in the art of printing by machinery which has yet been made. New fibres for paper making also were prominently brought before the public in this exhibition, and the attention of the English trade was directed to the advances made by Russia in water-marked papers.

Last year, when the classes were carriages, silk, food, and cooking, the immediate public benefits which arose out of the exhibition were the improved cabs produced to compete for the prizes offered by the Council of this Society, and the establishment of a School of Cookery, the success of which has resulted in the formation of a permanent National Training School for Cookery. The exhibition of silk presented some points of very considerable interest, notably the silk-reeling machine shown by M. Jouffray, of Vienne, for the exhibition of which especial thanks are due to M. Lintilhac, and the silkworm magnanerie, in which M. Roland carried out, with complete success, his system for the production of grain in the open air. The exhibition of this interesting system was due entirely to the energy and aid of Sir Daniel Cooper. Mention should also be made of the machines for utilising waste silk which were shown by Messrs. Greenwood and Battley, and kept at work by Mr. Tucker.

The usefulness of the Annual International Exhibitions lies in their bearing on technical instruction, and opportunities afforded for the study of particular industries; and in view of increasing the sphere of their usefulness, her Majesty's Commissioners have invited the alliance of corporations, trade companies, and special societies, in order that the students in schools connected with

them may be sent to study the exhibition. Considerable support has already been met with towards the furtherance of this object, and a National Association for the Promotion of Technical Instruction has been formed. This association consists of two classes of members. A subscription of £5 entitles the subscriber to receive 200 tickets for artisans or 400 tickets for children, together with a transferable season ticket; a subscription of £3 entitles the subscriber to receive 120 tickets for artisans or 240 school tickets, together with a non-transferable season ticket. The artisans and children's tickets will be available on Mondays or Saturdays during the months of August, September, and October; and it is in contemplation to institute a series of lectures on the industries shown in the exhibition. This Society has already commenced to make use of the exhibitions for giving aid to technical instruction. This aid, which can be afforded by no other means, consists of scholarships offered for the best examination in the industrial classes of each year. The technological examinations conducted by this Society furnish the necessary machinery, and the scholarships are awarded on the condition that the recipients go for one year to some place of scientific instruction, such as the Royal School of Mines, the Royal College of Science in Dublin, Owens College, Manchester, or the English, Scotch, or Irish Universities, or other approved schools, or travel abroad for the purpose of improving themselves in their trade.

In 1873, two scholarships of £50 each were awarded for the best examinations in carriage-building and steel manufacture, and this year similar scholarships will be offered for examinations in civil engineering, leather and harness, and in methods of heating.

His Royal Highness the Prince of Wales held a conference at Marlborough-house, on Monday, 21st July, 1873, of representatives of the principal City Companies, with the view of discussing how technical instruction might be promoted by the City Companies acting in concert with the International Exhibitions. The conference was attended by the Lord Mayor, the Earl of Carnarvon (chairman of the Board of Management of the Commissioners), Sir William Anderson, K.C.B., and by the representatives of the following companies:—Blacksmiths', Clockmakers', Clothworkers', Coach and Coach Harness Makers', Coopers', Curriers', Drapers', Dyers', Fishmongers', Glass-sellers', Gold and Silver Wire Drawers', Haberdashers', Ironmongers', Joiners', Masons', Mercers', Merchant Taylors', Plasterers', Saddlers', Stationers', Tin Plate Workers', Wheelwrights', and Woolmen's. The meeting promised the best support and co-operation of the City Companies.

In organising the present series of exhibitions it was considered that the awarding prizes by juries was not expedient. The opinion formed by Mr. Cole, and recorded in his report on the management of the Paris Exhibition of 1855, was that the judgment of juries merely follows and confirms public opinion, but that, in so far as serious omissions are made, it is absolutely in arrear with public opinion, and becomes unjust.

The experience of past exhibitions has shown, too, that the system of award by juries did not tend to the uniform appreciation of merit in the works of each country, as the estimation of the goods of each country was ultimately determined very much in proportion to the number of its jurors. In discarding the jury system, it has been also determined to abandon that of giving prizes. Objects for exhibition are selected by a committee, and the public is then left to be its own jury as to comparative merit.

But whilst no prizes are given by Her Majesty's Commissioners, exhibitors are not left wholly without the prospect of obtaining notice or reward, as the Council of this Society has in former years undertaken the arrangements for issuing reports of the various classes, in which such principles are inculcated as will enable the public to arrive at a standard of judgment. The issue of reports has always been too much delayed. The reports of the Paris Exhibition of 1867 are even yet not completed. But this Society has so organised, that its reports were published whilst the exhibition was going on.

The Society has also determined to offer gold and silver medals for the best collection in any one industrial class, or for any strikingly excellent works of applied fine art. Schools of Art have been invited to compete at this coming exhibition for such medals, and a number of works have been received from students.

I think I have now briefly touched on the general scheme of the exhibitions, and turn to the particular one of this year. Commencing with the Fine Art division, there will be oil paintings, sculpture, and applied art from foreign countries and the United Kingdom, and the picture galleries will be well filled. Space will be reserved for a collection of works of applied fine arts, and it is felt that this will meet the demand for a "Royal Academy"—so to speak—for Industrial Art. There will be a special exhibition of sketches subjects from the Queen's dominions over the world, executed by officers of the Army and Navy; and there will be collections of architectural designs, photographs, and engravings. Among the designs, the committee recommended the formation of a special collection of those for scholastic buildings. As last year, and in revival of the example set by this Society, when collections were made of the works of Mulready (in 1848) and Etty (in 1849), there will be a collection of the works of deceased eminent British artists, and the owners of the works of some of the following artists have contributed to the exhibition:—

Painters in Oil.

	Died.		Died.
J. Constable, R.A. ..	1837	David Roberts, R.A.	1864
Augustus Egg, R.A.	1863	David Wilkie, R.A.	1841

Painters in Water Colours.

	Died.		Died.
J. Coney	1833	A. Pugin	1832
J. S. Cotman	1842	J. M. W. Turner, R.A. (Architecture only)	1851
F. Mackenzie	1854	C. Wild............	1835
S. Prout	1852		

The collections are intended to be educational, and for the purpose of illustrating the careers of well-known British artists.

In the industrial division for this year, the classes are:—

Lace (hand and machine made).

Civil engineering, architectural and building contrivances.

Heating, by all methods.
Leather, including saddlery and harness.
Bookbinding.
Foreign wines, in the vaults of the Royal Albert Hall.

As regards the prospects of each of these, there will be lace from France, Belgium, Austria, Russia, &c.; there will be machine lace, and a machine at work, contributed by the Nottingham Chamber of Commerce; lace from Bedford, Buckingham, Ireland, &c., and workwomen to show how it is made on the pillow. There will also be a very interesting collection of ancient lace, formed under the direction and advice of a special committee of ladies, the Princess Christian being the president.

In civil engineering and building, France will contribute models of new buildings in Paris; and there will be a large show of structural buildings, models, and designs. Several sewage processes will be shown in operation, as also methods for concrete buildings. In heating, there will be a good collection of all kinds of stoves entered to compete for the prizes of this Society, and tested in houses constructed for the purpose in the exhibition grounds. In leather, there will be an abundance of machinery in operation, and a good show of finished goods. In bookbinding, there will be illustrations of machine processes by steam and hand; a show of modern works in cloth, paper, and leather; also a collection of old bindings.

The exhibition of foreign wines in the cellars of the Albert Hall promise to be one of the striking features of the exhibition. A committee of gentlemen has laboured hard to bring together every conceivable variety of honest wine from all parts of the world, and the public, after being charged 6d. a-head, may enter the well-lit cellars, and there, as in the sampling-rooms of wine merchants, may obtain wine to taste; the agent of the exhibitor being permitted to make a charge at discretion. There will be wines from France, Spain, Portugal, Italy, Hungary, Austria, Greece, Australia, &c.; and as far as possible the wines of each country will be kept in separate cellars.

The third division of the exhibition, *i.e.*, scientific inventions, will be well represented. Gramme's electro-magnetic light, and a system of casting under pressure being among the most notable of the exhibits.

In concluding, I would again remind you that if you do not find the exhibition of this year an attractive *coup-d'œil* of trophies, you will find some branches of industry made intelligible, and you will be able to study such a picture of the state of art in Europe as cannot this year be examined in any other spot in the world.

Arrangements for Industrial Objects to be Exhibited from 1874 to 1880.

The following are the Manufactures proposed for each of the Seven Exhibitions to follow that of 1873; but any modifications which may be found necessary will be duly announced:—

1874.

Lace (Hand and Machine made).
Civil Engineering, Architectural, and Building Contrivances.
- *a.* Civil Engineering, Architectural, and Building Contrivances.
- *b.* Sanitary Apparatus and Constructions.
- *c.* Cement and Plaster Work, &c.

Heating by all Methods and Kinds of Fuel.
Leather, including Saddlery and Harness.
- *a.* Leather, and Manufactures of Leather.
- *b.* Saddlery, Harness, &c.

Bookbinding.
Foreign Wines, in the Vaults of the Royal Albert Hall.

1875.

Woven, Spun, Felted, and Laid Fabrics (submitted as specimens of Printing or Dyeing).
Horological Instruments.
Brass and Copper Manufactures.
Hydraulics and Experiments. Supply of Water.

1876.

Works in Precious Metals, and their imitations.
Photographic Apparatus and Photography.
Skins, Furs, Feathers, and Hair.
Agricultural Machinery and Products.
Philosophical Instruments, and Processes depending upon their use.
Uses of Electricity and Magnetism.

1877.

Furniture and Upholstery, including Paper-hangings and Papier Mâché.
- *a.* Furniture and Upholstery.
- *b.* Paper Hangings and General Decoration.

Health Manufactures, &c., promoting Health with Experiments.
Machine Tools.

1878.

Tapestry, Embroidery, and Needlework.
Glass.
- *a.* Stained Glass used in Buildings.
- *b.* Glass for Household Purposes.

Military Engineering, Armour, and Accoutrements, Ambulances, Ordnance, and Small Arms.
- *a.* Clothing and Accoutrements.
- *b.* Tents, Camp Equipages, and Military Engineering.
- *c.* Arms, Ordnance, and Ammunition.

Naval Architecture—Ships' Tackle.
- *a.* Ships for purposes of War and Commerce.
- *b.* Boats, Barges, and Vessels for Commerce, Amusement, &c.
- *c.* Ships' Tackle and Rigging.
  Additional.
- *d.* Clothing for the Navy.

Lighting by all Methods, with Experiments.

1879.

Matting of all kinds, Straw Manufactures.
Flax and Hemp.
Iron and General Hardware.
- *a.* Iron Manufactures.
- *b.* Tin, Lead, Zinc, Pewter, and general Brazing.

Dressing Cases, Travelling Cases, &c.
Horticultural Machinery and Products.

1880.

Chemical Substances and Products, and Experiments Pharmaceutical Processes.
- *a.* Chemical Products.
- *b.* Medical and Pharmaceutical Products and Processes.
- *c.* Oils, Fats, Wax.

Articles of Clothing.
- *a.* Hats and Caps.
- *b.* Bonnets and General Millinery.
- *c.* Hosiery, Gloves, and Clothing in general.
- *d.* Boots and Shoes.

Sewing Machines.
Railway Plant, including Locomotive Engines and Carriages.

DISCUSSION.

Mr. Henry Cole, C.B., said the Exhibition of 1851, with which both the Chairman and himself were connected, had been a fruitful parent, but none of its successors had equalled it, either in brilliancy or financial success. It was the means of introducing many novelties, and also of reviving much which was thought to be new. As as instance, he might mention reaping machines, for which the Americans took great credit, though, in fact, an exactly similar machine was now in the Patent Museum at South Kensington, which was invented some 35 years ago by the Rev. Mr. Bell, and had been at work in Scotland until a very recent period. Having briefly alluded to the succeeding exhibitions at New York in 1853, at Paris in 1855, which were not so successful in a pecuniary point of view, to the London Exhibition of 1862, which very nearly paid its way, to the Paris Exhibition of 1867, which cost about half a million of money, and led to an immense number of lawsuits, the British Commissioners having been involved in several, though they got out of them at such a nominal expense as to show they were not much in the wrong, and to the Vienna Exhibition of last year, which he believed contained a brilliant assemblage of objects, though it entailed a loss of more than a million sterling, Mr. Cole said he could not avoid the impression that the world was getting tired of great exhibitions, and he doubted if there was any chance of one being held in England for a long time to come; at any rate, such an enterprise would require a guarantee fund of from 1½ to 2 millions. Still there was a great demand arising for technical instruction, a phrase which was translated in various ways, some even thinking that the State ought to establish workshops, *ateliers nationaux*, which he thought a mistake, for in his opinion it was hardly the business of the State to decide on the calling or occupation of any of its citizens. All were agreed, however, that English people should be as well instructed as those on the Continent, for the lesson could not be mistaken, that the nation which had been able to gain the greatest victories in arms was the nation which was best educated—that the German nation, which throughout its whole extent provided not only for the education of the infant and the youth, but also for the instruction and civilisation of the adult, was more advanced than any other in Europe, as well in the arts of peace as in military pursuits. Now technical instruction seemed capable of great development by means of exhibitions. Of late years Parliament had not only determined that all children should learn to read, write, and cipher—which was but a miserable termination to education—but also that those who desired it might be assisted in acquiring the elements of science and art; some 25 subjects being open to them, including botany, chemistry, geometry, physiology, &c. Anyone could start a school in a garret or a cellar, no credentials were required; but if the students passed the requisite examinations, the teacher received from the Government a certain reward for his labour. But there still remained the question of applying the science so learned. He did not think the State should interfere in this, as some suggested, but there could be no doubt that it was of the highest advantage to all the world to see what was being done in the different industries, and what improvements had been introduced, and it appeared to him, therefore, that exhibitions afforded a mode in which technical instruction could be conveyed with the greatest advantage to all parties. At present, England was said to be at the apex of manufacturing industry, but it was evident that other nations, Germany especially, were treading closely upon her heels, and if she were not to be a loser in the race, she must use every effort to retain her place. To this end, he had been very pleased to be able to render any assistance towards making exhibitions useful as means of technical instruction, and he doubted not they would be so increasingly in the future. They had fine art exhibitions at the Royal Academy, commenced by the Society of Arts, agricultural, floricultural, and various other exhibitions, and it would never do for the greatest manufacturing people in the world to let it be said that they could not get up an industrial exhibition, in which science and art realised their highest aims. Although they were rather difficult to manage, these exhibitions had hitherto proved financially successful, and he believed they would do for the industry of this country that which could be done by no other means.

Major Beaumont, R.E., M.P., thought Mr. Cole was quite correct in saying that one of the main objects of these exhibitions should be the technical education of the people, for it was by this means only that England could hope to retain her commercial supremacy. This was due in the first place, no doubt, to her mineral wealth, but coal and iron were now being found abundantly in other parts of the world, thus placing other countries on a level with ourselves as regards natural advantages, and rendering it even more necessary than ever for education to be attended to. Now he thought exhibitions were perhaps the most popular way of imparting technical education, combining, as they did, instruction and amusement. He had seen something of them, both as exhibitor and manager, having had the control of the machinery department in the Paris Exhibition of 1867, and he feared they had somewhat fallen off in the public estimation. Many large manufacturers seemed to be getting tired of them, and did not care to exhibit, and this feeling he attributed to their being in some cases made too much like huge bazaars, the instruction being too much sacrificed to amusement, and the exhibition of real improvement and important manufactures giving place to petty huckstering. This tendency culminated in the Paris Exhibition, where large manufacturers found themselves to some extent pushed on one side by exhibitors whose goods were more of a bazaar character. He believed, therefore, that it would be advantageous in every way to keep instruction in view rather than amusement, and this was the especial feature of these annual exhibitions. It was supposed that a certain lapse of time must take place in every trade before they could have made progress sufficient to warrant them again appearing before the public as exhibitors, and if that were properly carried out, they might fairly expect exhibitors would only come forward with something which it was really worth while to show. Thus exhibitions, instead of being mere spasmodic efforts of feeling, would become permanent means of instructing the people. In one respect the Paris Exhibition stood alone, viz., in the admirable arrangement of the different objects in zones, which again were divided laterally according to the countries, so rendering it perfectly easy for a visitor to discover what he was in search of, and study it with its cognate objects, instead of being obliged, as was frequently the case, to go from one end of the building to the other. The circular form, however, was not well adapted for arrangement, particularly with reference to machinery. At Vienna, there was a most splendid collection of goods, but the difficulty of finding anything was almost insurmountable. The English collection was highly creditable to the nation, especially considering that Parliament had voted very little money for the purpose, instead of from £100,000 to £130,000, as it did for the Paris Exhibition. He felt quite satisfied it was the duty of Parliament to give a certain amount of support to exhibitions of this kind, though he would not venture to lay down the limit to which it should go, and that they would do wisely to spend public money in giving encouragement to exhibitions when properly conducted, and particularly when principally devoted to objects of real utility.

Mr. Pearsall thought, considering the large extent of wall space occupied, which rendered it quite impossible for anyone to make himself acquainted with the exhibi-

tion in one visit, that it would be well if greater facilities were offered by reducing the charge for admission.

The Chairman thought that Lieut. Cole had shown them very clearly that the exhibitions to be held in this country in future must be limited to a very few subjects, probably to fewer even than were now included in the Annual Exhibitions, and that the real object of such exhibitions of industries occurring once in every ten years was to compare the progress made in industries all over the world, in order that they might take stock of what was doing both in England and other countries. It was a remarkable thing, looking at the progress of industry over Europe, that the mere possession of the materials of industry was the smallest factor in production. This had resulted chiefly from the facilities of intercommunication, by which raw material could be carried from one part of the world to another at such comparatively cheap rates, that the possession of that raw material was as nothing in comparison to the skill and intelligence applied to turning it to utility. For instance, cotton was exported from America, it came to this country, was converted into calico, and sent out again to the United States; and after all the cost of converting and carriage, it undersold the mills in America. That was even more extraordinary in the case of a country where there was no fuel, like Switzerland, where this bulky raw material had to be carried overland by difficult mountain roads, and where coal had to be got from Belgium, France, or Germany, yet in that country cotton was converted into a useful substance and sent back to America, still underselling the country which produced it. This showed that the possession of raw material, however important, was insignificant when compared with the science which converted that substance into a useful product. Last year, in Switzerland, he remembered visiting a narrow valley, some few miles from the baths of Ragatz, closed in with a mountain, over which there was nothing but a mere mule path. He found the whole place teeming with industry. Every part of the valley was taken up with works for the production of calico and dyed goods, especially Turkey reds, competing with Glasgow, Manchester, and other places, for cheapness of production, and sending the products back to America. Ireland, which possessed infinitely greater facilities for manufacturing industries, having a seaboard, which Switzerland had not, and though it had no coal being near the coal fields of Wales and Scotland, with abundant intercommunication for raw material, yet with all these advantages had scarcely any manufacturing industry. What was it that made Switzerland so busy in all parts of the country, and left Ireland so unprosperous? There was only one answer, the education of the people. In Switzerland every child was taught well at school; they were not satisfied with the miserable three R's which were considered sufficient in England, but really only constituted the knife, fork, and spoon of education without any meat. As soon as the children passed out of school with an infinitely greater knowledge of the world around than the three R's can ever give, with a knowledge of economics in the best sense of the term, they passed into a better school, where they were taught the sciences bearing upon industries, and this made Switzerland prosperous in spite of all its difficulties. This was a question to be deeply considered. In the metropolis there were 130,000 children not possessing any education at all, or scarcely any worthy of the name. What would any parent before him think of ending the education of his children at eight or nine years of age, when they were just able to read a paragraph in the newspaper or write a small sentence from dictation? Yet that was the education which the children of the working classes of this country considered it a great merit to obtain, an education which could not bear the friction of the wear and tear of life. Unless this was fully understood, and the people were educated according to the new requirements of the world, it would be useless to expect a continuance of the prosperity which the great wealth of raw materials in this country, and the energy and honesty of the people, enabled them to enjoy. Twenty years was a small time in the life of a nation; but even in that time some industries had nearly vanished from this country, and unless the schools were raised from their present position, unless the artisans were instructed so as to enable them to take that intellectual position which the progress of the world required to promote the wealth and industry of this country, the consequences would be really serious. He was therefore glad to hear such a discussion in that room, because it was in the Society of Arts that the Exhibition of 1851 had its first birth. It was the Society of Arts which first had the courage to promote higher education by means of examinations throughout the country, and which had recently taken up the larger subject of technical education, and had sown a small seed which might grow into a great tree. If they had faith in themselves and continued in such useful acts, the country would recollect that the Society of Arts, small as it was, had had an enormous share in improving the state of the country, and the arts and manufactures for the promotion of which it was established. The exhibition of this year he was told would be an excellent one, being got up with energy and great judgment, and ought to succeed. He was not so sanguine as Mr. Cole in thinking that exhibitions were a great financial success, but as yet they had not been a failure, and the exhibition shortly to be opened with limited industries would prove whether the public would support them and make them self-supporting. In conclusion, he begged to propose a most cordial vote of thanks to Lieutenant Cole for his valuable and interesting paper.

The resolution was passed unanimously.

Lieut. Cole, in reply to Mr. Pearsall, said, as it was impossible to see properly all the pictures exhibited at the Royal Academy in one day, it was not to be wondered at that exhibitions could not be properly seen in the same time. He thought a person required to go a great number of times before he could properly understand the various specimens exhibited.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

The preparations at South Kensington are now going on busily, though it is difficult to see how all can be ready for opening on Monday, the 6th of next month. However, this is always the case with exhibitions, as nearly everybody puts off his work till the last moment, and then hurries on to get it finished in time. Some parts of the exhibition are more forward than others. In the waste ground known as the "western annexe," various buildings are being erected, some for the display of the various methods of treating sewage, others to exemplify different modes of construction. Of some of these the foundations only are laid, while others show considerable progress towards completion. Here the Society's testing houses form a prominent object, if not a very attractive one. As has already been stated in the *Journal*, there are six of them, built of concrete, each consisting of a single room with door and window, the doors of each adjacent two houses opening into a common porch, so as to prevent direct admission of the outer air. As two days are allotted to the trial of each stove, while the fixing and removal often take as much more, the whole series of experiments will last a considerable time. Every effort is being made to render the tests as complete

and reliable as possible, so that trustworthy data for future use may be obtained. For this purpose the results will be carefully tabulated, so that not only will the relative merits of the various competing stoves be settled, but a useful mass of facts be obtained, which it is hoped may serve to throw considerable light on the really little known subjects of domestic warming and ventilation.

The machinery gallery is by no means full. The big lace-making machine from Nottingham is a conspicuous object, and there seems a great number of sewing machines, as well as other machinery for working in leather. On the opposite or eastern side of the Exhibition, many of the cases for showing lace, specimens of bookbinding, and manufactured articles of leather are already well filled, though some are still empty. In the saddlery department various descriptions of harness, &c., are being fitted on dummy horses, while other articles of saddlery, as well as other leather-finished goods, are shown in cases. As boots and shoes are included in the clothing section of a future year, they are not especially admissible for the present Exhibition. The loan collection of ancient lace is in process of arrangement, and will occupy a considerable space. In the bookbinding section there is a good deal yet to come in before the collection can approach completeness.

The heating apparatus sent in are numerous. They will be located near the machinery gallery on the east side. As will be remembered, this section is under the control of the Committee appointed by the Society to superintend the testing of the prize stoves, so that although the two classes are quite distinct, they are under the same management.

The collections for the Ethnographical Section are being got together, while in the vaults below the Albert Hall preparations are going on for arranging the specimens of wines.

The fifth meeting of the Committee for Scientific Inventions was held on the 17th inst., Mr. T. Sopwith in the chair. There were present—Sir Eustace F. Piers, Bart., Mr. F. A. Abel, Capt. Hans Busk, and Lieut.-Col. Crossman, R.E. The Committee after inspecting the objects received up to date, adjourned until the 31st March.

The tenth meeting of the Ethnological and Geographical Committee was held at the International Exhibition Offices, on Friday, the 20th of March, at which Dr. Mouat (in the chair), Sir Vincent Eyre, C.B., Col. Lane Fox, Mr. Brabrooke, Col. Harley, C.B., Major Donnelly, and Mr. G. S. Saunders, secretary, were present. Col. Harley reported that he had taken steps to procure as many prize articles of ethnological interest as possible from Ashantee. A letter was read from Mr. Charles Saunderson, offering to present a suit of Corean armour to the Exhibition. It was resolved to accept Mr. Saunderson's donation, and express to him the thanks of the Committee.

His Royal Highness the Prince of Wales presided on March 25th, at Marlborough-house, over a meeting of her Majesty's Commissioners for the Exhibition of 1851. There were also present—His Royal Highness the Duke of Edinburgh, his Royal Highness the Prince Arthur, his Royal Highness the Prince Christian, his Serene Highness the Duke of Teck, the Marquis of Lansdowne, the Marquis of Ripon, the Earl of Carnarvon, Sir Wm. Knollys, Sir Bartle E. Frere, Mr. Playfair, Sir Thomas Bazley, Sir Wm. Anderson, Sir Thomas Biddulph, Sir F. Sandford, Mr. Edgar Bowring, Mr. T. Field Gibson, Mr. Thomas E. Harrison, General Ponsonby, General Probyn, Mr. Cole, and General Scott, secretary.

The collection of Ancient and Modern Lace promises to be very complete. Her Imperial Highness the Duchess of Edinburgh has sent some Russian specimens to be exhibited. There will be lace workwomen from Bedford, Buckingham, Honiton, and Brussels to show the process of making pillow-lace.

EXHIBITIONS.

PHILADELPHIA EXHIBITION.

The following account of the present condition of the preparation for the Centenary Exhibition is given by the New York Correspondent of the *Daily News*. The letter was written before the refusal of Congress to make a grant which has been reported by telegraph, as already noticed in the *Journal*:—

The prospects of that celebration have been for some time extremely discouraging. When the scheme of a great jubilee in honour of the one hundredth anniversary of the signing of the Declaration of Independence at Philadelphia first expanded into the design of a World's Fair, it was generally agreed that no money should be appropriated for the purpose by Congress. The city of Philadelphia promised to subscribe a large sum, and the individual States would doubtless appropriate something; these contributions, with stock that might be taken by private citizens, would pay the whole cost. But that plan has failed. Philadelphia gives half a million dollars. Pennsylvania gives a million more. The other States withhold their aid almost entirely, and the private subscriptions are inappreciable. The Legislature of Massachusetts has shown itself opposed to any grant of money, and, indeed, to any international celebration at all. The Legislature of New York has discovered that the Commission which it appointed in 1871 to represent this great State in the management of the Centennial had Mr. William M. Tweed, prisoner in the Blackwell's Island Penitentiary, at the head, and some other objectionable persons in the body of it, and instead of changing its composition has abolished the Commission altogether. The proposal to seek aid from Congress has met with a great deal of hostility everywhere outside of Philadelphia, and as time goes on it is more and more evident that the country looks forward to the coming festival with profound indifference. In their extremity, a delegation of the Philadelphia managers went to Washington the other day, and laboured with the President. The result was General Grant's urgent recommendation to Congress to appropriate a handsome sum of money to save the enterprise from a deplorable failure. "Let us have a complete success of our Centennial Exposition," he says, "or suppress it in its infancy, acknowledging our inability to give it the international character to which our self-esteem aspires." In their report accompanying this message, the Centennial Commissioners state that "reports received through several channels concerning the action of foreign governments in regard to the President's recommendation to them of the Exhibition are such as to encourage the belief that, if the President had been authorised to give a more direct and explicit invitation, the acceptances would have been more general and prompt." Thus far no foreign powers have signified an intention to be represented except Germany, Belgium, the Netherlands, Mexico, Ecuador, and Hayti. One of the clerks in the employ of the Commissioners took the singular course, a year ago, of sending to the ex-Empress Eugenie, at Chiselhurst, an invitation to the Prince Imperial to visit the Exhibition; but, after the lapse of four months, M. Pietri, in her Majesty's name, returned a polite refusal.

If the celebration had been confined to an appropriate national observance of a purely national anniversary, its success would have been assured long ago; but when it became a World's Fair, a thousand objections sprang to light. First of all, there is the financial difficulty.

The lowest estimate of the cost is ten millions, and only three millions have been obtained. If Congress makes up the deficiency now, it will no doubt be called upon to make up other and perhaps larger deficiencies when the expenditure overruns the estimates, as it always does. Now the United States Treasury is in no condition to honour a draft like this. The problem of the day is how to meet an inevitable deficiency in the revenue. Mr. Richardson has been paying the current expenses of the Government for the last few months by the manufacture of paper money; and Congress is at its wits' end to reduce the expenditure to something like the national income. Where are the centennial millions to come from? Every department of the administration protests that it cannot get along with a penny less than its present allowance. The navy shows a large deficit as the result of the difficulties with Spain. The Post-office will probably be overwhelmed by the restoration of the costly franking privilege, abolished only last summer. Work on the public buildings is coming to a stop because there is no money to pay the hands. The House of Representatives has not the courage to impose fresh taxes in the present depression of business, and the ingenuity of General Grant's financiers is exhausted in the effort to tide over the hard times, until commerce revives and the customs yield again their usual revenue. But besides the financial difficulty, there is a general and half-confessed unwillingness to take the responsiblility of an International Exhibition on any terms. The bitter lesson of Vienna has not been forgotten. The latest of the world's great shows was in some respects a terrible failure. Strangers did not visit it in great numbers, and those who did go to Vienna were almost always in a hurry to get away again. The display was also inadequate in many particulars, however brilliant it may have have been as a whole. What reason is there to suppose that the expected throngs who would not go to the fascinating Austrian capital will cross the Atlantic to find midsummer amusement in the decorous and hospitable, but most dull and uninteresting city of Philadelphia, which is reputed to be one of the hottest capitals in the United States? And what guarantee is there that the mismanagement which ruined the American department at Vienna will not be repeated, only on a grander scale, when America has her fair at home? The people are thoroughly ashamed of the figure they presented last year, and I think they would be glad to have the whole thing forgotten. Certainly they do not want to risk a second mortification. Hence there is no enthusiasm over the Philadelphia scheme, and no hearty popular response to the President's recommendation. What Congress may do I will not predict; there are strong influences urging an appropriation, and if it is voted, I dare say American manufacturers will make a very large and creditable display at the appointed time, provided everything is ready for them.

But here comes the further trouble, that the period for preparation is too short. The Centennial is only two years distant, and the Commissioners have not yet matured their general plan. The ground has not been broken for the building. The management is still in the hands of a huge committee, cumbrous and inexperienced. It will take months to reduce them to something like system, and obtain an effective residuum by the elimination of useless or deleterious elements. We do not know, indeed, that the faculty of organisation and the executive ability required for such a great work are to be found anywhere in these enormous boards of Commissioners, for it does not appear that the members have been selected with any special reference to their fitness for the duty, although most of them, I am happy to say, are reputable and educated gentleman. But if all should turn out well, if a competent body of managers should be evolved in the course of time out of the heterogeneous multitude in which is now lodged the direction of affairs, is there any ground for believing that the year and a half which will still remain at their disposal will enable them to collect at Philadelphia even a tolerable museum of the products and manufactures of the world? This is a question which suddenly finds place in everybody's mouth. Hitherto the country has given very little thought to the subject, but has approached the Centennial in the same listless, idle fashion wherein it approached the world's fair at Vienna, making no special preparation for it, but trusting that somehow or other there would be somebody to do whatever was necessary. The first to utter a loud voice of warning was Mr. Charles Francis Adams, jun., who, having been one of the Massachusetts Commissioners at Vienna, recently made an official report, in which occurred some refreshingly plain speech. Mr. Adams told the Legislature that the entire arrangement of the American organisation at Vienna, "whether to exhibit or to observe," was "an utter, entire, and disgraceful failure; a failure in conception and a failure in execution; a failure unjust to our industries, discreditable to the country, and humiliating to those more immediately concerned." He pointed out the particulars in which the exhibition itself was a failure, and the causes which made it so; and though he said not a word in discouragement of the Philadelphia scheme, he left a very clear impression that the prospects of its success were by no means flattering. His report has made a very marked and wide spread influence, and I think will do great good, either by infusing a new spirit into the management of the Centennial, or leading to the abandonment of the international plan altogether.

Many people, indeed, who were dazzled at first by visions of all the civilised and uncivilised nations of the globe sailing up the Delaware with shiploads of their choicest productions, have now reached the sober conclusion that it will be much wiser and more becoming for the United States to keep their birthday by a purely domestic festival, bringing together specimens of their own arts, and rejoicing over their own prosperity. For after all, the great achievement of the past hundred years in this country is not the invention of reaping machines, nor an improvement in steam engines, nor discoveries of precious metals. It is the accomplishment of a political experiment upon which the Governments of the rest of the world, with one or two exceptions, cannot be supposed to look with approving eyes. Why should they be asked to come and make merry over it? That is the question which Mr. Sumner put very forcibly recently in the United States Senate, and I do not see that anybody has answered it.

A bill has been introduced into the U.S. Congress proposing an appropriation of 7,000 dols. to enable the Department of Agriculture to make a collection of all the species of trees growing throughout the United States, and for their exhibition in suitable cases. The collection itself, when completed, is to be exhibited at the Philadelphia Centennial Exposition, but to belong to the Agricultural Department, and to be returned to it at the conclusion of the Exhibition.

Geographical Congress and Exhibition.—The Paris Geographical Society has decided that an international congress for the geographic sciences shall be convoked in that city in the spring of next year, and that there shall be held in connection with it an exhibition of apparatus, maps, charts, instruments, and all other things connected therewith. The object of the meeting is described as the same as of that held in Antwerp in 1871, namely, the discussion of all the great problems which arise out of the study of the earth. The French Government gives its support to the enterprise, and the Society hopes to enlist the aid of all foreign Governments. The date of opening, the details of organisation, and the programme of the Congress will be published shortly.

INSTITUTE OF NAVAL ARCHITECTS.

The session of 1874 commenced on Thursday last, the meetings being held as usual in the large room of the Society, which was lent for the purpose. The following is the list of papers, &c.:—

Thursday.—Morning Meeting, at 12 noon. Annual Report of the Council. Address by the President, Lord Hampton. Papers—1. Mr. Nathaniel Barnaby, "Recent Designs of Ships of War for the British Navy." 2. Mr. H. Boulby Willson, "High-speed Channel Steamers." 3. Mr. William Froude, "Experiments with H.M.S. *Greyhound.*

Evening Meeting at 7 p.m. Papers—1. Mr. Wm. John, "On the Strength of Iron Ships." 2. Mr. Chas. H. Jordan, "On the Strength of Classed Ships." 3. Mr. Philip Watts, "The Effects of Change of Trim upon the Transverse Stability of Ships." 4. Herr Victor Lutschaunig, "Notes on Stability."

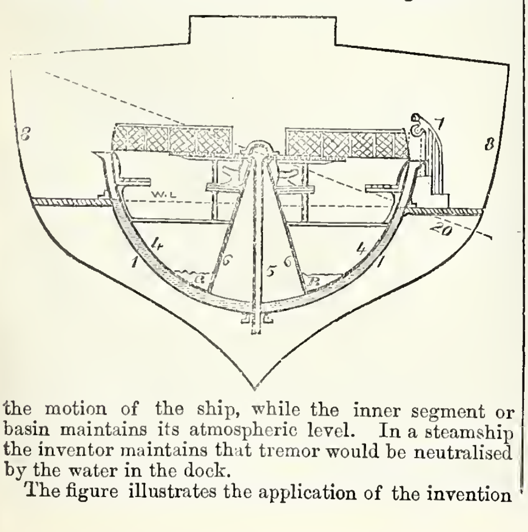
Friday.—Morning Meeting at 12 noon. Papers—1. Mr. Benjamin Martell, "On Freeboard." 2. Mr. W. W. Rundell, "The Load-draught of Steamers." 3. Mr. William Froude, "Useful Displacement as Limited by Weight of Structure and of Propulsion Power." 4. Mr. G. B. Rennie, "On Three-throw Crank Engines of the Compound System; H.M.S. *Boadicea* and *Bacchante.*" 5. Mr. T. A. Hearson, "Strophometer or Speed Indicator."

Evening Meeting at 7 p.m. Papers—1. Mr. Robert Griffiths, "On Screw Propulsion and Screw Ships." 2. Mr. Thomas Moy, "A New Form of Steam Engine." 3. Mr. John McFarlane Gray, "On Clearance and Compression in Steam Cylinders." 4. Mr. Spencer Deverell, "Ocean Wave Power."

Saturday.—Morning Meeting at 12 noon. Papers—1. Rev. W. R. Jolley, "The Ark Saloon, or Utilisation of Deckhouses for Saving Life in Shipwreck." 2. Herr Gustav A. Mitzlaff, "A Steam Lifeboat." 3. Mr. A. Folkard, "Improvements in Apparatus for Lowering, Hoisting, Engaging, and Freeing Ships' Boats." 4. "Description of the Dromoscope invented by Dr. Taugger, of Trieste." Commuuicated by Herr Victor Lutschaunig.

CHANNEL PASSAGE.

The arrangement figured below is the invention of Mr. A. Allan, of Scarborough. Its object is to give a steady saloon cabin or gun deck at sea. It is constructed of two spherical segments, the outer segment (1) or dock being fixed in the ship or yacht, and the inner (4) being floated on a film of water in the dock, like one basin floated in another. The outer or fixed segment takes



the motion of the ship, while the inner segment or basin maintains its atmospheric level. In a steamship the inventor maintains that tremor would be neutralised by the water in the dock.

The figure illustrates the application of the invention to the cabin of a ship or yacht, for maintaining a steady table and seats. (8) Outline of the hull, skylight, and cabin deck. (1) Outline of dock, and (4) of the floating body. There are railings with space fore and aft; the space between the rail and top side of float being filled with open wire-work. (w l) Water line in the dock. (5) The centre pillar which guides the float from below, or from the deck above; the cone removed allows 20° of roll, or 40° out and out. (b) Ballast. (7) A small sheave on the hand-rail, with a hand-rope attached to the float, to assist those entering. By removing the segments of the table, an ottoman can be placed around the centre cone, and the outer circle of seats can be converted into sofas and berths, allowing space for a dozen sitters at table. The floating support at the immersed line (w l) will equal double the entire load, so that the water may be lower in the dock, and thus provide for a larger angle of roll. This description has been supplied by the inventor.

TECHNICAL EDUCATION IN EUROPE.

There is now in course of issue from the Munich press a series of volumes intended to illustrate the progress of science and the arts, and to form, when complete, a sort of encyclopædia of science and physics. Of this series, one volume has already been published—"The History of Technology from the Middle of the Eighteenth Century," by Professor Karmarsch.* A lengthened notice of this work, and extracts therefrom, appeared in the last two numbers of the "Practical Magazine." To readers of the *Journal*, perhaps a brief summary of the Professor's account of the various European institutions for the promotion of technological instruction may be interesting. As is natural, the writer begins with his own country.

Germany.—In 1745, the Brunswick Carolinum was founded. This was an educational institution, intended to provide special classes for the study of agriculture, trade, the mechanical arts, and commerce. In 1835, a special branch was devoted to technology, and by 1863 that had grown into a complete polytechnic school. In 1747, Hecker founded the Realschule in the Trinity Church, at Berlin. Technical instruction is still given here. In 1770, a similar institution was established at Vienna, which was in 1815 united with the Polytechnic Institute. Technical schools were also established as follows:—Krefeld and Magdeburg in 1819, Halberstadt 1822, Barmen 1824, Cologne 1828, Elberfeld 1830, Berlin (Metropolitan Commercial Academy) 1828. It is since 1830 that tho greatest progress in technical education has been made in Germany. The polytechnic colleges were the first founded, than lower handicraft schools, and lastly preparatory schools. The fact that the highest schools were thus the earliest founded had a bad effect in lowering the standard at first. In consequence of this the whole system was re-organised, and it now stands as follows:—First, preparatory trade schools, in which general rudimentary instructions is given suited for preparation for any trade; second, intermediate schools, which have for their object the study of the higher branches of industry and commerce; and thirdly, polytechnic schools or colleges, which grant certificates, and in which the most advanced technical instruction is given. There are also special schools of various grades (Gewerbliche Special-Schulen), such as spinning schools, sewing schools, schools for instruction in the silkworm trade, &c. The straw-plaiting and lace-making schools have been superseded by the introduction of machinery.

In 1850, a watch-making school was opened at Furtwangen, in the Grand Duchy of Baden, and in 1845 a weaving school at Elberfeld, which closed in 1868. In other parts of Germany, Muhlheim on the Rhine (1852),

* "Geschichte der Technologie seit der Mitte des Achtzehnten Jahrunderts." Von Karl Karmarsch. Published by the Historical Commissioners of the Royal Academy of Sciences, Munich, 1872.

Krefeld (1855), Grunberg in Silesia (1864), similar institutions have been started.

SWITZERLAND.—In 1855, the Polytechnic school at Zurich was founded,* and in 1854, the first watchmaking school was set on foot at Geneva. A similar institution has existed at Chaux de Fond, Locle, since 1831. There are also numerous lower trade and mechanic schools.

FRANCE.—The Ecole Polytechnique was founded in 1795, as an institution for technical instruction; it, however, long since became a military school. The Ecole Centrale des Arts et Manufactures is not a State foundation, but it practically resembles the German trade schools. There are three Ecoles des Arts et Métiers under State authority, Compiègne (1803), Beaupreau (1811), Aix (1843). The school at Compiègne was moved to Châlons-sur-Marne in 1866, that at Beaupreau in 1815 to Angers. All are more or less military in character. Similar establishments exist at Marseilles, Lyons, Lille, and elsewhere. The oldest provincial school of the kind was established at Nevers in 1822; the latest in 1863, at Sainte Marie aux Nîmes.

The Collège Chaptal and the Collège Turgot, both in Paris, are the nearest analogues of the German Real-Schulen. Courses of lectures on industrial as well as on scientific and other subjects, are frequently given in provincial towns. There are also some establishments resembling English mechanics' institutes, under the direction of two companies, the Polytechnic Association (1831), and the Philotechnic Association (1848). In 1864, the former had four establishments in Paris, three near Paris, and four in the departments; the latter had three in Paris, four near Paris, and one at Nice. These two bodies then employed over 150 teachers. They give instruction during the winter evenings only. There are also the schools of the Messageries Maritimes, at La Ciotat, near Marseilles, one connected with the machine factory of Graffenstadt, in Alsace,† and those of the national arsenals.

In 1864, there were in France 26 progressive schools, of which the first was opened at Clermont in 1824.

There are also handicraft schools, as follows:—Two silkweavers at Lyons (1831 and 1862 respectively); weaving Nîmes (1856) and Tourcoing (1857); dyeing, Nîmes (1820); also public lectures on dyeing, Lyons (1860) and Amiens (1863); lace-making, Dieppe, Bailleul, Bayeux, Saint Brieuc, Creuzot (1843), Mende (1858) and Murat; watch-making, Macon (1831), Besançon (1862), Cluses, Gallanches and Thones. There are about forty schools of technical drawing, nine of which are in Paris; most of these date from about 1820.

For many years free lectures have been delivered to working men at the Paris Conservatoire on arts and manufactures. These began in 1796, with lectures on geometry, connected with a school of practical drawing. Amongst the subjects treated are mentioned mechanics, physics, chemistry, descriptive geometry, political economy, trade legislation, spinning and weaving, dyeing and stuff-printing.

BELGIUM.—Technical schools are appended to the two State Universities of Liège and Ghent, and in connection with these are ten "gymnasia," in which there are industrial sections. It was about 1835 that these establishments were set on foot.

At Liège there is an Ecole Préparatoire, an Ecole des Mines, an Ecole des Arts et Sciences, and an Ecole des Elèves Mécaniciens; at Ghent there is an Ecole Préparatoire, an Ecole du Génie Civil, and an Ecole des Arts et Manufactures. The Ecole Centrale at Brussels, and the Ecoles Moyennes (about 50 in number) give general certificates.

* See *Journal*, Vol. 21 (1873), p. 678.

† Now, of course, in Germany, as well as the important industrial schools of Mulhouse, of which no special mention is made by the Professor—at least in the English version in the *Practical Magazine*, from which the above is abridged.

At Liège (1825) and Ghent (1826) there are trade schools in connection with workshops. There are also numerous schools of technical drawing throughout the country. There are also handicraft-schools; amongst others, some for glove-making, and the making of domestic furniture.

HOLLAND.—There is a Polytechnic School at Delft, which took the place of an Academy for Civil Engineers, established in 1842.

GREAT BRITAIN.—Here the Professor finds hardly anything worth mention. He alludes to the Science and Art Department at South Kensington as being an institution rivalling the "Polytechnic" in Regent-street, says that the lectures on scientific and industrial subjects are given at King's College and a few other educational establishments, and refers to the Mechanics' Institutions as the only establishments at all resembling the German working-men's schools.

DENMARK.—In 1829, there was formed a Polytechnic School at Copenhagen; in 1843, the Technical Society founded an institute where practical instruction is given in metallurgical science; in 1800, an Elementary Mechanics' Sunday School was set on foot.

SWEDEN.—There is a Technological Institute at Stockholm (1826), and a Mechanical School (1829) at Gothenborg. The Swedish Trades Society support a trade school at Stockholm, and there are also several Mechanics' Sunday-schools. In the higher elementary schools (about thirty in number) some practical instruction is given.

RUSSIA.—There is a Technical Institute at Moscow (1825), a Technological Institute at St. Petersburgh (1831), a Technical School at Helsingfors (1847). At Abo and Wasa, in Finland, are two other similar institutions of an elementary character. At Riga is a Polytechnic School (1861), and at Mitau (1860).

GREECE.—There is a Polytechnic School at Athens.

CHINESE LACQUER.

The following is extracted from the *Courrier de Saigon*:—

It was supposed for a long time that the lacquer was a peculiar compound of which the Chinese and Japanese carefully guarded the secret; and the Catholic missionaries, and especially Père Incarville, we are told, were the first to learn that this precious varnish, which gives so much lustre to wood-work of all kinds, was simply a resin of rather reddish colour, extracted, by incision, from a tree indigenous to some provinces of China and Japan.

The same missionary gives an account of the mode of preparing and employing the varnish obtained from this resin. The first operation consists in removing from the juice of the tree all the water, and for this purpose it is exposed to the sun for two or three hours, being stirred all the time with a wooden spatula. Without the evaporation thus caused, the varnish would not possess its beautiful transparency. Certain substances are added to produce the varieties of varnish known in Chinese industry; thus to produce the fine ordinary varnish, pig's gall and Roman vitriol dissolved in a little water; to produce the fine black Japanese varnish, of which the Chinese remained long ignorant, powdered hartshorn, charcoal, or ivory black is mixed in certain proportions with tea oil and added to the resinous liquid.

An able Chinese artist, in executing ornamental work in gold or colours, commences by sketching his design on the varnished wood with a brush and white lead; when satisfied with his outlines he passes over them a very fine steel point, and then traces all the details. More often, however, the design is first sketched with pencil on paper, and finished with Indian ink. These latter designs are then carefully brushed over by apprentices with orpiment dissolved in water, and

are immediately applied to the varnished wood, the hand being passed over the paper, so that all the parts of the design are transferred to the wood. When the paper has been taken off, all the lines are re-touched with orpiment or vermilion in gum water, which fixes the design firmly on the lacquer, and then with varnish mixed with a little camphor, which renders it more liquid; and this, when dry, is ready to receive the shell gold in powder, applied by means of a puff or dabber, over the whole of the design; the surface is then lightly wiped or rubbed, when every line of the original design becomes brilliant.

When it is desired to bring portions of the design into relief, such as the inequality of the trunks of trees, the nerves and veins of plants, &c., the camphore varnish is applied over the gold, and the gold again over that, often many times, until the desired relief is obtained. All the important lines of the design, the eyes, lips, &c., of figures, the folds of drapery, and all the ornamental portions of the work are touched up carefully with the brush.

Beautiful as Chinese lacquered work is, that of Japan excels it; and one cause of this is the superior transparency of the Japanese varnish, which is as limpid as the purest water, while that of the Chinese has always a yellow tinge.

Kang-hi, the famous Emperor, who was a great *connoisseur* and patron of art, admitted the superiority of the Japanese lacquer work, but he attributed it to the climate, stating that the production of the best varnish required a soft, fresh, humid, and calm atmosphere; that that of China was rarely temperate, almost always hot or cold, and charged with dust and salts, while Japan being surrounded by the sea, had just the sort of air to dry varnish without causing it to become wrinkled or discoloured. This opinion of the Emperor is borne out by the practice of the lacquerers of the present day; and it is a known fact that the air of China is often loaded with dust, which the rain brings down in the form of mud.

White lacquer is made by mixing silver leaf, carefully divided, with the ordinary varnish; red lacquer by the mixture of mineral cinnabar or carthanum flowers; yellow lacquer with the addition of orpiment only; green is produced by a mixture of orpiment and indigo; and violet lacquer by the addition to the varnish of a certain mineral of that colour, reduced to an impalpable powder. The older the articles varnished with the above, the more brilliant and beautiful are the colours. Another compound lacquer of which the materials are not given, is used by the painters for the richest Chinese ornamental work which is decorated with gold.

The perfection of Chinese and Japanese lacquer work does not, however, depend solely on the excellence of the varnish, or the careful preparation of the various colours, for the application of the lacquer demands the most elaborate pains. In the first place, the surface of the wood to be lacquered is prepared with the greatest care; when necessary, the joints are filled in with fine tow and then covered with thin strips of silk or paper. The surface is then dressed with an oil obtained from a certain tree which grows on the mountains and highlands of China; when the oil is perfectly dry, the varnish is applied. With two or three coats of the varnish, its transparency is so great that all the veins and marks of the wood are perfectly distinct; to disguise the wood entirely many more coats have to be laid on, and finally the surface is made as smooth and brilliant as glass.

It is on such a surface that the gold and silver ornamentation is effected, and the whole, when finished, is preserved by a light coating of the varnish.

Another kind of lacquer is produced by covering the surface of the wood with a composition made of paper, tow, lime, and some other materials. This is laid in the form of paste, and produces a solid and uniform ground with which the lacquer amalgamates.

The lacquer and varnish are laid on with flat brushes with excessively fine hairs, at first in all directions, but equally, and afterwards lightly and in one direction, each coat being allowed to dry perfectly before another is laid on. No single coat exceeds the thickness of the thinnest paper, otherwise irregularities would be produced which could not afterwards be corrected.

The workshops in which lacquered work is produced are closed in the most careful manner, in order to prevent the possibility of dust, the men even taking off all their clothes except a pair of drawers. Contrary to all European practice, the lacquered work is dried in places which are rather damp than otherwise, and the workmen exhibit the greatest ingenuity in keeping the atmosphere therein in perfect condition. When a coat of varnish is sufficiently dry, the slightest irregularities are removed by burnishing with an instrument made of a hard composition of brick, extremely finely powdered, and mixed with a certain oil, pig's blood, lime water, and a peculiar kind of earth, common in China. The last coat of varnish is not, nowever, touched with the burnisher, which would dim its lustre. Upon the perfection of this last coat all the beauty of the work depends, and the greatest care is taken that no particle of dust shall reach it and no foreign substance touch it but the hair of the finest sable. It is only under these elaborate conditions that the beautiful lacquer work of China and Japan can be produced.

THE PROGRESS OF JAPAN.

The series of consular reports from Japan show a considerable extension of public works in that country, the establishment of a general system of education, changes in the laws, customs, and manners of the people, and an expansion in commerce. The movement of the Japanese Embassy, which left for America and Europe in January, 1872, had been watched with interest by the mercantile portion of the community. Some curiosity was felt with regard to the manner in which the minds of the Ambassadors were likely to be influenced by an inquiry into the different manufactures for which each country they intended to visit was celebrated; and it was hoped the experience acquired by the Embassy would prove to its members that commerce constitutes the greatness of a nation, and that, while the Legislature provides such laws as expediency directs for the governance of trade, it wisely abstains from a direct or active interference in the business transactions of merchants. Amongst the events of the year, we are informed that the first section of the Trunk Railway, intended to connect Yedo and Yokohama with Kôto, Osaka, and Hiogo, had been opened, and already attracted more traffic than it could conveniently carry on a single line of railway. The section connecting Hiogo with Osaka was expected to be opened in the course of the following year. Information has not been procurable with regard to the cost of the line and the various disbursements which have gone to make up the total cost. It would have been interesting to know the amount of compensation given for land enclosed by the railway, and how such compensation was assessed. A comparison of these ascertained figures, with the cost of similar undertakings in England, would interest both the speculators and the general reader. The eost of railway construction in Japan should be cheap; money is easily procurable, material plentiful and at hand, and labour abundant; preliminary outlay, such as parliamentary expenses, should be almost nil, and sums given in compensation are not likely to attain a high figure, a contrast to the expense of railway undertakings in England, where, to quote one instance, the Great Northern Railway Company, a sum of nearly £2,800,000 was spent before the actual construction of the line was commenced. The telegraph wires have been stretched from Yedo to Nagasaki, but the line, which is

830 miles long, had not then been pronounced in working order. When finished, it will connect Yedo and Yokohama, Hiogo and Osaka, and Nagasaki, witb the telegraphic system of tbe world, and the delay in this useful work, when apparently so close upon completion, is deemed therefore all the more to be regretted. It has been found that the desire evinced by the Japanese officials to take an early share in the execution and management of such works, and to confine within a limited scope the efforts of their foreign employés, occasions obstructions and delays, and causes less real advance in this respect than might otherwise have been looked for from so enterprising a people.

The scheme of a Government postal system for the benefit of all classes alike, was announced to the nation in the early part of the year 1871. Shortly after, offices were opened in, and for the transmission of letters between, the principal capital cities and the towns and villages along the principal high road of the empire. Events fulfilled the wisdom of the Government in commencing the experiment on so limited a scale. For some months the amount of letters that left each capital by the daily post could be carried by a single courier, and although a conception of the nature and object of the institution gradually spread among the people, it was not till nearly a year afterwards that the heads of the postal department found it expedient to extend the line of communication as far as Nagasaki. Although the amount of correspondence transmitted was still very small, the inland lines of communication were gradually extended, and subsequently the whole country, with the exception of the northern part of the island of Yedo, has been brought into postal communication with the capital. Still the institution is as yet in its infancy, and owing to the ignorance of the people, and consequent paucity of correspondence, many of the more remote stations are visited by the courier only two or three times a month. The expenditure is, of course, far in excess of the receipts, but a uniform rate of postage for a letter between any postal stations witbin the empire, would, it is thought, indefinitely increase the amount of correspondence, and in no long time lessen the disparity. The introduction of gas into Yokobama was another important feature of the year 1872. As yet only the streets of the native town are lit, with the exception of a few houses in the proper settlement. The lighting of the streets in the latter had engaged the active attention of a few gentlemen, and arrangements with the gas company were approaching completion. Many newspapers have been started throughout the country, and show a better idea of the style and requirements of a newspaper than the semi-official gazettes, mis-named newspapers, which appeared shortly after the revolution of 1868. There has been an issue of a new edition of "Dr. Hepburn's Japanese and English Dictionary." This valuable work has been increased by some 3,000 words, and is eagerly sought for both by foreigners and Japanese.

At Hiogo, building had been carried on steadily during the year, and the largest warehouses and stores built by foreigners in Japan had been erected. Tbe streets—which are regular, spacious, and well drained—have been macadamised; and large wells were being sunk in different parts of the settlement, in order to give a more abundant and more convenient supply of water for the extinguishing of fires. New municipal buildings were being erected in a central position. At Osaka also a municipal hall was in course of construction. Large additions had been made to the Imperial mint buildings for the minting of copper coin, and for the manufacture of sulphuric acid. These additional works, however, had not yet been completed. At Nagasaki the many and great changes in the whole country were very apparent. Some of them—such for instance as the almost compulsory adoption of European styles of dress and living—cannot, it is thought, be too much regretted, whilst others, which are noticeable, will doubtless prove advantageous. Many of the Samurai class are now attending to trade, and great numbers are busying themselves as manufacturers. The necessity which all are now under of providing themselves with a livelihood must bring out such resources and energies as the people and country possess. It is considered as no small sign of the times to notice the introduction into Nagasaki of wheeled carts and "ginrikishas," and to observe the change these quicker modes of locomotion must cause to the Japanese character by urging it out of its former *dolce far niente* existence. With these and other changes, a Japanese will now devote less time to ceremony, will appreciate its value more, and will think and decide quicker than he was accustomed to do. For the first time, rice appears on the export side of the Japan trade. It must be remembered, however, that the shipments are not made in the ordinary course of trade, as the export of rice of Japan is prohibited, but solely by and on account of the Government themselves, and consist of the surplus of the rice tax received by them in kind. The mode adopted by the Government for the disposal of this surplus has been generally condemned. Instead of putting up the rice to public auction and giving due notice of the sales, which would have attracted purchasers and freights from adjacent markets, the Government preferred to become dealers themselves, and to favour a particular foreign firm witb their brokerage. The out-turn, as was natural under such circumstances, proved less favourable than it would have done if open competition had been allowed. It is to be hoped, however, that the attention attracted to the subject will, in the end, induce the Japanese Government to free tbis particular industry from the prohibitions which now weigh upon it. The Japanese farmer has at present no inducement to grow more rice than can be consumed at home, and large tracts of land are allowed to lie barren in consequence. In times of dearth, Japan purchases rice at high cost from abroad, but debars herself in years of plenty from disposing of the surplus of her harvests. The exportation of rice, if freely permitted, would do much to turn the balance of foreign exchanges in favour of Japan, and to provide her foreign trade witb an abundant supply of cheap tonnage.

It is curious to observe that a large portion of the bronze exported has been furnished by the Buddhist temples. The discouragement given to that sect by the Government—anxious to favour and foster Shintoism, the ancient national religion—and the appropriation to Imperial purposes of the revenues of many of the temples, have induced the priests to realise as much of their moveable property as possible; and the massive bells, which formed such a striking feature of these temples, have with other bronze articles of use or ornament, found their way into the hands of foreign merchants. The high prices of copper at home made it profitable to ship the bronze to England, and then extract from it the copper which it contained.

The whole production of the precious metals throughout the world during 1873 is estimated to have been worth nearly £44,000,00.

According to an American paper, a building in San Francisco that has 500 rooms is to have a clock with 500 dials, a dial for each room. The dials will be operated with compressed air, conducted in pipes all over the building.

During the past three years there has been a remarkable increase in the quantity of sugar used for brewing purposes, especially in 1873, when 29,968 tons were returned in the United Kingdom, against 16,818 tons in 1872, and 13,574 tons in 1871.

Working expenses on the Belgian State Railroads, says the *Engineer*, which in 1871 were 52·0 per cent. of the gross receipts, and in 1872, with larger receipts, 59·95 per cent. are reported unofficially, but without contradiction, to have been 78 per cent., or 80 per cent. in 1873. If true, the net earnings, which were 7·36 per cent. on the investment in 1871 and 5·21 per cent. in 1872, have fallen 3·27 per cent. in 1873.

CORRESPONDENCE.

CHANNEL PASSAGE TUNNEL.

Sir,—There are two statements made by Mr. Bateman in the discussion on Mr. Hawes' very valuable paper which I cannot let pass without remark. Mr. Bateman said:—"All observant geologists knew that almost every valley in this country was merely the longitudinal dislocation of strata, over which water had flowed and scooped out the superincumbent soil, and that nearly all rivers in the same way followed the line of geological faults." This is by no means generally admitted, and in my opinion, observant geologists will say that as a rule rivers do not follow lines of faults, and that consequently, even if there were once a river running through what is now the Straits of Dover, it does not necessarily follow that great dislocations of the strata will be found there. With regard to a second statement, viz., that "they continually had to plug out the sea at Botallack mine," I must simply say that Mr. Bateman is mistaken. There is a place in the Wheal Cock part of Botallack mine where, some 40 years ago, they followed the copper ore upwards, and bored through to the sea bottom. The holes were plugged up at the time, and the plugs may still be seen by the curious; but it must not be supposed that this plugging out of the sea is a matter of every day occurrence, as would be inferred from Mr. Bateman's words.—I am, &c.,

Clement Le Neve Foster,
H.M. Inspector of Metalliferous Mines for Cornwall, Devon, and Somerset.

Truro, March 23, 1874.

Sir,—The objection raised by Mr. Hawes in his paper against the proposed central shaft and lighthouse combined for ventilation, coming up from the tunnel centre through the "Varne ridge shoal," is absurd, for instead of forming an obstruction it would be a great boon to the ships passing up and down the Dover Channel, acting as a warning prominent light and protector to keep clear off the "ridge," which has been the cause of many shipwrecks.

I positively deny that all other plans excepting that of Sir J. Hawkshaw have been put aside, for I assert that my plan for a triple arch tunnel is still under the practical consideration of English and French engineers in connection with the French Commissioners, who will, I trust, ere long positively decide which is the best plan and site for the tunnel.

The first question to be decided is the best line of route for the tunnel to pass across the Channel, in the shortest range, for the railway from London to Paris, and also for the direct railway through the European and Asiatic continents to India, passing over the Bosphorus at Constantinople by an iron bridge, and continuing onward through the Mount Taurus passes, to Aleppo, Bussorah, Kurrachee, Bombay, Madras, Calcutta, and Singapore, and eventually to China, Japan, and Asiatic Russia, crossing the Behring Straits by another submarine tunnel railway, and then spreading over the great continents of North and South America.

The second question is, what is the best stratum for safe construction and permanent endurance of the tunnel? There are three strata that have been named by Mr. Hawes as available for the purpose, chalk, London clay, and weald clay, but I assert that they are neither of them fit or proper for constructing the tunnels; and I am borne out in this statement by the opinions of celebrated practical engineers and geologists, that my selection of a strata of pure gault clay which crosses from English to French coasts, beneath the Channel ocean, in a continuous range of about 22 miles length from the Eastware Bay, Folkstone, to a point between Wissant and Cape Grisnez, France, is the only safe and reliable stratum for carrying out the proposed works. I propose to carry a triple-arched tunnel through this gault clay, and to line the interiors with a concreted masonry or casing of cast blocks, ranging from four to seven tons weight each, dovetail bonded together in arches, the material being a compound of ground slag mixed with hydraulic lime and portland cement.

It was stated that Sir J. Hawkshaw's attention had been given to the subject only since 1865, or nine years since. Prior to this Sir J. Hawkshaw was antagonistic to any submarine tunnel being formed across the Channel. I have personally devoted 21 years of labour and thought, and incurred considerable expense since 1853, when I first introduced plans for a channel submarine tunnel, and have long studied which should be the best site, materials, form, and capacity for it, separating fast and slow passenger trains, excursion, and goods trains from each other by double lines of railways in each circular arc range, so as to carry the immense quantity of Continental traffic with speed and safety. The bare idea or notion of a single-arch tunnel, with one line forward and one line back only, for European traffic alone, is simply absurd.

I am assured that nothing less than a triple-arched tunnel will suffice for the requirements and safety of this great international communication.

It was stated by Mr. Hawes "that the only available place for Channel tunnel crossing was from Dover to Calais," or from St. Margaret's Bay, England, to Sangatte, France. This is wrong, for a crossing can be effected from Eastware Bay, Folkstone, to Cape Grisnez, France, which will save 27 miles of useless railway wear and tear and loss of time, wasted expenses, &c., in the journey from London to Paris alone; and supposing also that gault clay could not be secured for a tunnel passage, which undoubtedly can be done, then there would be still available grey chalk to cut through, quite as good, or as bad for the purpose, as grey chalk from Dover to Calais would be.—I am, &c.,

Wm. Austin, C.E.

62, Dartmouth-terrace, Bermondsey-park, London, March 24, 1874.

ON BELLS AND MODERN IMPROVEMENTS FOR CARILLON MACHINES.

Sir,—In the paper recently read before the Society of Arts on "Bells and Carillons," Mr. Lund took credit to himself entirely for all the recent improvements in carillon machines. As the columns of your *Journal* are not the proper place wherein to discuss questions of patent right, we will not enter into any controversy on the subject, but we hope you will allow us to put on record the fact that the actual improvements claimed by Mr. Lund are really our improvements, and that the patent principle which he is working was taken out by Imhof in his own name without our knowledge or consent, in spite of an agreement between us that it was to be taken out in the joint names of Imhof, Gillett, and Bland. Mr. Lund's right to use it will have to be settled in the proper place. We also distinctly deny that our carillon machines at Worcester Cathedral, Bradford and Rochdale Town-halls, are made on Imhof's plan, since they are made on an entirely new system, of which we were the sole inventors. Suffice it to say that these statements will be substantiated elsewhere, but in common justice to ourselves we cannot allow Mr. Lund's assertion to go uncontradicted.—We are, &c.,

Gillett and Bland.

Steam Clock Factory, Whitehorse-road, Croydon West, March 13th, 1874.

The Junior Naval Professional Association offer a prize of Twenty Pounds for the best essay on "The Comparative Merits of Simple and Compound Engines as applied to Ships of War." The essays must be sent to the Hon. Sec., care of Messrs. Griffin & Co., Portsea, before the 1st August, 1874.

NOTICES.

THE LIBRARY.

The following works have been presented to the Library:—

A Paper on the Economy of Fuel in Domestic Arrangements. By James R. Napier, F.R.S. Read at the Philosophical Society of Glasgow. Presented by the Author.

The Rules of Evidence as applicable to the Credibility of History. By William Forsyth, Q.C., M.P. Presented by the publisher, Robert Hardwicke.

Tests adapted to determine the Truth of Supernatural Phenomena. By George Harris, F.S.A.

Transactions of the National Association for the Promotion of Social Science, Norwich Meeting, 1873. Edited by C. W. Ryalls, LL.B. Presented by the Association.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

The following arrangements for Wednesday evenings have been made:—

April 1.—*No meeting.*

April 8.—"On the Importance of a Special Organisation for the Diffusion of Sanitary Knowledge." By Major-General Synge.

April 15.—"On the Proportion which Investments in the Purchase of Objects of Fine and Industrial Art ought to bear to the National Income and Expenditure." By Henry Cole, Esq., C.B.

April 22.—"On Progress recently made in Ornamental Processes connected with Metallic and other Industries." By W. C. Aitken, Esq.

April 29.—"On some Recent Inventions and Applications of Lambeth Stoneware, Terra Cotta, and other Pottery for Internal and External Decorations." By John Sparkes, Esq., Head Master of the Lambeth School of Art, and of the Art Department of Dulwich College.

May 6.—"On Timber Houses." By Frank E. Thicke, Esq.

May 13.—"On Coffee; a Review of the present posision of its Growth, and a consideration of its Treatment and Consumption in the United Kingdom." By W. P. Branson, Esq.

Indian Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

April 17.—"On the Indian Famine, with Especial Reference to the Means which should be Adopted for Preventing or Alleviating Famine." By General Sir Arthur Cotton, K.C.S.I.

May 1.—"On the Ruins of Cambodia, and the Antiquities of Indo-China." By H. G. Kennedy, Esq.

African Section.

These meetings are arranged for Tuesday evenings, at 8 o'clock, and the following arrangements have been made:—

April 14.—"On Trade in Western Africa with and without British Protection." By Andrew Swanzy, Esq.

April 28.—"On the History, Progress, and Prospects of South Africa." By Col. J. C. Gawler.

Chemical Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

April 10.—"On some Recent Processes for the Manufacture of Soda." By C. W. Vincent, Esq., F.C.S.

April 24.—"On Pyrites, as a source of Sulphur, Copper, and Iron." By Dr. C. R. A. Wright, F.C.S.

May 8.—"On Sugar Refining, with special reference to Finzel's Sugar Crystals." By Dr. Griffin.

May 22.—"On the Manufacture of Chlorine." By W. Weldon, Esq., F.C.S.

CANTOR LECTURES.

The third course will be by Professor Barff, M.A., "On Carbon and Certain Compounds of Carbon treated principally in reference to Heating and Illuminating Purposes."

The object of these lectures is to explain the scientific principles involved in all heating and illuminating processes, and to apply those principles to practical purposes. The absorbent properties of carbon will be briefly noticed.

Lecture I.—April 13.

Carbon: the different forms in which it is found in nature; its properties as a disinfecting and decolorising agent, &c.

Lecture II.—April 20.

Compounds of carbon and oxygen, carbonic acid, carbonic oxide.

Lecture III.—April 27.

Gaseous compounds of carbon and hydrogen, marsh gas, and olefiant gas.

Lecture IV.—May 4.

Liquid compounds containing carbon and hydrogen, and fuel.

Lecture V.—May 11.

Coal gas, its composition and purification, and its illuminating properties.

Lecture VI.—May 18.

Heat of combustion; how heat is communicated, and how quantity of heat is determined.

Lecture VII.—May 25.

Consideration of furnaces, stoves, lamps, &c., in which the principles stated in the former lectures will be applied.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Mon. ...Royal United Service Institution, Whitehall-yard, 8½ p.m. Mr. Nathaniel Barnaby, "Trials of H.M.S. *Devastation*."
Medical, 11, Chandos-street, W., 8 p.m.
London Institution, Finsbury-circus, E.C., 4 p.m. Professor Bentley, "Elementary Botany."
Social Science Association, 1 Adam-street, Adelphi, W.C., 8 p.m. Dr Hardwicke, "On the Abolition of Slaughter-houses and Legislation on Noxious Trades."
Institute of Actuaries. Mr. George Humphreys, M.A., "On the Practice of the Eagle Company with Regard to the Assurance of Lives Classed as Unsound, and on the Rates of Mortality prevailing amongst the Lives so Classed, assured with them during the sixty-three years ending 30th June, 1871."

Tues. ...Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. 1. Mr. Richard Christopher Rapier, "On the Fixed Signals of Railways." 2. Captain Henry Whatley Tyler, "On Simplicity as the Essential of Safety and Efficiency in the Working of Railways."

Wed. ...Microscopical, King's College, W.C., 8 p.m.
Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.
Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.

Thur. ...Linnæan, Burlington House, W., 8 p.m. Mr. W. K. Parker, "On the Morphology of the Skull in Picidæ."
Chemical, Burlington House, W., 8 p.m. 1. Dr. Phipson, "On Sulphocyanide of Ammonium and Sulphocyanogen." 2. Mr. H Procter, "Note on a Reaction of Gallic Acid." 3. Mr. W. Noel Harsley, "On the Cobalt Bromides and Zodides. 4. Mr. E. Neison, "On the Distillation of Sodium Ricenoliate." 5. Mr. H. Piesse, "Note on the Solubility of Plumbic Chloride in Glycerine." 6. Mr. C. T. Kingzett, "On Ozone as a Concomitant of the Oxidations of the Essential Oils." Part I.

JOURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, APRIL 3, 1874.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

MARRIAGE OF H.R.H. THE DUKE OF EDINBURGH.

The following address has been presented by the Society to his Royal Highness :—

To His Royal Highness The Duke of Edinburgh.

We, the Society for the Encouragement of Arts, Manufactures, and Commerce, venture to approach your Royal Highness with our Loyal and Hearty congratulations on your Royal Highness's Marriage with Her Imperial Highness the Grand Duchess Marie of Russia, and to express our confident hope that this union, so auspiciously commenced, may not only prove a source of lengthened domestic happiness, but may tend to unite two great countries in those peaceful relations which are essential to progress in Arts, Manufactures, and Commerce.

Sealed with the Seal of the Society for the Encouragement of Arts, Manufactures, and Commerce, this 27th day of March, 1874, in the presence of

P. Le Neve Foster,
Secretary.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1874, early in May next. This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows :—

In 1864, to Sir Rowland Hill, K.C.B., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Mons. Michel Eugène Chevreul, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

The Council invite members of the Society to forward to the Secretary, on or before the 11th of April, the names of such men of high distinction as they may think worthy of this honour.

INTERNATIONAL EXHIBITION OF 1874.

The Council have resolved to offer the Society's Gold and Silver Medals in connection with the International Exhibition of 1874.

A gold and a silver medal is offered in each class, and these medals will be given for any object exhibited which, in the opinion of the Council, shows paramount or very great excellence, whether in respect of the final result, the machinery, method of production, or novelty.

INDIA COMMITTEE.

The Committee met on Friday, 27th March, at half-past four o'clock. Present :—Mr. A. Cassels (in the chair), Dr. Boycott, Dr. Campbell, Mr. FitzWilliam, Mr. Hendriks, Mr. Maitland, and Mr. S. Ward. The Committee took into consideration and decided upon the conditions for the offer of a Prize for an Essay on Indian tea.

ESSAY ON INDIAN TEA.

The Council, on the recommendation of the India Committee, have decided to offer a Prize for the best Essay "On the Cultivation and Manufacture of Indian Teas." The prize will consist of a Gold Medal, or 20 Guineas. The essays are to have especial reference to the following points :—

1. The cost, *i.e.*, the price or rent of land in the various districts, and considerations for the judicious selection of land in respect of soil and climate.

2. The best method of raising and planting out tea plants, and the effect of the use of manure.

3. The effect of the use of mechanical inventions and contrivances in tending to reduce the cost of production and manufacture, more especially in leaf-rolling; and the application of steam or hot air in the roasting or drying processes, with a view to the economy of fuel.

4. The manufacture of brick tea, such as will find a profitable sale in Central Asia, and compete successfully with that from China.

5. The rolling and sifting of tea.

6. The utilisation of tea-seed in making oil or oil-cake for cattle, as fuel, or for other purposes.

7. The best machinery or means for simplifying and cheapening the manufacture of tea boxes, and the best sources of supply of timber suitable for making the same.

8. The best size for tea packages.

9. The condition of the supply of labour.

10. The cost of cultivation in full detail.

11. The cost of manufacture in ditto.

12. The cost and nature of transit ditto—first, to sea-port; second, to London.

13. The process through the different stages of tea manufacture.

14. The causes of tea becoming sour, and how they may be avoided.

15. Writers are requested to be as concise as possible.

16. The essays must be sent in for adjudication on or before 1st May, 1875.

17. The Council reserve to themselves the right of withholding all or any of the above prizes, as the judges appointed by them may determine.

VISIT TO THE BRIGHTON AQUARIUM.

Arrangements are now being made for a visit of the Members of the Society of Arts and their children to the Brighton Aquarium, under the guidance of Mr. Frank Buckland, M.A., Her Majesty's Inspector of Salmon Fisheries, who will then deliver his Fourth Juvenile Lecture. Friday, the 10th of April, during the Easter Holidays, is selected for the visit, and a ticket can be had for 10s. 6d., entitling the bearer to travel first-class by special train to Brighton and back, with admission to the Aquarium and luncheon. A sufficient number of names has now been received to justify the Council in definitely carrying out the proposed arrangements, and the issue of tickets has consequently commenced. Members desirous of securing to themselves and friends the privilege of obtaining these tickets, are requested to send in their names at once to the Secretary of the Society of Arts, with a remittance, and stating the number of tickets they will require.

PUBLIC MUSEUMS, &c.

The following letter has been received by the Secretary, in answer to a request from the Council that the Lord Chancellor would receive a deputation on the subject of the present condition of the Patent Office Museum:—

23rd March, 1874.

Sir,—I am directed by the Lord Chancellor to acknowledge the receipt of your letter, enclosing the resolutions of the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce, relative to the National Museums and Galleries and Public Education.

The Lord Chancellor has had his attention called to the interview which took place between Lord Selborne and a committee of your Society upon the same subject, and he has also had a conversation with Mr. Woodcroft, of the Patent Museum Office, in reference to your letter; and it is his Lordship's intention to lay the matters in question fully before the Patent Commissioners at a meeting, which has been summoned for Friday next.

Under these circumstances, and with the prospect of the resolutions of the Council receiving an early and full consideration from the Patent Commissioners, his Lordship thinks that possibly an interview may not be deemed necessary any longer by the gentlemen under whose instructions you wrote to request one.

I am, Sir, your obedient Servant,

Henry J. L. Graham, Principal Secretary.

P. Le Neve Foster, Esq.,

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The first course of Cantor Lectures for the present Session was "On Spectrum Analysis as aided by and aiding the Arts," by J. Norman Lockyer, F.R.S.:—

Lecture I.—Monday, November 24th, 1873.

Those of you who know best how the Society of Arts always places itself in the forefront of any movement which is likely to benefit mankind by the application of the various sciences to the practical affairs of life, may recollect that, as nearly as may be 30 years ago, the dawn of a comparatively new science was brought before an audience in this room. If I look no longer to the *Journal*, but to the "Transactions" of the Society of Arts, Manufactures, and Commerce, as far back as the year 1843,* I find a paper there by the late Mr. Claudet, who then gave an account of the progress which had been made up to that time in an art and a science which is now perfectly familiar to all of you; I refer to photography; and it is excessively curious that his lecture on the origin of this science, and my present lecture on the application of photography to spectrum analysis, are complementary to each other, so much so, that one may almost say that Mr. Claudet's lecture, admirable though it was, was incomplete, because he did not show in it, as of course he could not show, how certain matters which he referred to in that lecture have been dealt with in the light of modern science.

If you carry yourselves back to the year 1839, some four years before this lecture to which I refer was delivered, you will recollect that Mr. Niépce had at that time brought photography to a more practical realisation than it had been by any of his predecessors. He had then for some years allied himself with Daguerre, and the daguerrotype was already in existence. The action of iodine on silver, first discovered by Fox Talbot, had been fixed by the vapour of mercury.† Now, in the daguerrotype we had not the action of light in its ordinary sense; and men's minds were very much exercised as to what could be the real cause of the effects which were then being revealed. Mr. Claudet, in his lecture, points this out in a most admirable way, and I will summarise, if you will allow me, just some of the principle points to which he alludes. You had a beam of light falling on a plate. On this plate was a certain chemical compound. What part of the sunlight, or was it sunlight at all, which so acted upon this compound, that you got an image more or less permanent?

* Vol. lv., p. 89.

† Fox Talbot, *Philosophical Magazine*, vol. xxii., p. 97.

What more natural than that this question should be investigated by means of various tinted glasses? The solar beam which the experimenters then used they made to pass through glass, now of one colour, and now of another. I can show you, by means of this electric lamp, nearly what they did. Imagine the lamp to be the sun; in the path of the beam differently coloured glasses are placed. We have now the action of a red glass; we now change the red glass for another one, and now we have the action of a green glass. There was an immense deal of difference of opinion concerning the action of light as investigated in this way. In fact, I shall have shortly to show that Mr. Claudet and a very distinguished French physicist, M. Becquerel, were considerably at variance with regard to one particular point which came out from this kind of investigation. But we had not long to wait. Sir J. Herschel, in the year 1839, pointed out that it was not a question of investigating these new qualities of light at all by means of coloured glasses; they should be investigated by means of the spectrum. Sir J. Herschel, in three papers, communicated to the Royal Society in the years 1839, 1840, and 1842, showed that the only philosophic way of investigating this problem was really by obtaining a pure spectrum, such a one as I now throw upon the screen. You see that we have at once, in different parts of this spectrum, exactly what we get at different times when we deal with red glass, yellow glass, orange glass, green glass, blue glass, and so on. And having such a spectrum as this to deal with, and supposing such a spectrum thrown on to the photographic plate, it is quite clear to all of you that if there were something magical or unknown in the red rays which gave us this new action on the molecules of the particular chemical compound employed, or whether this magic really resided in the blue rays, that we should at once have this pointed out to us in the most unmistakeable manner, by the action in the part of the plate on which the red image fell, or in the part of the plate on which the blue image fell.

Now, although Sir John Herschel was the first in this country to point out the extreme importance of this point of view, he was by no means the only one. Then, as now, there were distinguished Americans who were well to the front, and among them was Dr. Draper, the father of another Dr. Draper whom I shall have to speak of by-and-bye. Those of you who are familiar with the enormous step in advance which was taken in spectroscopic investigations by Wollaston, who substituted a slit for a round hole, will perhaps be somewhat surprised to find that the first observations were conducted by throwing a converging beam of sunlight, giving an achromatic image of the sun on the plate, through a prism. This method of procedure of course did not go so far as a better one might have gone, but it went a considerable way. Sir J. Herschel, from his observations made in this manner, stated that he had found a new kind of light—a new prismatic colour, "lavender grey," altogether beyond the blue end spectrum, such as you have seen it on the screen—altogether beyond the blue end of the spectrum, not the red end. Professor Draper, on his part, also came in the main to the same conclusion, stating that he had discovered a "latent light."

When we have come from the year 1839 to the years 1842 and 1843, we find a great advance, an advance just the same as far as photography goes, as Wollaston's advances on Newton was with regard to spectroscopic observation. Both Becquerel and Draper introduced, instead of this achromatic image of the sun, the simple arrangement of throwing sunlight through a slit and a proper combination of lenses on to a plate. The result was that on the 13th of June, 1842, Becquerel did what I may venture to call a stupendous feat.* He did what has never been done since, so far as I know. He photographed the whole solar spectrum with nearly all the lines registered by the hand and eye of Fraunhofer. I do not mean merely the blue end of the spectrum, as you may imagine, but the complete spectrum, from the "latent light"—the ultra violet rays of Draper—to the extreme red. Draper also did something like the same thing, but not quite the some thing, in what he calls a "tithonographie representation" of the solar spectrum. He gives certain lines in the extreme visible blue part of the spectrum,* certain other lines, which none but Becquerel had ever seen before (Draper's work being done nearly a year later), and in the extreme red—beyond the visible red of the spectrum, he gives other lines which even Becquerel had not photographed. This of course was such a tremendous revelation to both these men that you can imagine a considerable discussion arose, not only in their own minds, but in the minds of others, with regard to the work which they had done. Becquerel found, from an absolute comparison between the Fraunhofer lines which he had photographed and the Fraunhofer lines which Fraunhofer himself had registered, tremendous evidence in favour of the fact that this new chemical agent which was astonishing the world, whatever it was, was not something absolutely and completely independent of the visible rays. Draper, on the other hand, in his "tithonographic representation," had, for some photographie reason or other, not succeeded in registering the lines in the yellow, orange, and green part of the spectrum, although he had fixed the lines in the blue, in the extreme violet, and in the extreme red; and he considered himself justified by his experiments in coming to exactly the opposite conclusion to that at which Becquerel had arrived, namely that the light, whatever kind of light it might be, which was at work in effecting this chemical change which rendered photography possible, was something absolutely and completely independent of the ordinary light which the retina receives.

This was in the year 1843. I need not tell you that by the year 1845, in which year Mr. Claudet read another paper before this Society, further investigations by means of the spectrum had shown that Dr. Draper's idea was heretical, and at the present moment you know it is the general opinion of physicists, an opinion founded upon the work which has been done to advance photography and other researches since that time, that the radiations which you get from any light source, from the extreme violet to the extreme red, differ only in the rate and in the magnitude of the vibrations which are at work, so that I claim for the application of photography to spectroscopy, as a first result, the establishment of this great fact, that the visible, the chemical, and the heat rays are really part and parcel of the same thing, that thing being a system of undulations varying in rate and wave length from one end of the spectrum to the other, whether you consider the visible portion, or the invisible rays—those outside the blue, in one case, and outside the red in the other. But that is not all; I claim another thing for the application of photography to spectroscopy. Sir J. Herschel, so soon as he applied the prism, stated, in a communication to the Royal Society, that it was no longer possible to proceed with that branch of research under the best possible conditions, unless opticians would construct lenses which would bring the visible and the chemical rays into absolute coincidence. This is now done by our Rosses and Dallmeyers in the camera-lenses, and that is the second great feature which I claim for the application of photography to spectroscopy.

The next step brings us down to the year 1852. In this year a paper† was communicated to the Royal Society by Professor Stokes, who had already announced

* "Bibliothèque universelle de Genève," vol. xxxix.-xl., 1842, p. 341.

* *Philosophical Magazine*, vol. xxii., p. 360, 1843. For his earliest work see Journal of the Franklin Institute for the year 1837.

† *Philosophical Transactions*, vol. clxii., 1852.

his discovery of what has since been called fluorescence; "or the long spectrum of the electric light." Professor Stokes, dealt in his first paper with the "change of refrangibility," or, as Sir William Thomson proposed to call it, "degradation of light," by virtue of which light, which was generally invisible to us, could, under certain circumstances, be made visible. It is no part of my present purpose to go into this magnificent paper, one of the crowning glories of the work of this century, at any great length; but you will see in a moment that, if it was a question of the degradation of light, then the invisible light to which Professor Stokes referred as being capable of being rendered visible, must have been light outside the blue end of the spectrum, and not outside the red end. Professor Stokes, in his investigations, in order to get at this invisible light under better conditions if possible than those with which he commenced operations, tested the transparency of the substances through which the light with which he experimented passed, and the transparency of glass was passed under review by him,* when he found that this invisible light, or whatever it was, could only get through glass with extreme difficulty. Continuing his investigations, he found that quartz on the other hand allowed this invisible light to pass. If you will allow me, I will read an extract from Professor Stokes's paper of the extremest importance to our subject. After referring to these experiments on glass and quartz, he proceeds to say:†—"I have little doubt that the solar spectrum," (which you recollect had already been photographed to a certain extent both by Becquerel and Draper beyond the visible blue end of the spectrum), would be prolonged, though to what extent I am unable to say, by using a complete optical train, in every member of which glass was replaced by quartz." He then adds that other substances which suggested themselves to him were not equally good. Then further, that if this invisible light does get through quartz, and does become visible to the eye, it does not at all follow that it will be capable of being photographed. Because already Professor Stokes, in order to continue his researches in fluorescence, had been, as it were, driven to photograph some of the results which he had thus obtained. I am sorry to say that, so far as I can find out, none of those photographs have ever been published.

Before I go further, I think it will be convenient to throw on the screen some photographs of the solar spectrum, showing exactly what I mean by the "invisible rays;" and you will then see the enormous advance which Professor Stokes made the moment he introduced his quartz train, and enabled both the eye and the photographer to take advantage of a new region of the spectrum in its entirety, in order to investigate it. In a note to his paper communicated to the Royal Society, he shows that his anticipations, so far as the eye was concerned, was perfectly justified by the facts.‡ He says:—"I have since ordered a complete train of quartz, of which a considerable portion, comprising, among other things, two very fine prisms, has been already executed for me by Mr. Darker; with these I have seen the lines of the solar spectrum to a distance beyond H," more than double that of P. So that the length of the spectrum, reckoned from H. (the outside line in the portion ordinarily visible), was more than double the length of the part previously known from photographic impressions. I will now throw on the screen the spectrum of the extreme part of the visible portion. The eye generally can see the two dark bands which you see in the middle of the screen, called H 1 and H 2. The least refrangible part of the spectrum lies to the right. When Professor Stokes, therefore, stated that the solar spectrum was prolonged, he means that the part of the spectrum visible either to the unassisted eye or on a photographic plate after impression, extends to a certain distance beyond these two dark lines. Another photograph I have here will show this better. In this we get a little more of

* Op. cit. Art. 202. † Art. 204. ‡ P. 599.

the structure of the spectrum beyond H. We have still the less refrangible portion to the right. This is a negative, and therefore what we have as dark lines in the proper representation of the solar spectrum are seen as bright lines; we have to the left of H 1 and H 2 more of the structure than we had before; just about so much of the spectrum, in fact, as was photographed by Draper and Becquerel in 1842. The part which Professor Stokes rendered visible by means of his quartz train extended a considerable distance to the left beyond the part of the spectrum which you now see on the screen.

So much for the solar spectrum. Now let me carry you on another ten years, to the year 1862. Professor Stokes, in a paper communicated to the Royal Society in this year,* refers to his former paper, and to what he had been enabled to do by means of it. He states—"A map of the new lines (the lines thus observed by him) was exhibited at an evening lecture before the British Association, at their meeting at Belfast in the autumn of the same year, and I then stated that I conceived we had obtained evidence that the limit of the solar spectrum in the more refrangible direction had been reached. In fact, the very same arrangement which revealed, by means of fluorescence, the existence of what were evidently rays of higher refrangibility coming from the electric spark, failed to show anything of the kind when applied to the solar spectrum;" and then he goes on to say that, in making observations by means of the electric spark, he had found that in the case of a spark taken between the poles of an induction coil like this on the table, or between the poles of an electric lamp such as you see here, that the visible spectrum which was revealed and rendered visible to him by means of fluorescence, was no less than six or eight times longer than the whole of the visible part of the spectrum. That, you see, was a revelation of the first order. He was so astonished at this, that he at first thought there was some mistake. "I could not help at first suspecting that it was a mistake, arising from the reflection of stray light." In fact, so astonished was he, so many methods did he try in order to break down the impossibility, if it existed, that he adds, in a subsequent part of the paper, "I tried different methods, without being able to satisfy myself as to the accuracy of the observations, and frequently thought of resorting to photography."

Professor Stokes thought of resorting to photography, but at the moment that Professor Stokes was thinking of this, Dr. Miller, of King's College (unknown to Professor Stokes) was not only thinking of resorting to photography, but had actually resorted to it, and was taking photographs of the so-called invisible part of the spectrum, in which the spectrum in the case of some substances was five or six times, and in the case of silver one might say almost seven times, as long as the spectrum ordinarily visible through glass prisms. Professor Miller goes very nearly over the same ground that Professor Stokes had done before him. He also investigates the transparency of quartz, and comes to the conclusion that quartz is almost the only substance that can be employed. Professor Miller, in this paper, which you will find in the "Philosophical Transactions,"† also gives for the first time a detailed account of the way in which such work is done. Permit me to give you a rough notion of this method of work. We have here a spark from an inductive coil, exactly such a spark as Dr. Miller wished to examine. He had a spectroscope something like this on the table, with two important differences. The first important difference was that instead of having two glass prisms he had prisms of quartz; and again, instead of having an observing telescope adapted for use by the eye he inserted a camera, or what was to all intents and purposes a camera, in the same place. So

* "On the Long Spectrum of the Electric Light." *Phil. Trans.*, vol. 152, p. 599.
† Vol. cit. p. 801.

that he had, first of all, a light source by which you get an intense illumination, due to the extremely high temperature of the spark. Then you have a quartz lens, and quartz prisms, and then simply the photographic plate. Having therefore an entire absence of the non-transparency of glass, Professor Miller was delighted to find that, on taking this spark in this way, between electrodes of different substances, he not only photographed what could be seen, namely, a spectrum ranging from red to blue, but one extending as a rule six times the length of the visible spectrum beyond the blue; although, in some cases, it is true it is only four times as long on the more refrangible side of H, as H is from the red end of the spectrum, that is to say, the line which is generally called A. In this paper of Dr. Miller's we have the germ of all the applications of photography to spectroscopic inquiry which have been carried on since; and I am sorry to say that altogether too little has been carried on. Not only did Dr. Miller investigate in this way the radiation of different vapours, and give photographs for the first time of the bright lines of a very large number of chemical substances, but he went further than this altogether, and dealt with the absorption of different substances. He commences his paper with the absorption of chemical rays by transmission through different media—through solids (transparent of course), through liquids, and through gases and vapours, the only alteration he made in his general mode of experimentation being that in the case of the absorption of gases and vapours, he placed the instrument further from the light source, and in the path of the ray inserted a tube containing the gas or vapour to be experimented with, as I am doing now, so that the light which passed from the spark to the telescope was compelled to traverse a thickness of vapour according to the length of the tube employed. In that way he not only determined the absorption of equal lengths of different vapours amongst themselves, but the absorption of different lengths of the same vapour; his paper is thus one of the most important contributions to spectroscopic knowledge that I am acquainted with, and I hold that the chief importance of it is the application of photography to spectroscopic observation. There is nothing so difficult, I think, as to make a proper spectroscopic observation, and from the little experience I have had with it at present, I should think there is nothing more easy than to make what I may call passable spectroscopic photographs.

That, then, was in the year 1862. In the year 1863 we have another equally distinct advance to chronicle, but this time the work is done in France. Mons. Mascart —a name very well known to physicists—undertook a tremendous work, which he has not yet completed, namely, a complete investigation of the ultra violet solar spectrum.* Instead of using a quartz prism, as Dr. Miller had done before him, Mons. Mascart uses a diffraction grating, that is to say, an instrument by means of which the light is not refracted, as in the case of the prism, but diffracted by an effect of interference of fine lines ruled on glass. Mons. Mascart has shown it to be possible, by means of reflecting light from the first surface of the diffraction gratings, to get light diffracted without its going through the glass at all. In this way, therefore, you avoid altogether the imperfect transparency of the glass. Professor Mascart has gone on advancing every year, until now he has completed a photographic map, not only of the solar spectrum extending about as far as the line R., by means of photography, but he has been able to observe as far as the line called T. There he finds the solar spectrum ends; but in the case of a great many vapours, such, for instance, as that of cadmium and other metals of the same nature, he finds he can go on photographing very much further, and has been able to photograph almost as far as the eye can see, that is to say, to a distance, as I have already told you, five or six, or even seven times as far from the line H as H is from A. So that you see, thanks to photography, we can now photograph six times more of the spectrum than we can see of it with the eye ordinarily.

I next come to a very beautiful reflex action of spectroscopy on photography; and now I must take you back to America. I am nearly certain that every one in this room is perfectly familiar with the name of Rutherford in connection with celestial photography, but if you will allow me I will point my reference to him by throwing on the screen one of his magnificent photographs of the moon, which he was good enough to give me some little time ago; and I am anxious to show this on the screen, especially to show you the wonderful skill of which he is capable. Unfortunately, I am not able to throw on the screen a photograph of the magnificent solar spectrum which we owe to him, the most magnificent photograph of the solar spectrum—and I say it with the intensest envy—which I think it is possible to obtain. However, I have a copy of it on the wall, and it is well worth inspection. Rutherford, whose name is associated with that of Mr. Delarue with regard to celestial photography, was not content with the reflector, the very instrument by which this beautiful photograph of the moon, which I will show you, was taken. He lives in the centre of New York, and I suppose New York is almost as bad as London for tarnishing everything that the smoke and atmosphere can get at; and he came to the conclusion that he must either abstain from celestial photography altogether, or else make a lens—and a lens with Mr. Rutherford means something over 15 inches diameter—which should give him as perfect an image in New York with 15 inches of glass, as a perfect reflector of 15 inches aperture would give him as far away from a city as you please. Mr. Rutherford, who never minces matters, knowing that it was absolutely impossible to get such a lens as this from an optician, who of course neglects almost entirely the violet rays—the very rays which Mr. Rutherford wanted—when he makes an ordinary telescope, determined to make such an one himself. He thought about the matter, and he came to the conclusion that in any attempt to correct a lens of the magnitude for the chemical rays, the use of the spectroscope would be invaluable. He therefore had a large spectroscope made, in order to make a large telescope, and then we have just as distinct an improvement upon the instruments which we owe to the skill of those who first adopted the suggestion of Sir John Herschel, and brought together the chemical and the visual rays, as the improvement we owe to Herschel was upon the instruments which dealt simply with the visible rays. Mr. Rutherford simply carts away the visual rays bodily, and only brings together the chemical rays; the result of his work being a telescope through which it is absolutely impossible to see anything, but through which the minutest star, down I believe to the tenth magnitude, can be photographed with the most perfect sharpness. This is the instrument of the future, so far as stellar astronomy is concerned. Having thus achieved what he wished in the construction of this instrument, and having the spectroscope, Mr. Rutherford commenced a most elaborate research, which, I am sorry to say, he has never published, for it would be of the greatest value to any photographer or any astronomer amongst us, upon every kind of collodion which he could obtain in America or in Europe, and upon every possible arrangement of lenses. Mr. Rutherford found that some collodions which he got were so perfectly local in their action, as to be almost useless for that reason, and that other collodions were so general in their action that they were also almost useless for the exactly opposite reason. I will now throw on the screen the line G and the lines in the green, or rather the lines approaching to the green near F: with ordinary collodions, such as on generally gets,

* "Annales Scientifiques de l'Ecole Normale Supérieure." Vol. for 1864, p. 219.

that is to say, collodions not absolutely good, but free from both the extremes referred to by Mr. Rutherford, we want something like five seconds for the part near the line G. Well, when you go a little way along the spectrum in the less refrangible direction, you have to put minutes for seconds—in other words, the exposure has to be sixty times as long. I have another photograph of the spectrum, which will show you the part of the spectrum less refrangible than the line F to which I have referred. This photograph which you see on the screen now required very nearly half-an-hour.

Those of you who are most familiar with the solar spectrum will recognise the extreme importance of Mr. Rutherford's contribution to photographic spectroscopy, when I tell you that, in the opinion of the best judges, his photograph of the solar spectrum is quite as admirable and excellent as is the photograph of the moon which I have just shown you on the screen. During the last year this question of the solar spectrum has again been considerably advanced by photography in America. Mr. Rutherford's photographs, admirablo although they are, are refraction photographs, that is to say, prisms were used, and more than this, prisms of glass. You will, therefore, quite understand that the photograph which yon see extends only a very little distance beyond the lines H. But America was not satisfied with this, and in the person of Dr. Draper, the son of the Professor Draper whose name is so honourably associated with the commencement of work done in photography 30 years ago, Dr. Draper has just now photographed a solar spectrum far beyond H. A copy of his photograph is on the wall, but unfortunately I have not a copy which I can throw on the screen.

I have already referred to the extreme importance of photography in astronomy, and the point that I wish to urge to-night, after what I have stated regarding all the work which has been done up to the present time, is this—That what photography has been in the past to astronomy—what it will be in the future no one can say—such can photography, and such must photography, be to chemists and to physicists. Of course, in the way of photographic application, it is scarcely fair to say that a daily photographic record of the prominences around the sun is a question either of physics or of chemistry. But still the method which enables us, or which, I hope, will enable us shortly, to obtain a daily photograph of every prominence which bursts out —although absolutely invisible to our eyes—on the sun, is a method which depends on physical laws, and has nothing to do with astronomy in the ordinary sense. If you will allow me, I will show you now on the screen a photograph of a drawing which was made by an eminent Italian observer in India during the last eclipse. It is a drawing made by Professor Respighi, of the sun's corona, as seen by the spectroscope; and I hope in the next eclipse we shall not any longer have merely drawings to refer to, but that we shall have a photograph which can be bodily brought here, and which will let us know exactly how the matter stood. You see there on the screen three rings—a red ring, a green ring, and a blue ring. They are red, green, and blue, because the element in that part of the sun's atmosphere hydrogen gives us lines in the red, green, and blue; and they are rings because the hydrogen atmosphere extends in the most admirably regular way all round the sun. In fact, we may say, that in observations of this kind, we use tho corona instead of the slit, and if that is good for the corona it is perfectly obvious to you it is good for the chromosphere—for the brighter regions lying closer to the sun than the corona does—as we know that it gives a line of such intense blue, exactly where photography, as it is generally carried on, has its strongest *point d'appui* in the spectrum; and it is quite clear to you that we ought to be able to get a photograph of this every day, just as easily as we saw it in India during the eclipse.

We will next consider the application of photography, no longer to the mere solar spectrum, but to the physics of the sun. What is the solar spectrum? It is the continuous spectrum of the sun, minus certain portions where the light of the continuous spectrum has been absorbed. What have been the absorbers? The gases and vapours, generally speaking, in an excessively limited zone of the sun's atmosphere, lying close to the bright sun we see; close, I say, to the photosphere. This zone is called the reversing layer. Then if the solar spectrum is the result of the absorption of this reversing layer, what will happen to the solar spectrum if the constitution of the layer changes? Obviously a change in the solar spectrum. Now, recent researches carried on by means of photography show us that if you take any particular vapour in the reversing layer, which you may call A, for instance, and then assume that the quantity of A in the layer is reduced, the absorption of that particular vapour will be reduced; what then will bo the result on the photograph of the solar spectrum? Some of the lines will disappear. Suppose that this particular vapour which we call A, instead of being assumed to decrease in quantity, increases in quantity, what will happen to the solar spectrum? The same researches have told us that as its quantity increases its absorption will increase, and that its increased absorption will be indicated by an increase in the number and in the breadth of the lines absorbed. What, then, will happen to the solar spectrum if any change of this kind is going on? The photograph of a solar spectrum taken, say, to-day, may be different from the photograph of the same part of the spectrum taken at some distant period. What is the distant period we do not yet know—whether three months, six months, six years, or eleven years; but, at all events, there is reason to think already that if we had a series of photographs of the solar spectrum, taken year by year, that we should see very great changes in the spectrum. Allow me to show you a photograph of a very limited portion of the solar spectrum, and I will prove my case; and let me tell you I could not prove my case if photography had not been called in, because if the existence of any particular metal, or of the increase of any particular metal, depends on such a small matter as one line among 10,000, what will happen if a man neglects to observe this change? People will say, "Oh! in a research of that kind it is altogether excusable if he has made a mistake." But if you have a series of phenomena recorded by means of a camera on "a retina which never forgets," as Mr. Delarue has beautifully put it, and if you compare those pictures day by day, and year by year, the thing is put beyond all question when you get one line disappearing, or another line appearing.

Now we have before us a part of the solar spectrum near the line H, and I wish to call your particular attention to one line. We have admirable drawings of the solar spectrum taken about the year 1860. If the draughtsman was recording by means of his eye the lines in the spectrum, he would not be very likely to overlook a line darker than some he inserts, but he might easily overlook finer lines. Now, it is a fact that in the most careful map that we have—a map drawn with a most wonderful honesty and splendid skill—a line is absent in the region indicated, which line is now darker than some that were then drawn, and that line indicates the presence of an additional element in the sun—strontium. I do not make this assertion thinking that subsequent facts will show the drawing to be wrong, but because I see reason to believe that what we know already of the sun teaches us that it is one of the most likely things in the world that strontium was not present in such great quantity in the reversing layer when the drawing was made; but, however that may be, I think you will see how important it is that this photograph, which I have just thrown on the screen, should be compared with photographs made five, ten, fifteen, a hundred, or two hundred, or as many years as you like ahead, and it is in this possible continuity of

observation of the solar spectrum, carried on for centuries, that I do think we have in photography not only a tremendous ally of the spectroscope, but a part of the spectroscope itself. Spectroscopy, I think, has already arrived at such a point, at all events in connection with the heavenly bodies, that it is almost useless, unless the record is a photographic one. I am glad to say that only to-day I have had a letter from Dr. Draper, who tells me he has at last succeeded in getting an admirable photograph of the spectrum of a star. Now that is of the very highest importance, because the sun is nothing but a star, and the stars are nothing in the world but distant suns; and as long as we merely investigate the sun, however diligently or admirably we do it, and neglect all the others, it is as if a man who might have the whole realm of literature to work at should confine himself to one book, and that book probably not a very good representative of the literature of the country he was examining into.

So much for the application of photography to what may be called the celestial side of spectroscopy; but let me tell you that this, so far as spectroscopy is concerned, does not exist. To the spectroscope all nature is one, and it is absolutely impossible to make a single observation, either on a sun, or a star, or a comet, without bringing chemical and physical considerations into play; and I pity chemists if they employ the spectroscope in terrestrial chemistry—they have not done much in that way yet—but I pity them if they commence operations in that way, unless they take the sun and all the various stars of heaven into their counsel when they do it, because the spectroscope is absolutely regardless of space, and shows us that the elements which are most familiar to us here, or at all events a good many of them, are present in the most distant stars, and the spectroscope shows us those elements existing under conditions which are absolutely impossible here. Therefore, if a man is studying cadmium chemically, and does not go the sun and see what cadmium is there, he simply leaves half his evidence out of the record.

There is another point, too—spectroscopy is, above all things, molecular. We are dealing with the ultimate atoms, or molecules, or whatever you like to call them, when, by means of the short wave temperature of the spark, we drive a substance into vapour. And if chemists, for instance, will simply ask themselves which substances have their lines reversed in the solar spectrum, I think, before they have thought that problem out—that very simple problem, as it seems—there will be such a flood of light thrown upon terrestrial chemistry, that the only wonder will be that it has not been seen before, years and years ago. These, you will say, are theoretical applications. It is perfectly true; and there are a great many other theoretical applications that it would be my duty, as it would be my pleasure, to bring before you, if time permitted. But that is not all. I have to refer to the application of the spectroscope in what are considered by some people more practical directions, although I am always sorry to see science get down to its practical side, because, when it has got there, it is more or less used up. The more you deal with the most abstruse considerations of science, the more likely you are to get practical applications out of them, if you care more for practical applications than for abstract truths. But, however, in my next lecture I shall have to talk about the practical applications, which some people may consider of more importance, but before I do that, there is one more method that I wish to call your attention to. You have already seen how excessively important it was to use a slit instead of a round hole in these experiments. It was the verdict of Wollaston, and it was the verdict of Becquerel and Draper, as I have shown you to-night with regard to photography. You have also seen that we can use the circular corona as a slit equally well. Therefore, if we like to take a long slit and divide it into as many portions as you choose, we see at once the improvement that we introduce into photography. All we have to do is to divide that slit into portions, as it were, by letting a window run down the slit, and when the window has arrived at the second part of the slit, let in light from a new source. Let me show you some photographs which illustrate better what I mean. Here is a single photographic plate on which a new method has enabled us to register no less than four different spectra; those of you who are more familiar with photographic processes will immediately see how it is that the number has not been 40 instead of four. Having a slit of a certain length, if I open all the length of that slit at once I should get a spectrum the breadth of which would depend upon the length of the slit; but if I commence operations by allowing the light first to come through one small portion of the slit, then we shall get the light from the particular metal which I employ in the electric arc falling on one part of the plate, and registering itself on the photographic plate. Then, if I close up that part of the slit, and open another one, I shall be able, through that newly opened part of the slit, all the rest being closed, to photograph on the plate the spectrum of another substance, say iron. Then, having used up that part of the plate, I can close that portion of the slit, I can bring my window lower down, and there we have the spectrum of cobalt. The window has been brought further down, and there we have the spectrum of nickel, so that we have, as the work of some eight or nine minutes at the outside, a photograph—not a perfect one in this case, but this was the first one taken on this method—which will register with the most absolute and complete accuracy and certainty not less than 1,000 lines. Now a careful student of these lines, working as hard as he can, thinks himself very fortunate if he can lay down ten an hour. Therefore, as ten an hour are to 1,000 in seven minutes, so is the eye to photography in these matters.

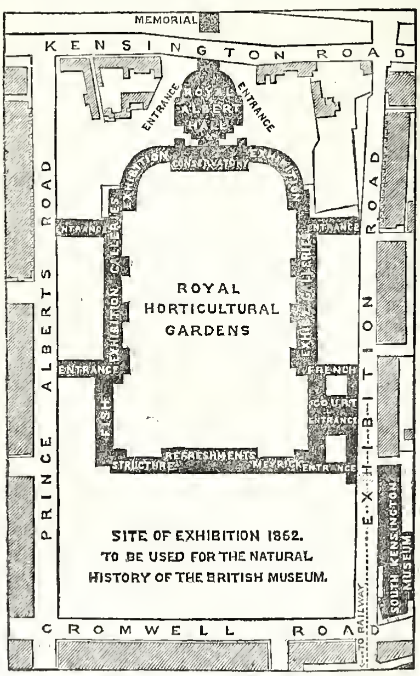
I have another photograph of a somewhat similar nature, which I am anxious to place before you. We have here an absolute comparison rendered possible, by means of photography, between the lines of the spectrum of iron and the lines of the spectrum of the sun. You see that in the case of most of the thick lines, you get a line in the solar spectrum corresponding with the lines of the iron. And, more than this, you see, I hope all of you that these lines of iron are of different lengths. The reason of that is that I have been careful to photograph on the plate the lines due to the various strata of iron vapour, from the rarest vapour, which is obtained at the outside of the electric arc, to the densest, which occupies the centre of the core, and you will see the most beautiful gradation as we pass from the outside part of the spectrum to the inside. This inside part represents the complete spectrum of the core, and the outside the incomplete and almost mono-chromatic spectrum of the vapour which surrounds the denser core in the middle of the spark; thus we have practically reduced the spectrum of iron to one line, instead of 460. That is the first photograph of the kind that has been taken; I say that, not because I am proud of it, but because you all know how enormously photographic processes are likely to be developed, the moment not one individual, but a great many, try their hands upon them, so that an enormous improvement upon what you now see may be anticipated. Not only have we developed, in the application of photography to spectroscopy, a valuable ally to science, as we have in the application of photography to astronomy—and you know what that has done, and what it is going to do—but we have, I believe, what we may almost call a new chemistry, some day to be revealed to us by means of photographic records of the behaviour of molecules. Recollect that the difference between the iron spectrum of one line and the iron spectrum of between 400 and 500 lines is simply due to the difference in the arrangements of the molecules or atoms of iron in the centre of the electric arc and its exterior. There is one question which all lovers of the

spectroscope may ask of photographers, and that is this, why should we any longer be confined in registering spectra to the more refrangible end of the spectrum, when one of the very first spectra of the sun that was ever taken was a complete photograph of the spectrum, including not only the blue, the green, and the yellow, but the red, and the extreme red? I think that if photographers will study the action of light on molecules, and read that extraordinary paper of Becquerel's, and will give those who are familiar with the spectroscope, and those who are anxious to promote the progress of spectroscopic research, a means of extending photographic registration, not only into the green part of the spectrum, which they do already with difficulty, but to the extreme red, then the use of the eye will almost entirely be abolished in these inquiries. And although no one has a higher estimate than myself of the extreme importance of the eye, I think that the more it is replaced by permanent natural records in these inquiries, the better it will be for the progress of science.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

The eleventh meeting of the Ethnological Committee was held on Friday, the 27th ult., at the International Exhibition Offices. Present:—Dr. Mouat (in the chair); Sir Vincent Eyre, C.B.; Mr. E. Thomas; Mr. H. Cole, C.B.; Mr. J. F. Collingwood; Mr. W. S. Vaux; Major Donnelly; Dr. Leitner; Mr. G. S. Saunders, secretary, A letter was read from the Rev. H. R. Haweis, offering to lend an interesting collection of articles from the South Sea Islands. Mr. Haweis's offer was accepted.



The objects are arranged as follows:—

Fine Arts.—French Fine Arts, Paintings, &c., in Galleries 19 and 20, east.

Belgian Fine Arts, in Gallery 16, east side.

Foreign Fine Arts, in Galleries 17 and 18a., east.

Foreign Paintings, &c., in Gallery 8, west.

British Paintings, in Gallery 10, west.

British and Foreign Water Colours, in Gallery 9, west.

Oil Paintings and Water Colours by deceased Artists, in Gallery 6, west.

Miscellaneous Art, Furniture, Bronzes, &c., in Gallery 7, west.

Army and Navy Sketches, in Gallery 18b., east.

Photographs, in Royal Albert Hall, First-floor, east.

Engravings, Lithographs, Designs, in Royal Albert Hall, First-floor.

Industrial Arts.—Lace, in Gallery 14, and North Half of Gallery 15, east.

Bookbinding, in Gallery 13, east.

Old Lace, lent, in South Half of Gallery 15, east.

Civil Engineering of all kinds, in South Galleries, Ground-floor, 21, 22, 23.

Leather, in East Arcade.

Saddlery and Harness, in Gallery 11, east, Ground-floor.

Machinery.—Machinery for Lace, Leather, and Bookbinding, in Gallery 1, west, Ground floor.

Machinery for Civil Engineering, Buildings, &c., in Galleries 2, 3, 4, and part of 5, west.

Machinery for British and Scientific Inventions, in Gallery 5, west.

Ethnological.—Ethnological Collections, in Picture Galleries of the Royal Albert Hall.

Wines.—Foreign Wines, in the Cellars of the Royal Albert Hall, Queen's entrance, Kensington Gore.

There have now been received for exhibition in the gallery of the Royal Albert Hall, the whole of Dr. Leitner's collections, illustrating the past and present of the Punjab Frontier, of various parts of Central Asia, of Thibet, and of Dardistan. The collections include a number of Græco-Buddhistic sculptures, Bactrian coins, rare manuscripts, and specimens of arts, manufactures, and commerce from Central Asia. Dr. Leitner has also brought over the first Siah Posh Kafir who has ever been south of the Sutlej river, or has visited Europe, and who will be daily in attendance at the gallery of the Albert Hall during the forthcoming exhibition.

The *Warehouseman* has the following on the lace exhibits in the International Exhibition:—

The exhibition of lace will be remarkably attractive. The Nottingham Chamber of Commerce occupy one entire room with the specimens which they have forwarded, ranging from the cheapest to the most costly varieties, with imitations of almost all styles. In some instances the work of the machine is supplemented by that of the hand, as in the production of a splendedly-embroidered bridal veil. There are imitations of Flemish lace, Russian point, Italian lace, Valenciennes, and numerous other kinds. The side of one glass case is occupied with coloured lace, cleverly arranged, and showing some very delicate tints. There are several rich examples of silk lace. Pile nets and laces for dress trimmings are likewise shown, some being exceedingly rich and effective. Lace shawls, black Spanish flounces, and numberless other examples make a very fine and well-arranged collection. On the ground floor of the western gallery will be a lace machine at work, also sent by the Nottingham Chamber of Commerce. Contiguous to the collection of lace thus briefly described, we meet with specimens from Bedfordshire and Ireland. Some beautiful examples will be sent from Belgium, as also from France. Of course the hand-made lace far excels the best performance of the machine; but it must be allowed that Nottingham has done well. When we come to the higher specimens of the art of lace-making

we can do little more than speak of what we see as thoroughly exquisite. The loan collection is especially rich, and the treasures in the gallery are multiplying daily. A quaint collection of Russian lace is lent by her Royal Highness the Duchess of Edinburgh. Among the other loan exhibitors are Lady Exeter, Lady Marian Alford, Mrs. Bolckow, Mrs. Morrison, Mrs. Henry Reeve, and Mrs. Austen. These, however, are but a few among a long and distinguished list. Mrs. Bolckow's collection includes some very remarkable specimens of ancient lace, as for instance, a tunic worn by Archbishop Fenelon. There is also a complete robe, formerly worn by one of the Archbishops of Padua. A lace decoration for an altar is marvellously wrought, having in its centre a figure apparently of St. Michael. Some rose *point de Venice* has a wonderful delicacy of tint as well as of workmanship. A splended collection of ancient lace has been lent for this occasion by M. Dupont, of Paris.

NATIONAL TRAINING SCHOOL FOR MUSIC.

On Thursday, 27th ult., a public meeting was held at the Birmingham Town-hall, for the purpose of founding local scholarships in connection with the school. The Mayor (Mr. J. Chamberlain) presided, and among those present were Colonel C. Ratcliff, Messrs. J. C. Lord, C. J. Beale, W. S. Harding, T. Spencer, C. Harding, Heap, Glydon, W. C. Aitken, T. Harrison, and A. Peyton.

Major-General F. Eardley-Wilmot, R.A., Chairman of the Council, Mr. Seymour Teulon, and Mr. P. Le Neve Foster (secretary), attended as a deputation from the Society of Arts.

The Mayor said he was sure it was the desire of all present to establish a National Training School for Music, in which the highest possible culture might be given in that branch of art. He understood that such an institution was greatly needed at the present time, as students requiring a musical training had to go the Continent to obtain it. He supposed that if the scheme was a good one, and recommended itself to the people of Birmingham, it would receive the hearty support of the town. There were two points in connection with the scheme which seemed to him to be of the greatest importance. First, he would like to know whether the local subscriptions would be locally applied, for if they were also supplemented by national resources, it would be a strong recommendation for the people of Birmingham. He should also like to know the position the Government would take with respect to the scheme, and also whether any assistance was to be expected from the Consolidated Fund, if the appeal was well responded to. He thought it would be better if branch colleges were established, as the Birmingham people would object to have the work carried on by one institution. After a few other remarks, he announced to the meeting that he had received a letter from Mr. W. G. Beale, offering a subscription of £50 a year for five years for the instruction and partial maintenance of one scholar. Mr. R. L. Chance had also offered a subscription of £20 a year for the same time.

Major-General Eardley-Wilmot and **Mr. P. Le Neve Foster** then explained the nature of the proposed scheme.

Mr. Abel Peyton moved, "That this meeting fully concurs with the proposed scheme of the Society of Arts for the formation of a National Training School for Music, and desires that Birmingham should assist and promote the objects of the Society by founding scholarships in connection therewith."

Mr. Millward seconded the resolution.

Colonel Ratcliff proposed, "That the following gentlemen, with power to add to their number, be appointed a local committee to assist in carrying out the objects of the society:—The Mayor, Colonel Ratcliff, Messrs. Richard Peyton, W. Beale, W. S. Harding, T. Kekewich, R. H. Millward, H. Richards, H. Rotton, G. W. Ingram, C. Harding, C. J. Lowe, A. Peyton, and F. Elkington." He suggested that there should be a representative on the General Committee from each district, in order that they might know what was being done in London. He also advocated the formation of a school where the pupils might receive their instruction before going to the training college, as a vast number could not afford to bear the expenses of receiving their training in London.

Mr. Anderton seconded the resolution.

Mr. Richard Peyton next addressed the meeting, and contended that the great thing to guard against was letting it become a party matter; the school should be a purely national one.

Mr. Benson announced that already more than £1,000 had been subscribed in Birmingham.

The meeting concluded with a vote of thanks to the Chairman, proposed by **Mr. Seymour Teulon.**

OBITUARY.

Sir William Bodkin.—Sir William Bodkin, the late Assistant Judge at the Middlesex Sessions, died at his residence, West-hill, Highgate, on Thursday evening, the 26th ult., at half-past six, at the age of 83. Sir William had been for some time suffering from cancer in the cheek. For some days he had been much worse, though immediate danger was not apprehended. The deceased was born at Islington, August 4, 1791, received his education at the Islington Academy; was called to the bar 1824; appointed Recorder of Dover, 1832; sat as M.P. for Rochester, 1841-47, and was appointed Assistant Judge for Middlesex, 1859. He received the honour of knighthood in 1867. He was the author of the statute by which the irremovable poor were made chargeable to the common fund of unions. Sir William's act was passed for one year only, but has been continued and extended, and is, in fact, the foundation of the present system. Sir William joined the Society in 1823, and was from that date up to the time of his death a most active worker in it. Till the present year he continued on the list of the Council, and his last act in connection with the Society was to obtain for it a sum of £500, from a gentleman who did not wish his name to be known, which sum was to be expended in promoting economy in the domestic use of fuel. The result of this was that the prizes for economical stoves, &c., now in course of adjudication, were offered.

Mr. Thomas N. R. Morson.—Mr. Morson died at his residence, 38, Queen-square, Bloomsbury, on the 3rd ult., in his seventy-fifth year. A recent number of the *Pharmaceutical Journal* gives a memoir of him. He was born at Stratford-le-Bow, in the eastern suburb of London, and received his early education at Stoke Newington. When only fourteen years of age he was apprenticed to an apothecary in Fleet-market (now Farringdon-street). After the expiration of his apprenticeship he went to Paris, and entered the establishment of a *pharmacien*, with whom he lived for some years. He was still a young man when he returned to London and established himself in business as a chemist and druggist in the house in which he had been apprenticed, in Farringdon-street. In a little room at the back of his shop was produced the first sulphate of quinine made in England, and the same may be said of morphia. He afterwards moved from Farringdon-street to Southampton-row, and soon afterwards purchased premises in Hornsey-road, where he built a laboratory for the manufacture of creosote, morphia, and other chemical products. He was in the foremost rank of those who originated the Pharmaceutical Society. In 1822, Mr. Morson became a member of the Society of Arts, and he was for long closely connected with the labours of its Chemical Committee.

NOTICES.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque, Post-office order, or Cheque Bank cheque, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

The following arrangements for Wednesday evenings have been made:—

April 8.—"On Coffee; a Review of the present position of its Growth, and a consideration of its Treatment and Consumption in the United Kingdom." By W. P. Branson, Esq. On this evening Robert Bentley, Esq., Professor of Botany at King's College, London, will preside.

N.B.—The date for this paper is altered from May 13th.

April 15.—"On the Proportion which Investments in the Purchase of Objects of Fine and Industrial Art ought to bear to the National Income and Expenditure." By Henry Cole, Esq., C.B.

April 22.—"On Progress recently made in Ornamental Processes connected with Metallic and other Industries." By W. C. Aitken, Esq.

April 29.—"On some Recent Inventions and Applications of Lambeth Stoneware, Terra Cotta, and other Pottery for Internal and External Decorations." By John Sparkes, Esq., Head Master of the Lambeth School of Art, and of the Art Department of Dulwich College.

May 6. — "On Timber Houses." By Frank E. Thicke, Esq.

May 13.—"On the Importance of a Special Organisation for the Diffusion of Sanitary Knowledge." By Major-General Synge.

Indian Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

April 17.—"On the Indian Famine, with Especial Reference to the Means which should be Adopted for Preventing or Alleviating Famine." By General Sir Arthur Cotton, K.C.S.I.

May 1. — "On the Ruins of Cambodia, and the Antiquities of Indo-China." By H. G. Kennedy, Esq.

African Section.

These meetings are arranged for Tuesday evenings, at 8 o'clock, and the following arrangements have been made:—

April 14.—"On Trade in Western Africa with and without British Protection." By Andrew Swanzy, Esq.

April 28.—"On the History, Progress, and Prospects of South Africa." By Col. J. C. Gawler.

Chemical Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

April 10.—"On some Recent Processes for the Manufacture of Soda." By C. W. Vincent, Esq., F.C.S.

April 24.—"On Pyrites, as a source of Sulphur, Copper, and Iron." By Dr. C. R. A. Wright, F.C.S.

May 8.—"On Sugar Refining, with special reference to Finzel's Sugar Crystals." By Dr. Griffin.

May 22.—"On the Manufacture of Chlorine." By W. Weldon, Esq., F.C.S.

CANTOR LECTURES.

The third course will be by Professor Barff, M.A., "On Carbon and Certain Compounds of Carbon treated principally in reference to Heating and Illuminating Purposes."

The object of these lectures is to explain the scientific principles involved in all heating and illuminating processes, and to apply those principles to practical purposes. The absorbent properties of carbon will be briefly noticed.

Lecture I.—April 13.

Carbon: the different forms in which it is found in nature; its properties as a disinfecting and decolorising agent, &c.

Lecture II.—April 20.

Compounds of carbon and oxygen, carbonic acid, carbonic oxide.

Lecture III.—April 27.

Gaseous compounds of carbon and hydrogen, marsh gas, and olefiant gas.

Lecture IV.—May 4.

Liquid compounds containing carbon and hydrogen, and fuel.

Lecture V.—May 11.

Coal gas, its composition and purification, and its illuminating properties.

Lecture VI.—May 18.

Heat of combustion; how heat is communicated, and how quantity of heat is determined.

Lecture VII.—May 25.

Consideration of furnaces, stoves, lamps, &c., in which the principles stated in the former lectures will be applied.

All the above Meetings and Lectures are open to Members, each of whom has the privilege of introducing two friends.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Mon. ...Farmers' Club, Salisbury-square, E.C., 5½ p.m. Mr. James Trask, "The Farmer's Interest at the next Election."
Royal Institution, Albemarle-street, W., 2 p.m. General Monthly Meeting.
Entomological, 12, Bedford-row, W.C., 7 p.m.
London Institution, Finsbury-circus, E.C., 4 p.m. Prof. Bentley, "Elementary Botany."

Tues. ...Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m.
Pathological, 53, Berners-street, Oxford-street, W., 8 p.m.
Biblical Archæology, 9, Conduit-street, W., 8½ p.m.
Sculptors of England, 7, Gower-street, W.C., 7 p.m.
Anthropological Society, 37, Arundel-street, W.C., 8 p.m.

Wed....SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. W. P. Branson, "On Coffee; a Review of the present position of its Growth, and a consideration of its Treatment and Consumption in the United Kingdom."
London Institution, Finsbury-circus, E.C., 7 p.m.
Graphic, University College, W.C., 8 p.m.
Royal Literary Fund, 10, John-street, Adelphi, W.C., 3 p.m.
Archæological Association, 32, Sackville-street, W., 8 p.m.

Thur....Mathematical, 22, Albemarle-street, W., 8 p.m.

Fri.......Astronomical, Somerset House, W.C., 8 p.m.
Archæological Institution, 16, New Burlington-street, W., 4 p.m.
Quekett Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.
Literary and Artistic, 7, Gower-street, W.C., 7 p.m.
Royal Botanic, Inner Circle, Regent's-park, N.W. 3¾ p.m.

[The Editor will be glad to receive notices of papers for insertion in the above list.]

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,116. Vol. XXII.

FRIDAY, APRIL 10, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

COMMITTEE ON THE MEANS OF PROTECTING THE METROPOLIS AGAINST CONFLAGRATION.

The Committee, having examined and obtained information from persons of the highest practical experience on the subject referred to them by the Council, have presented the following

REPORT.

It is proved that, by reason of defective mechanical and structural arrangements, as well as insufficient supply of water, in addition to the dangers of ordinary fires in single houses, or a few houses at a time, the metropolis is exposed to such extensive conflagrations as have occurred in the United States, at Chicago and Boston. This danger is considered by insurance companies to be considerable and well deserving attention. We refer to the testimony of Mr. Reynolds, the manager of the London and Southwark Insurance Company on this subject.

The growth of manufactures and commerce has occasioned the construction of immense warehouses without the requisite addition of special securities against fire. Some of the largest warehouses have only supplies of water for minor domestic uses, as for small common tenements supplied from small branch mains under the intermittent system; while for adequate protection, water should be available on the instant in increased quantities at high pressure. It appears that only about one-third of the mains of the water companies are kept in that condition. A failure of the water supply in the district of Bermondsey lately took place, from an accident to the works, and for several days the population there was exposed to what was called a "water famine."

The incompleteness of the water service for extinguishing ordinary fires is most fully stated in the evidence of Mr. Swanton, the experienced manager of the Salvage Corps, and for many years a member of the Fire Brigade.

The evidence appears to be conclusive, that if, with the present water supply, a fire occurred during a hurricane, an extensive conflagration must take place. The late Mr. Braidwood declared that if once a fire got a head in one of the large stacks of new warehouses during a high wind, there was no existing power of staying it, and that another great fire of London would occur one day or other, if the local administration and arrangements were allowed to remain as they then were and still are.

Besides the danger of extensive conflagrations from accident, late events show dangers of conflagrations from design. Plots for incendiarism on a large scale have been detected in New York, and have stimulated the adoption of very special precautions. At Manchester, during the Fenian outbursts, there were distinct threats of the destruction of manufactories, which led to the formation of vigilance committees for their protection.

While the population of the metropolis has more than doubled during the last forty years, and the provision against fire by fire-stations and engines has been augmented from nineteen to fifty, or, including some special stations, to sixty, the number of fires has, according to the report of the present chief officer of the Fire Brigade, more than trebled. It is in evidence that a large proportion of the increase of the ordinary fires may be ascribed to incendiarism for insurance money; and defensive provisions against this as well as against the fires arising from common accidents are required.

The insurance companies urge that, besides putting the water supply of the metropolis on a complete system of constant pressure in all the branches, as well as the trunk mains, the whole of the works of the eight separate districts of supply should be capable of being united, so as to enable the entire water power of the entire area of water supply, suburban as well as urban, of the north as well as the south sides of the river, to be brought to bear for the service of any one district.

The late break-down of the service for the district to which we have referred is demonstrative of the expediency of that measure. The suggestion had, indeed, been anticipated by Mr. Quick, the engineer to the Grand Junction and the Southwark and Vauxhall Companies.

Accelerated as the arrival of engines has been by the increase of stations and the improved organisation of the Fire Brigade, they yet, in a large proportion of cases, arrive only in time to prevent the spread of the fire, and not to extinguish it or save the premises where it originated. For the means of prevention to be effectual, the engines must be at all times close at hand. A few buckets of water applied in two or three minutes, it is proved would have stopped the greatest of the recent conflagrations in America. Mr. Braidwood laid it down as a rule that for fire-escapes to be effectual for the protection of life they must be brought to bear within five minutes. This outside limit of time is also needed for the effectual protection of property. But—except those in close proximity to the sixty fire-engine stations, and some large buildings where special provisions are made—all private houses and great masses of warehouses containing combustible materials may be said to be, to a greater or less extent, all outside that limit of security. The mean distance of the fire-stations from each other is three-quarters of a mile and 196 yards. It is declared on experience that this distance can only be traversed in 23 minutes. It takes a swift foot messenger ten minutes to traverse a mile, and sixteen minutes more to put the horses in harness, get the engine to the spot, and bring the water to bear on the fire. But Captain Shaw's report for 1873 states that "The number of journeys made by the fire-engines of the different

stations has been 6,556 miles, and the distance run 20,503 miles," that is to say, taking the mileage to and fro, about a mile and a-half. The example of Manchester, where the supply of water is under public control, on the constant system, illustrates the results to be obtained by closer means of relief. There the whole arrangement is in the hands of the police, and at every police-station there is a hose-truck or cart with a fire-escape on wheels, containing 200 yards of hose and all the necessary appliances to supply two effective streams of water from the constantly-charged mains, a power equivalent to two hand-engines of seven-inch cylinders. The water mains of that city are all "hydranted," and give off jets of an average height of eighty feet. The distance between the police-stations there is about half a mile; but from the greater readiness of the men running out with the hand-hose-truck, than harnessing horses, and the instant application of the water on arrival at the spot, the water appears to be brought to bear, as a rule, in a third of the time required in London, and as it seems, with more than two-thirds of gain in the result. The larger engines, steam or hand-engines, such as are in general use in London, are only brought out in Manchester in instances where, from the additional height of the houses or otherwise, additional power is needed. In only about three per cent. of cases is such additional power required in Glasgow, which is on the same system. Where more than a sixth of the property is destroyed, the loss, in Manchester, is ranked as "serious," and of those so classed the loss has been about 3 per cent. In 1873 the much more serious fires in London were below the average, and they amounted to eleven per cent. In Manchester there has not been one case of the total destruction of a property in three years, and but three cases, during twelve years, of loss of life from a building taking fire. In Liverpool and in Glasgow, where the fire arrangements are under the police, the stations multiplied, and the relief speedy, as in Manchester, and the water supply on a public footing, the results are much the same —the average losses of all classes less than one-third those of London.

Here then we have clear, undoubted, and important results from administration by the police and of a water supply on a public footing; and this experience may safely be adopted as the basis of an immediate practical measure of defence against the spread of fires in the metropolis.

In addition to unity of system of water supply and police administration in the metropolis, a further advance may be made by connecting the various pumping stations and reservoirs of supply with the police or fire stations by lines of telegraphs.

It is to be borne in mind that the chief service of the fire-engines in such instances as those cited of Manchester, Liverpool, and Glasgow, as well as in the metropolis, is to give increased power and higher jets than those which can be obtained on the spot from the mains, the power of which will vary with higher or lower levels, or with the amount of distribution that may happen to be going on at the time. During the hours of the private distributory service the pressure on all the mains is lowered, and it is then especially that fire-engines are needed to give additional elevation to the jets;—but it has hitherto been overlooked that extra engine power is the less needed in those cities, on a constant system of supply distributed under public authority and well preserved, than in districts under an intermittent system of supply. Such a supply is shown to be wasteful in a high degree, and all waste of water may be considered as waste of power. The quantity of water distributed in Manchester is on an average about 21 gallons per head of the population; in London it is 33 gallons per head; and this excess in London is waste and loss of power. In London, as a rule, the jets will be more than one-third lower than in Manchester—and hence, under the existing conditions of the intermittent system, there is the greater need of engine power to augment the force.

In some of the lower districts of London, covered by poor tenements, with ill-conditioned fittings and a constant leakage going on, it is declared that more than half the water supply is now pumped to waste. In some of those districts it would not be possible now to obtain jets from the main that would reach higher than the first floor of a house, and hence for fire extinction the ordinary fire-engine power is there more especially necessary.

But by the prevention of waste, and the conservancy of force by a constant supply under a public authority, that necessity is reduced. On the occurrence of a fire, even under the constant system of supply, the force of the jets would be immediately augmented by shutting off, for the time, the collateral distribution of water power in the neighbourhood. If the fire spread and the need increased, additional force would be got by telegraphing to the chief source of supply—whether it were by gravitation or by pumping power—when the distribution to other districts would be immediately shut off, and force concentrated in the neighbourhood endangered. Under existing conditions, from the time of the "call" being given to the nearest fire stations for extra force by fire-engines, some 15 minutes or more must elapse before it can be got to the spot. From the time of a "call" being given by telegraph to the chief water station, rarely more than two or three minutes would elapse before extra speed could be given to the engine, and an immediate improved supply would be available at the fire, although the pumping station might be several miles distant.

To take, for illustration, the recent destruction of the Pantechnicon by fire. In that instance, from defective arrangements, water was not to be found within the building in time or in sufficient quantity, and was not brought from without in less than fifteen minutes for the first engine, and, as reported, full supplies were not brought to bear in less than an hour. It would be in the interest of the owners of neighbouring property that such large buildings should be required to have a constant supply. In this case a powerful jet could have been applied at the Pantechnicon in less than a minute and a half, and the fire in all probability would have been extinguished at once. In the event of the persistence of the fire, every police constable patrolling the streets being furnished with a key—like those of the postmen to the letter boxes—to get at the hydrants, as proposed

by Mr. Swanton, the police would have got out the hose and attached it to the water main—which near such property should be at the least a 12-inch main —and brought to bear four or more jets of additional power within not more than as many minutes. The distribution to the houses in the immediate neighbourhood would have been at once shut off, and by telegraphing to the great pumping stations, the distribution of water to other districts would have been shut off for the time, and the entire force concentrated on this one. With proper arrangements, an augmentation of direct power from the main might have been got in one-half or one-third of the time now required to bring additional engine force from a distance. In the case of the Pantechnicon it is evident that, had there been a strong wind, or even had the east wind which prevailed three days before continued, a wide-spread conflagration would have occurred, and realised the apprehensions of the insurance offices. Such a fire might occur, even under a constant system of supply, during a high wind, while the one-trunk main of the district, such as that of the Chelsea Company, was broken or under repair or alteration. But under a combined system, the whole force of the Grand Junction supply, which has a pressure of 250 feet against the 164 feet of the Chelsea supply, together with the whole force of the West Middlesex Company might be concentrated. The New River power, which is yet higher than the Grand Junction power, might be immediately brought, moreover, as a reserve in aid.

On this principle, then, by the change of system from the intermittent system to the system of constant supply, there could be obtained—

1. An augmentation of water power throughout all the districts of supply.

2. A gain in time in the immediate application of the augmented power, to the extent of nine-tenths or more.

3. A gain nearly to the like extent in the time of obtaining further augmented water power from the distant pumping station.

4. A gain by a proper union of all the trunk mains of all the now separate districts, of affording such concentration as to keep all the mains of any one district full and at high pressure ready for any emergency.

On a due consideration of the facts stated by experts of the greatest experience, it will be manifest that the first object to be achieved will be to bring the separate works into union, and to get the whole into complete working order as one machine, on the constant system of distribution. As one machine of some thousand horse-power, while working under regulations for the maintenance of the purity of the domestic supply, as well as for its sufficiency, it would, under a proper arrangement of the mains, be so working that the heads should be everywhere maintained at the full height of more than three hundred feet of pressure, either by pumping or by the power of gravitation, to be wielded by the electric telegraph in any direction where needed. And it would be workable to convey supplies almost instantaneously from stations at the most remote points from the centre of the metropolis. Commission after Commission have agreed that unity of management should be effected for the metropolis, as it has been found necessary to do it in other great cities, on a public footing. All further delay in doing it is at the sacrifice of life and injury to persons, and at the loss of property and increasing danger from fire. The recent instance of great destruction by fire may be justly set down as one consequence of the neglect of forewarning distinctly given.

The question of the supply of water for preventing the spread of fires opens up the question of the arrangements for the distribution of water for domestic and other purposes.

In respect to the waste of water, it may be a surprise to many of the inhabitants of the metropolis to be informed, that whilst there is nevertheless at some points an actual want of water for domestic purposes, to the amount of two hundred millions of gallons daily, the total of the supplies delivered by the eight trading companies amounting to about one hundred and six millions—upwards of one-third, or thirty-six millions of gallons daily are wasted; the waste being enough to supply more than two millions of additional population, on the scale of supply of Manchester. Now the trading companies are not in a position to prevent to any material extent this large ordinary waste, or to prevent an augmented waste on the introduction of the system of constant supply. For where the fittings of the private service pipes are defective, there certainly will be increased waste, and examples may be adduced to justify the apprehensions of the companies in this respect. At Sheffield, when the constant supply was first adopted, it rose from 21 to 40 gallons per head. At Liverpool, on a change from an intermittent to a constant supply, the consumption was increased in one large district from 19 gallons to 33 gallons per head; but vigilant attention being directed to the subject, and due care taken by the officers, the consumption has been reduced to 13 gallons per head. There are indications that the Manchester standard of consumption on the constant system of supply, though one-third lower than that of London, is yet greater than the real consumption, and that the actual waste in the metropolis is nearer three-fifths than one-third of the water pumped in. As traders, the companies are to a great extent in antagonism with the consumers, who think it right to get as much as they can for their money, regardless of any general effect. The consumers are jealous of the entrance of the companies' officers on their premises for the purpose of inspection and the probable restriction of the delivery. In view of the deficiency of the ordinary supply in the eastern districts, arising from the defects of the house services, Captain Tyler suggested that the East London Company should have, with other companies, the power of putting the necessary fittings into the houses, and of levying a fair extra rate for their cost and maintenance. But to this the company decidedly objected; stating that "in the case of the better description of properties the company's interference would be considered a nuisance, and in the lower description of property, which alone required consideration, ceaseless and ineffectual war between the company and the consumers must result if the directors were to have the proposed power thrust upon them. Whereas, if a public authority, whether such as pointed out in a recent report of the Select Committee on Water Supply in the Metropolis, or one

in more direct local contact with the particular properties, were armed with more direct authority to enforce the provision and maintenance by and at the expense of the owners and occupiers, of proper fittings and receptacles, the duty would be performed by those to whom it probably belongs." In other words, it is necessary to put the supplies on a public footing as a service, directed by responsible officers, who would be recognised and received as public officers acting on public authority for the common advantage.

While there is this enormous waste of water, beyond the present means of control by the companies, there is a large waste in the current expenses by reason of the multiplied establishments. Mr. Quick estimates this waste at upwards of £100,000 per annum. Mr. Robert Rawlinson considers the amount even greater. On one item, that of collection of rates, it is estimated that some fifteen thousand pounds per annum would be saved by its consolidation with the collection of the public rates and taxes. Besides the waste of current expenses, inevitable from multiplied establishments, great waste has been incurred in works, and further large waste is declared to be impending in works, to make each district complete in itself, on the footing of an independent supply, apart from the other sectional supplies. As an example of the past waste, there is the case of a trunk main twenty miles long, from the east to the west, passing through two other sections, for the supply of the East London section, the greater part of which would have been saved if, as proposed by the General Board of Health, the sections had been brought under unity of management. Another example of what is presumed to be mere waste, was recently the subject of popular agitation, the formation of a reservoir at Thames Ditton, which would have caused an expenditure estimated at £150,000, for supplies which might have been obtained, at an inconsiderable expense, from adjacent sections.

Since the proposal was first made by the General Board of Health to put the sectional supplies together, under one system, and that system a public one, upwards of three millions of capital has been invested in works, a large part in sectional works of the wasteful character described.

It appears from the evidence that by the measure lately proposed a very large and serious burden, amounting to several millions, might be considered as impending on householders, the consumers of water in the metropolis, for new house fittings to receive the constant supply.

The waste of the water pumped into the metropolis is attributed wholly to the defective condition of the house services, such as bad taps, which allow the water to run away whilst the intermittent supplies are on. It is assumed by the greater proportion of the engineers of the companies that the pipes which sustain only an intermittent pressure are unfitted to sustain a constant pressure, and that they must be entirely changed. It is also assumed that no other than very stout and expensive lead pipes will bear the necessary constant pressure. It is laid down by them that cisterns must yet be retained in various forms, and that there must be a new apparatus, called a waste-preventer, in all the houses under the constant system of supply.

Under the Public Health Act it was generally arranged that the private house service apparatus should be provided under a common contract, and that the principal and interest should be distributed over a period of years, and levied, as an "improvement rate," by equal annual instalments of principal and interest, so that if the outlay for a poor tenement were £4, instead of that amount being called for at once, an addition of 1s. 6d. only should be levied upon the occupier, for the time being, for twenty or thirty years, according to the estimated duration of the improvement. The lessee, who for a short period had only a fifth or sixth part of the benefit, paid only a third or fourth part of the charge. The last Metropolitan Water Act is made apparently without knowledge of that precedent. As the Act stands, every occupier or owner must employ his own plumber, and make the required alterations of the house services at his own immediate cost. Such immediate charges are very serious to poor owners. However proper immediate charges may be in themselves, they are frequently grievously unjust, as levying the whole cost on owners who may not receive even a small fraction of the intended benefit. The mode of levy, as described in the evidence of Mr. Quick, and admitted by Mr. Rawlinson, and the excessive amounts of the charges imposed by the companies, have excited strong resistance, and, acting through the vestries, which most strongly represent the lower class of owners and occupiers, they have hindered the change contemplated from the intermittent to the constant system.

It is demonstrated that the intermittent system occasions more frequent and trying hydraulic shocks than the constant system, which thus needs less repair from this cause.

In various instances where a change has been made from the intermittent to the constant supply, it has been effected chiefly by the removal of defective taps, and a small proportion of services, and at an inconsiderable total expense. Mr. Berrey, the chief officer of the Manchester waterworks, who conducted the change of system under greater difficulties there than in London, states that in London it might be accomplished for 11s. per house. Mr. Marten, who had practised as an engineer at the East London waterworks, and conducted a change from the intermittent to the constant system, estimated the expense of such a change at about 2s. 2d. per head on the population. Mr. Rawlinson considers that estimate to be a fair one. As regards the statements by the engineers of the water companies' works, that only lead pipes can sustain the system of constant pressure, and on a very positive declaration of one of them that wrought-iron pipes are positively unsuited to such a service, Mr. Rawlinson, who has carried out waterworks in twenty towns—every one on the constant system of supply—states that he has used wrought-iron pipes in preference to lead, and that they have lasted very well for some twenty years. In none of those towns has he ever found it necessary to use "waste-preventers," or special cisterns, as proposed by the companies' engineers; and he states that, as a rule, in those same towns, under the constant system, the consumption is under 20 gallons per head of the population in place of 33 in London.

In one district of the metropolis, the West

Middlesex, and only in one, as reported, an examination has been made of the condition of the house services in the 44,000 houses supplied by that company, and that alterations of the fittings are required in about 11,000. The alterations specified as needed consist of fresh taps, requiring a few shillings of expense in each instance. On a close examination of the proportion of house services out of order in the district of the East London in 1866, the proportion was found to be, according to Capt. Tyler's report, 23·89 per cent. If the entire cost in such district of putting them in order were spread over a period of years, the cost of the charge in the entire district would probably be greatly below the estimate stated by Mr. Marten.

On the whole it appears that on correct principles about half a million of expenditure would, so far as relates to the house services, suffice to effect the change. It appears to be due to the classes affected by the change to urge that the legislative error which entailed such oppressive and unnecessary charges upon them should be rectified without delay. The enforcement of that measure would be met with very strong and just resistance. Its repeal and the substitution of amended provisions are necessary for the attainment of a constant supply.

The next measure of security for protection against the extension of fire is the provision of hydrants at proper distances in all streets and roads for immediate use on the occurrence of ordinary fires; these would also be available for proper street cleansing and road watering.

On examination of the engineering details, it appears to be conclusively established that the amount derivable from capitalisation of the savings derived from unity of management would, after the payment of liberal compensations to the shareholders and officers, suffice to provide the needful alterations for a constant supply, to supply hydrants for all the streets, to put the sectional systems into union, and to complete the public as well as the private works.

The Bill prepared in compliance with the recommendation of the last Royal Commission on the Water Supply of the Metropolis, proposed to place the service under the charge of the Metropolitan Board of Works. This proposal was so ill received, so much opposition to it was threatened, such strong reasons against the eligibility of that body were alleged, that the proposal was abandoned, and, notwithstanding the previous expensive failure of that course, it was again endeavoured to compel the several companies to make the required change from the intermittent to the constant supply. Without entering into the justice of the grounds of unpopularity alleged against that Board, several *prima facie* objections present themselves against it.

In the first place, the area of its jurisdiction does not extend over much more than one-half the area comprehended by the supplies of the several companies. From the evidence it will be seen that economy and efficiency depend upon unity of administration over the whole area, and that every reduction of the area is detrimental to efficient and economical administration. The extension of the jurisdiction of the Board of Works over large new districts, bringing with it the probability of increased charges from the course it appeared to contemplate, would be violently resisted by the ratepayers.

Another ground of objection is the obvious pre-occupation of that body in the administration of several millions of expenditure for the formation of new lines of streets. It is stated that on a late occasion, before a committee of the House of Commons, in answer to a suggestion that a particular measure was one fitting to be undertaken by the Board, the chairman of the Board declared that the members of it were so occupied on various committees that they really were not in a condition to undertake anything new.

Attention has at the same time been drawn to the Corporation of the City of London, as an eligible body to undertake the required general works, if it could be got to do so.

It is true the area of the direct jurisdiction of the Corporation, as to houses and population, is small in comparison with that of the Metropolitan Board of Works; but within that jurisdiction the corporate functions are more complete, embracing branch as well as main and house drainage, paving, &c. In respect to the source of the water supply, it has the most extensive jurisdiction, comprising the conservancy of the chief present source of the metropolitan water supply—the Thames and its tributaries, from Staines to Cricklade.

Application was made at the outset of the inquiry to the ex-Lord Mayor, Sir Sidney Waterlow, to act upon this Committee, but he declined on account of the pressing exigencies of his duties. It was stated that a special committee had been appointed three years ago to consider the question of the water supply, and this committee invited communications on the subject, but it did not appear that they were prepared to deal with the subject; and avowed pre-occupation with other affairs precluded attention to it by the general body of the Corporation.

The trial works and the demonstrations made more than twenty years ago by the first General Board of Health showed the superiority of the method of street cleaning by jets from hydrants, since adopted successfully in Paris, in Madrid, and other cities. These were repeated about six years ago by the corporation engineer, Mr. Heywood, but no action appears to have been taken, though it had been demonstrated that the hydrant method is essential to prevent the evil of slipperiness and the fair treatment of the new asphalte pavements.

There has long been public discontent with the present fragmentary local administration in the metropolis, and a desire has been expressed to have an improved and complete municipal government commensurate with the magnitude of the metropolis. The constitution of such a body, however, would be a task requiring rare power of successful administrative organisation, and involving conflicts with strong interests, in existing local expenditure, from which every government has hitherto shrunk. No plan has yet been proposed which has met acceptance, nor has it been anywhere clearly defined what are the functions that should be exercised by such a body for the whole metropolis.

If either of the existing chief local authorities would come forward to undertake the requisite work, with the assurance of support from the numerous population outside the areas of their

respective jurisdictions, and would become responsible for its efficient achievement without the imposition of extra charges on the ratepayers, it would be most satisfactory. But inasmuch as it appears evident, on a fair view of the case, that neither is in a condition to undertake the task, the question arises—What may be done to stay the existing waste of life and property? On due consideration, the alternative is presented of a provisional measure, founded on a precedent on a small scale, that is deemed applicable to the present requirements on a large scale, namely, of a special commission to meet the existing exigencies.

A large proportion of the suburban roads of the metropolis, under the care of a number of small turnpike trusts and parishes, were in so deplorable a condition that it became imperatively necessary to take some steps for their amendment. A special commission was appointed to whom they were committed. That commission appointed a staff of officers, under the best special road engineer of that time, Sir J. McAdam. By the staff under his direction the roads were brought in first-rate condition. Witnesses declared that they could almost tell at night, by the jolting they experienced, when they left the jurisdiction of the commission and got on the roads of parochial or smaller trusts. But by an agitation against the metropolitan toll-gates, the tolls by which the commission maintained their roads were abolished, and their functions devolved upon the several parishes, with the result, it is declared, of excluding comprehensive, scientific, and economical direction, and occasioning increased charges for inferior and wasteful work.

On examining the works now required for the protection of the metropolis against fire, it will be perceived that they are of a very special character, with which few bodies can deal without imminent danger of very expensive error. One security against error is special aptitudes, undivided attention, and undivided responsibility on the part of those charged with the execution of the works. In France, much obstruction and undue expense has been incurred by placing new works under the charge of numerous bodies—bodies not specially qualified, either scientifically or otherwise—with diverse functions, and especially political functions. In several cities of the United States it has been found necessary to take sanitary work out of the hands of political bodies, and to charge it upon specially qualified bodies, appointed to give undivided attention to them.

The alternative measure now proposed consists of the appointment of a special provisional commission composed of a few specially qualified persons for the performance of the duty of bringing the several works into one system, of providing hydrants, and of getting all the house services in order for the general application of the constant system of supply.

A Provisional Commission having put together the several parts, and got the whole into complete working order as one machine, it might hereafter be handed over to any local authority whenever such an authority is constituted and accepted for the general local government of the metropolis.

The work needed, it is to be borne in mind, is a combination of engineering mechanical art and sanitary science of a very special character, which requires undivided attention for its most speedy execution. At the same time the executive work should admit of supervision, in matters of finance, by committees chosen from existing representative local authorities.

The following are the conclusions adopted from all the evidence, as well that taken before recent parliamentary committees, as that taken before this committee:—

First.—That of the separate sections of the eight trading water companies' services, in the metropolis, only about one-third of the mains are kept in a state of constant high pressure by the want of proper hydrants and apparatus, in constant use and preparation; there is frequent delay in obtaining adequate supplies for extinguishing and preventing the spread of ordinary fires, causing frequent loss of life and great loss of property.

Second.—That from these defects in the existing provisions for protection against ordinary fires and incendiarism, and from entire dependence on separate sectional and independent supplies with only the existing defective apparatus, the metropolis is now, from large and increasing masses of ill-protected buildings, peculiarly exposed to increasing dangers on the occurrence of any fire from accident or design during hurricane winds, to devastating conflagrations, such as those which have occurred at Chicago and Boston.

Third.—That to guard against extraordinary conflagrations, as well as to check ordinary fires, measures ought to be taken with the least delay to put the whole of the metropolis on the constant system of supply, under such conditions that the entire force of the whole area of supply may be brought to bear upon any considerable fire occurring in any part of it.

Fourth.—That whilst there are frequently serious deficiencies in the supplies of water under the existing conditions, there is a constant waste of between thirty and forty millions of gallons daily —a quantity equivalent to the adequate supply of between one and two millions of additional population, a waste which lowers power and can only be saved by putting the entire supply on a public footing.

Fifth.—That whilst the executive arrangements for the administration of the supplies are disjointed and defective in important parts, there is an estimated waste of upwards of one hundred thousand pounds per annum of expenditure beyond what would suffice for the administration of a more efficient combined system of local administration.

Sixth.—That this sum, which may be saved by unity of management, would suffice to relieve the consumers of water from the expenses of altering their house services, to defray the expense of the new hydrants required, and of making the other arrangements needed for the protection of the metropolis against extraordinary conflagrations, as well as to give better protection against the ordinary losses of life and property from fire, as well as effect some needed sanitary improvements.

Seventh.—That under practical arrangements, whilst the shareholders and officers of the several companies may receive liberal compensation on recognised principles, the consumers may receive

an improved constant supply, and the public may receive additional service, without additional rates.

Eighth.—That, from the inadequacy of administrative areas and from defective constitutions, inadequate functions, and from the want of the special scientific preparation and special agencies needed—the chief existing local authorities, as now constituted, are ineligible to effect with efficiency and economy the complete change of the system of Metropolitan water supply required.

Ninth.—That under existing conditions, and the urgency of the earliest arrangements, the most expedient practical course for protecting life and property, and staying accruing waste, will be to appoint a Special Commission, provisionally, to get the several parts together, to supply the specified defects in the apparatus, and to get the whole into the earliest complete action, in one system, and that system a public one.

There are questions remaining for consideration—as to the alterations required in the functions of the police in connection with those of the Fire Brigade, for working an improved system of water-supply for fire prevention; also questions of structural arrangements for the prevention of fire; and the collateral sanitary question as to street cleansing and road watering by jets from the hydrants, which are not so immediately pressing as those treated of, and that may stand over for separate examination and report.

By order of the Committee.

P. Le Neve Foster, Secretary.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1874, early in May next. This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Mons. Michel Eugène Chevreul, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

The Council invite members of the Society to forward to the Secretary, on or before the 11th of April, the names of such men of high distinction as they may think worthy of this honour.

MUSEUMS AND PUBLIC GALLERIES.

A meeting of this Committee was held on the 2nd inst. Present—Mr. Andrew Cassels, Mr. F. A. Abel, F.R.S., Mr. Henry Cole, C.B., Mr. U. J. Kay-Shuttleworth, M.P., Mr. Thomas Webster, Q.C., F.R.S.

NATIONAL TRAINING SCHOOL FOR MUSIC.

A meeting of the Committee of Management was held on Tuesday, at the Royal Albert Hall. In the absence of the Duke of Edinburgh, the President, his Royal Highness the Prince Christian, took the chair. Present—Lord Clarence Paget, K.C.B., Sir William Anderson, K.C.B., Major-General F. Eardley-Wilmot, R.A., Mr. Henry Cole, C.B., and Major Donnelly, R.E. Mr. Alan S. Cole, hon. secretary, attended.

PROCEEDINGS OF THE SOCIETY.

SEVENTEENTH ORDINARY MEETING.

Wednesday, April 8th, 1874; Professor Robert Bentley, F.L.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Barnes, William Charles, Oak-hall, Buckhurst-hill, Essex.
Epps, Hahnemann, 1, South-hill-park, Hampstead, N.W.
Finlay, Kirkman J., Abergwynant, Dolgelley, North Wales.
Gill, C. Haughton, 59, King Henry's-road, N.W.
Hack, Daniel, Sunnyside, 151, Upper Lewes-road, Brighton.
Hinks, Joseph, The Patent Duplex Lamp Works, Birmingham.

Lawes, Robert Murray, 9, Clarges-street, W.
Manning, F. A., 18, Billiter-street, E.C.
Mitchell, William Augustus, F.R.G.S., Marlborough-villa, Lea-bridge-road, Leyton, Essex.
Morrison, John, Viaduct Chemical Works, Widnes, near Warrington.
Morson, Thomas, 124, Southampton-row, Bloomsbury, W.C.
Muspratt, James Liebig, Widnes, near Warrington.
Roche, John, 31, South-terrace, Cork.
Searle, Samuel, North View, Central-hill, Upper Norwood, Surrey.
Varley, John, C.E., Swadford-street, Skipton.

The following candidates were balloted for and duly elected members of the Society:—

Ballingall, James, jun., 38, Great College-street, Camden-town, N.W.
Broome, Richard Tarrant, 58, Highbury New-park, N.
Deacon, Henry, Widnes.
Fairbairns, William Henry, 2, Crosby-hall-chambers, Bishopsgate-street, E.C.
Gladstone, John Hall, Ph.D., F.R.S., 17, Pembridge-square, W.
Hartnell, Wilson, Rodorough, Stroud.
Johnson, Samuel W., LL.D., Lichfield-house School, Newbury, Berks.
Kaufmann, Adolph, Grove-house, The Grove, Clapham-road, S.W.
Stephenson, Charles, 3, Eastcheap, E.C.
Witherby, Richard, Morden Cliff, Lewisham, S.E.

The Paper read was:—

COFFEE: A REVIEW OF THE PRESENT CONDITION OF ITS GROWTH, WITH A CONSIDERATION OF ITS TREATMENT AND CONSUMPTION IN THE UNITED KINGDOM.

By W. P. Branson.

An illustrious living teacher commenced a valuable work with a profound aphorism—"The aspects of Nature provoke in man a spirit of inquiry." There is not one of Nature's bountiful gifts to man which merits a fuller and more earnest inquiry than that which we have met to consider this evening. Whilst during the last 50 years we have made rapid progress in most branches of science and industry, we cannot but regret that in this late age there should be with us so little attention paid to an article of food, which a former great nation freely used and valued centuries ago. No authority, however, has directed attention in any remarkable way to the great benefit which we should derive from a better appreciation and use of coffee, and this neglect has tended to promote the undue consumption of a dangerous rival, that is largely, and which threatens still further to become, the cause of a lamentable deterioration of the stamina of the people of this country. Interesting as we shall find this branch of our subject to be, I propose to show you also, and first, that its production will more largely affect the future prosperity of some parts of our Indian and Colonial empire. With these objects in view, I have not thought it well to bring before you either tabular statements of its organic composition, or, as is usual at these meetings, samples of various coffees; these details were and are supplied at the International Exhibition of last year and at the South Kensington Museum. I rather wish to offer to you some original observations which may supply practical information of its value, the absence of which is the sole cause of my addressing you on this occasion.

The coffee plant is popularly considered to be indigenous to Arabia, where it was only first known in the fifteenth century, and it is from that country undoubtedly that its cultivation has in recent times spread, but it was known long preceding that time, in what was then populous Persia. It appears rather that its first home was in the mountainous regions in the south-west of Abyssinia, the word coffee being derived from Caffa, the name of a province of that country. It was afterwards cultivated in the province of Yemen, anciently called Arabia Felix, and during the sixteenth and seventeenth centuries Arabia supplied all the coffee then used. There is little doubt also that the wild coffee, grown in exactly the same parallel of latitude on the western side of Africa which lies to the north-west of Ashanti, is indigenous to that region. It was also known to Peru long before its culture either in Brazil or our Western dependencies. This valuable plant produced last year 400,000 tons of its cured berry for the consumption of the United States and Europe, excluding Turkey, worth for these countries alone, on an average of years, nearly £30,000,000 sterling, but last year its value was 40 millions.

Although naturally growing to a height of from 10 to 20 feet, for the purpose of fruiting and picking it is not allowed to exceed 5 or 6 feet in height. It has a single stem, of 2 or 3 inches thickness, with dark smooth shining leaves, its pearly white blossom of great fragrance being produced in clusters at the base of the leaves. The succeeding fruit grows directly on the branch, somewhat like a small cherry in appearance, but without stalk, more oblong, and having on the top a dent like that in an apple. The pulp is useless, and encloses twin berries, lying flat, face to face, and covered by a skin which is called parchment. Sometimes the fruit contains an abortion, the two flat berries growing together into one round berry; and this, called a pea-berry, having taken the strength of the plant which is otherwise given to two, is esteemed as having a greater richness. The coffee tree, although a hardy plant, is strictly inter-tropical. The whole success of its culture depends upon a plentiful supply of cheap labour in the countries situated at from 5 to 15 degrees both north and south of the Equator. It is in these belts, in the hilly districts from 1,000 to 4,000 feet above the sea level, that the greatest success is to be attained. Sufficient attention has not hitherto been paid to this, but I shall show you that the produce of the inner equatorial regions is superior to, and will possibly supersede, the produce of other countries which are in this respect less favourably situated. In the district of Natal, in 30 degrees south latitude, although the plantations have now and then produced crops, the quality does not rank high, and the culture has proved anything but a commercial success, not only because the labourers, the Zulu Kaffirs, are difficult to control, but that the climate being unsuitable, the harvests have been short and intermittent. The countries I shall briefly glance at are Java, Southern and Central America, Jamaica, Arabia, and lastly Ceylon and Southern India. The first two grow heavy crops, but there are some indications that in these two countries causes are at

work, the effect of which will be to throw this great and valuable interest to a much greater extent, in the future, into the hands of British growers. The culture of coffee in Java is effected by tribute or partially forced labour. The Dutch Government maintain the old Indian idea of sovereign right to a supreme lordship of the soil. They do not allow freehold possession of land to the people, except where a few foreigners held certain rights before our cession of the island, and also where the native princes have maintained their ancient rights. With these exceptions, the Government have a monopoly of the land, and each family holds its farm on the stringent condition of having to plant and maintain in bearing 650 trees, of which they must harvest and deliver the produce, about 2 cwt., only into the Government warehouse. For this they have to leave their villages and camp in the hills, receiving a payment of 35s. or 17s. 6d. per cwt. In such a task the people have naturally more interest in the speed with which they get through their harvesting than in a good result, and much coffee is wasted. A better feature in this island is the employment of Malays, who, without suffering the hardships of slavery, are yet not free, but are fed, clothed, and housed by the Government on the plantations, and being tractable and with few wants, prove valuable labourers. Under this compulsory system the production has reached 1,000,000 bags per annum; but it is so little in accord with the progress of civilisation, that under it the highest out-turn has been passed, and the export now is 100,000 bags less yearly than that of ten years ago. We come next to the greatest coffee-growing country of the world, Brazil, which is also the greatest slave-holding country; and the rule of its enlightened Sovereign has not availed to overcome the powerful opposition of the pro-slavery party, the agricultural section of whom have in an underhand way succeeded in neutralising the abolition treaty and the legislation founded upon it. By a treaty with England, the Brazilian Government agreed to stop all importations of negroes, and engaged to submit a Bill to its General Assembly for the gradual emancipation of its then existing slaves. The direct importation of negroes was stopped, but for many years there was a systematic evasion of the treaty, and many indirect shipments of slaves were effected. Our minister at Rio wrote, in 1870—"The institution of slavery is as yet untouched." In that year an Act was passed in supposed accord with the spirit of our treaty, but it was cumbrous in its details. The agricultural interest, whose party controlled the Bill, succeeded in exempting themselves largely from its provisions; their slaves could only purchase their freedom, and all children of slaves, born after the passing of the Bill, could only attain their freedom at 21 years of age, a condition sufficient in itself to retain the institution of slavery for another fifty years. But for however long a time slavery may be retained in Brazil, it is doomed to extinction, and during the period of manumission the labour difficulty will increasingly present itself. The freed African will not work in a tropical climate. The coffee-growing districts are in the South of Brazil, out of the latitude for the growth of fine coffee, for which the northern part of the Empire would be more suitable. Brazil coffee is of a strong, coarse quality, far inferior to our East Indian coffee. Its production is not increasing, the export for the last ten years being less by 200,000 bags per annum than that of the preceding ten years, and if the labour difficulty increases, as it must, how will Brazil hold her place as the largest coffee-growing country? Passing Venezuela, which produces a steady small crop, we reach Central America, where of late years coffee-planting has proved a great success. It is worth noting that in opposite quarters of the globe, Costa Rica and South India lie in the same position of north latitude, and that their respective growths approach one another in fine quality. This line also cuts directly through the Abyssinian coffee districts which of old supplied Persia. We now come to Jamaica, which formerly, by the aid of slave labour, exported 13,000 tons per annum, on the emancipation of the slaves suffered a collapse of her entire planting interest. The negroes, demoralised by so radical a change in their position, have ever since been difficult to govern and control, and the extreme bounty of nature encourages their incorrigible indolence. The same difficulty has had to be faced more recently in the Southern States of America, and although some persons feel a hope that the solution of the labour question is becoming clearer, it rather appears desirable that the more tractable and industrious of the eastern races should be steadily introduced, who, by their competition would, if it is possible to do so, stimulate the Negro to equal industry; and as the mountain coffee of Jamaica has a most delicate quality of flavour, we must regard with great interest a revival of its culture. Stretching across the northern coffee belt we come to Arabia, the coffee of which is called mocha, and possesses an interesting peculiarity that is not to be found in any other growth. The import from Aden direct was known before the opening of the Suez Canal as Alexandrian or green mocha; but the old East India Company used to ship the ripest growths to Bombay, where, by a storage of about three years, it mellowed and developed a high aromatic quality and a deep golden colour of berry, which no other Arabian coffee otherwise possessed. This was known as "Bombay" or "yellow" mocha. Mocha coffee is still shipped there, but it is neither so well selected nor so long stored in Bombay as formerly, and fine yellow Bombay mocha has become a thing of the past. Travelling eastwards, we come to the island of Ceylon and the southern part of the Indian peninsula, situated in from 6° to 15° N. latitude, and unquestionably the most rising and valuable coffee-growing countries of the world, since it is here that the best conditions of climate, coupled with an ample supply of free labour, co-exist to a greater extent than in any other country. The Cingalese do not, however, supply much labour, being Buddhists, who are described as Dissenters, having revolted against the caste arrogance of the Brahmins; although they do not regard caste as a sacred institution, yet caste is perpetuated in civil life, and prevents them taking service for hire. They cultivate their own gardens, the produce of which we know as "native Ceylon." The labour on the plantations is supplied largely by Hindoos from the Coromandel coast, chiefly from the districts of Tanjore, Madura, Tinnivelly, and the small native State of Poodoo-

cattah, and by Mohammedans from the Malabar coast. These all migrate annually for about eight months, and return home for the remainder of the year. Ceylon, then, has to thank itself for its close proximity to the densely-populated Indian continent, without the supply of labour from which it would be impossible to cultivate coffee. But the southern part of India is even more advantageously situated. From an experience of many years, we know that the Mysore and Neilgherry districts grow the richest coffee in the world. No caste prejudices interfere with any sort or description of labour required in coffee plantations. Where caste presents obstacles is in the arrangements for lodging the coolies, and especially those for their eating and drinking. The wages of a coolie are about equal to the interest of money in the value of a Brazilian slave, without the slaveholder's charge of providing subsistence. The difficulties connected with labour in Java and Brazil have a constant tendency to contract their production. Thus whether that decreases, or whether the world's consumption should increase in the ratio of the last twenty years, but one conclusion can be arrived at in either case—Ceylon and South India will rapidly become the most valuable coffee-growing countries of the world, offering every year an ever-widening field for British capital and enterprise. There are probably hundreds of high-spirited young men in this country at their wit's end for a good purpose in life. Let some of them embrace this golden opportunity.

When I spoke of the inner equatorial regions, I excepted the centre of the tropics, that is, to 5° on either side of the equator. The only coffee growing countries situated on the line, are the island of Sumatra and the republic of Ecuador, neither of which produces coffee even equal in quality to that grown in Santos, at the extreme south of the tropic. This would not be of importance to us, as we have no territory in the equator, but that, when British settlements and colonies are formed in Eastern Africa, the best coffee harvests there will be in what I have called the coffee belts from 5° to 15° north and south latitude. This would be, in the south, that country which was so graphically described in Dr. Livingstone's letters sent home by Mr. Stanley, the base ports being Zanzibar and Mozambique, and in the north, the old coffee-growing country of Abyssinia, and the equatorial Nile basin out of Egyptian territory. Both Dr. Livingstone and Sir Samuel Baker describe these countries as a terrestrial paradise, the latter speaking of boundless tracts, situated at a mean altitute of 3,000 to 4,000 feet above the sea level, with a fertile soil, healthy climate, regular rainy season, and a docile population, eminently adapted for coffee cultivation.

I have thought it necessary to place before you this rapid review, because it presents many interesting features. Coffee is in the highest sense one of the "kindly fruits of the earth," and yet one which, in this country, we neither appreciate nor enjoy. I have shown you that, excluding Turkey, the continent of Europe and the United States alone actually consumed last year 400,000 tons; to this you must add the unknown but considerable consumption of the Turkish Empire and the producing countries, which must be at least half as much again. As other civilised nations on an average consume 5 lbs. per head per annum, against a diminishing consumption here, which is now so low as 15½ ounces, it is very evident that it is high time for us to inquire why we do not value coffee, which is in other countries a food of prime necessity; and this inquiry will be so much the more important if we find in prosecuting it that the neglect of coffee is a cause of the undue consumption of beer and spirits amongst our labouring classes. The common idea is, that every country appropriates a particular drink, suitable to its climate, and that our choice has fallen upon tea. Since 1841, a large preference has undoubtedly been given to tea, but before that time the relative consumption of tea and coffee was equal, and we have to account for the steady and remarkable change which has since taken place in the habits of the people. In 1841 the consumption of tea and coffee was 24 ounces per head per annum of each article, and in 1873, following the increase of general prosperity and population, that of tea had risen to 64 ounces, while coffee had fallen to 15½ ounces. Now, large as is the the stride in the consumption of tea, it is capable of much further extension, as it only supplies one half of the drink of one half of our population, and we may presently find out why coffee does not supply, at least, a moderate proportion of the remaining three-fourths. Unfortunately, however valuable a beverage coffee may be, there has been of late years so wide-spread a want of intelligence observable in the purchase and preparation of coffee by the public, that under the most favourable circumstances, it may be a generation before it half recovers the place it has lost. We will compare the three non-alcoholic drinks, the essential or active principles of each of which are somewhat identical, although their effect on the system is altogether different. Tea is refreshing and staying, and is especially adapted for all persons whose condition of life is outside that of actual bodily labour. Cocoa, equal in nourishing power to butchers' meat, is valuable to those whose supply of that food material sometimes runs short, and is especially valuable for the young, the growth of whose frames is strengthened and built up by its use. Coffee I may describe as possessing a power of producing vital energy. It prevents the too rapid waste in the tissues of the body, enabling it to be supported upon a smaller quantity of food. It promotes health, because the superior vital energy it produces enables us better to resist injurious influences which undermine health. A keen brain and a firm muscle follow the judicious use of good and pure coffee. The permanent vitality it produces is equal to, if not greater than, that produced by alcohol, without its baneful effects on the brain. The late Captain Parry, who was the son of an eminent physician and dietist, when on his Arctic voyage, put his starboard watch, which was on the exposed side of the vessel, on coffee, the port watch on rum, and it was found, after an ample trial, that the coffee watch retained a vigour of health which was absent on the other side of the vessel. A consular employé recently testified that he has passed safely through many dangers of malarious climates mainly by the daily use of strong coffee. The dock labourers in Holland drink cold coffee in summer, and in winter warm their coffee in the cans, and they say—if we drink gin we are lazy and

stupid, but if we drink coffee we can do our work with ease. And further, Julius Froebel, in his "Seven Years in Central America," says, "For the men accompanying the great mercantile caravans, coffee is an indispensable necessity. Brandy is taken as a medicine, but coffee is quite a necessary food, and is drunk twicc a day. The refreshing effects of this beverage in heat or cold, in rain or dry weather, are extraordinary." If from Norway to the Mediterranean coffee is largely used, if in the Netherlands, which has the climate most resembling ours, the consumption of coffee is the highest in the world, then the argument of climatic preference for tea as against coffee is seen to be fallacious. The people of this country work harder than any other nation, and would welcome the use of good coffee if they could but obtain it, and there are two reasons why they cannot. Coffec, like tea, cannot be used for food without first being submitted to a dry heat, for the purpose of developing certain properties without which they are not available; but the difference is this, that tea is fired at the place of growth, and coffee can be roasted only at the place of consumption. The firing of tea in China is done skilfully, and the roasting of coffee by us in just the reverse way. Our national dislike of coffee results then, first, from the unequal and most unskilful manner of roasting, and also, in a greater degree, from the pernicious practice of its admixture with a noxious root which has been christened chicory. If any one thing more than another has proved a bar to improvement in the roasting process, it is because the presence of this overpowering adulterant has rendered it of little consequence whether the delicate aroma of coffee is developed or not. A mistaken notion of French excellencc in coffee is prevalent; they use for the most part a medium quality only; they roast it to a very high point, and drink it with a great deal of sugar, and make perhaps as much of second-rate coffee as it is possible to do. The French are the next lowest to us in consumption, and use chicory largely, which may partly account for the want of stamina evident in that people. Really fine coffee roasted to their high point would have its aroma driven off, and its other rich qualities over carbonised. The confectioners in the larger towns in Austria are, I believe, the best manipulators of coffee; they roast it skilfully to a full development without burning it, and the "conditoreien" of Prague and other towns are notorious for their popularity. On the Continent coffee is roasted in private houses and also by the grocers, daily, in small quantities. We roast in bulk roasts, the quantity usually being 0 lbs., and the larger the roast the greater the difficulty of controlling it in its later stage. Our roasting appliances are antiquated, and ill adapted for the control of an operation of so great nicety a the development at a particular temperature o so extremely inflammable a substance as coffee when near its roasting point. Our roasters rather regard the out-turn of a large tonnage than good quality, and their low charge for roasting cannot pay for efficient skilled labour in manipulation. Many attempts have been made by able members of the trade to improve the process. Amongst the patents of this century, the only one worth mention is that of Mr. Richard Evans, who, in 1832, introduced the hollow axis for permitting the escape of the noxious gases which are evolved during the action of roasting. But if inventors have failed, it has arisen, not from a lack of perseverance, but from the want of knowledge of the subtle action of heat upon the many constituents of the berry. In this they have not been aided by science, and the rule of thumb has prevailed. I may here state that ncarly four years ago an experimental factory was erected for the purpose of testing the possibility of producing a bulk roast of equal quality to the smaller Continental roasts. For two years the results were not good, and it was evident that, the expcriments not being based on any certain principles, a deeper investigation of the problem was necessary. We are indebted to the researches of thc latc Dr. Sheridan Muspratt for his exposition of the laws of carbonisation, the sum of which I will endeavour to put before you so far as they may apply to the roasting process:—

"When several bodies enter into the composition of a substance, it readily yields to the decomposing effects of fire, especially if the constituents have an affinity for one another, whereby simpler combinations are produced; some of the ingredients of these bodies are of a volatile nature, and as soon as the force of heat applied overbalances that of the affinity which binds them together, in the peculiar state in which the vitality of the plant arranges them, they assimilate and disperse, whilst others are left in a solid state. When the matters submitted to the action of heat are out of contact with air or oxygen, the quantity and numbers of the compounds formed depend for the most part on the intensity of the temperature applied, but when oxygen or air is admitted, and the action of heat is still exerted, the bodies already modified will undergo another change, the results of which will be more simple and permanent."

These are accompanied in the coffee roasting process by the phenomena both of combustion and dry distillation, first of its saccharine and other components, and then of its woody fibre. The important question arises—what is the temperature at which the aroma and quality of coffee is developed? In the absence of information on this point, a series of close registrations of temperature during the roasting process have been made, and the roasting temperature found to be from 435° to 440° Fahrenheit, a difference in the quality and substancc of various coffees causing a variation of about 5°. But the action of heat upon coffee is, in various stages, very unequal. Professor Tyndall, in his "Heat a Mode of Motion," throws some light upon the cause of this. A woody substance like coffee, containing 13 per cent. of water, and a large percentage of volatile constituents, is, from its ligneous nature, a great non-conductor of heat; at first it resists strongly exposure to heat, but its temperature rises steadily to 212°, and then the evaporation of the water commencing, the power of the heat is consumed in forcing the 13 per cent. of it out of the coffee, and causes the temperature during the time to rise but slowly. When that work is done, the temperature again rapidly rises, some of the constituents become inflammable, and without the greatest care, the point of the roasting temperature is passed, and the coffee burnt. In endeavouring to avoid this, our roasters for the most part turn out their coffee without its ever having reached the roasting point; it is consequently undeveloped. This explains the preference by some persons for an admixture of chicory; undeveloped coffee lacks fulness of taste in the mouth, and the pyroligneous acid, not being fully driven off, makes it disagreeable, whilst the

powerful burnt saccharine of the chicory hides the defects. You will now understand what an exceedingly delicate operation coffee roasting is, and how necessary it is so to control the heated bulk when near its cooking point, that you may not apply 10° too little heat, which makes an undeveloped raw roast, nor 10° too great a heat, which, by burning the coffee, destroys the quality. A French coffee roaster recently remarked to me that "it requires an artist to roast coffee;" perhaps we shall agree with him.

Upon the basis of these considerations a large apparatus has been constructed, which works well; its heating power is under perfect control, and by free contact with hot air, or oxygen, the baser products of combustion are dispersed, consequently their absorption into and retention by the coffee is prevented, and the aroma and quality developed without any danger or excess of heat. It has been the custom of foreigners to disparage us in this matter, but I can see no reason why we should not equal, if not excel them in skill in roasting.

The result to the revenue of the duty on coffee is not rightly understood. The duty is 14s. per cwt. The import of 1873 was 84,183 tons; and I noticed a recent leading article in a daily paper, in which that quantity was represented as our home consumption. But London, being an important coffee depot, exported last year 68,000 tons; and we used 13,000 tons, or one-sixth of the whole, the latter only paying the duty, amounting to about £200,000, and bearing the whole burden of the cost of state supervision and customs charges. A very large staff of officials are engaged in this detail, and last year 68,000 tons passed through their hands without paying one farthing to the revenue. I need not say that under these circumstances, the collection of this duty is a loss, and the impost should be repealed. This is no part of the cry of "the free breakfast table." Before that question can be settled, it will be requisite to find an equitable substitute by which all consumers may contribute their fair quota to the revenue. It is not the act of a wise Government to levy a tax the collection of which entails a loss to the Exchequer, and only provides useless occupation for a numerous staff of civil servants.

No critical examination into our use of coffee would be complete without a deliberate consideration of the cause and effect of the use of chicory, and in coming to this, the last part of my argument, I have taken upon myself a disagreeable but necessary duty. More than 20 years have elapsed since the "great chicory question" was prominently before the public, and since that time we have swallowed 150,000 tons of this root, a large part of which has been sold under the name of coffee, and the substitution of an injurious weed for a nourishing fruit has been found to so diminish the value of coffee as food, that not only has the consumption of chicory decreased, but it has dragged coffee also out of general use, and caused a marked preference for other liquors. There is so much prevailing misconception as to what chicory is, that I must ask your especial attention to its nature and history. Pereira places the *cichorium intybus* in the tribe of *cichoraceæ*, in which is also included *taraxacum* or dandelion, to which it has analogous properties. Its English name is wild succory or wild endive, the roasted root of which has been named chicory. Where the digestive organs are weak and readily disordered, it is very apt to occasion dyspepsia, flatulency, pain, and diarrhœa. Professor Lindley says—

> "Chicory is entirely destitute of those properties which render coffee an agreeable beverage; whilst, on the other hand, it possesses medicinal properties closely like those of the dandelion, and which therefore render it unwholesome for constant use."

This is used in medicine as a diuretic, and in renal and liver diseases. Now, if healthy persons make a food of a drug which is useful in the cure of these diseases, on the principle of *Similia similibus curantur*, they lay in themselves the foundation of and set up those diseases. Does not this account for the ill effects which so often follow the use of what is supposed to be coffee? In the reign of George III., chicory was regarded rightly as a gross adulterant, and an Act was passed prohibiting its possession. In 1832, a Treasury minute allowed the sale of chicory, provided it paid a duty of £20 per ton, but its admixture with coffee was forbidden, and the sale of chicory was only made under its own name and price. Up to 1840, coffee held an equal place in public estimation with tea, and their consumption was relatively equal. Since then the consumption of tea has quadrupled, whilst that of coffee has steadily declined. In this year (1840) a minute was issued, allowing the mixture of coffee and chicory to be sold, and from that time to the present, except during four months in 1852-53, coffee has been strangled by its unholy alliance with chicory, the admixture of which is the undoubted cause of its want of popularity. You must bear in mind that up to 1840 all the chicory used was foreign grown, but when the admixture was then allowed, the culture of chicory sprang up at home, and, paying no excise duty, it pushed out foreign import; few persons only being in the secret, enormous profits were made, until the falling off in the consumption of coffee directed attention to the question. In the year 1852, the Ceylon planters, of whom we were then the only customers, finding the use of their produce threatened with extinction, memorialised the Government of which the late Lord Derby was the head to withdraw the minute of 1840 and revert to that of 1832. To their great honour it is to be said, they estimated truly the danger of the fraud upon the public interest, and in the House of Lords, on the 2nd August, 1852, Lord Derby declared the admixture minute rescinded. This did not take effect until the end of October, and the consumption of coffee then largely increased. But the Government of Lord Derby quitted office early in the next year, and were succeeded by the coalition Cabinet under Lord Aberdeen, several members of which now survive, the late Prime Minister being then Chancellor of the Exchequer. One of its first acts was, on the 25th February, 1853, notwithstanding the protests of the Ceylon interest, to restore the admixture minute. The home growers of chicory were, no doubt, at that time very powerful; its annual consumption was 12,000 tons, paying no duty whatever, and it was an immense source of profit; to use the words of a member of the Upper House, "it was the impression that the producer of chicory had an undue influence with certain parties

in securing particular arrangements in their favour." I have before me a full report of that debate, which Viscount Torrington, the Governor of Ceylon, opened on the 2nd August, 1853. He had previously used every effort with the Chancellor to prevent the alteration, but without result; the minister's inconclusive reasons were that chicory was expensive to cultivate, and that it would not be drunk unless it was mixed with coffee.

Chicory having in recent years had to bear an equal duty with coffee, its home growth has entirely disappeared, and since this debate in 1853 no further attempt has been made to stop the evil. The Ceylon planters have happily found foreign buyers, who eagerly compete for their produce, and they have no further interest in the matter. Indeed, that applies to the whole London coffee interest. The foreign trade is so extensive that it offers a wide field for its prosecution, and as a trade interest, it little matters whether the population of the United Kingdom drink coffee or not.

The admixture of chicory with coffee is not a grocer's question; it is a State question. The practice has been fostered by the State for such a number of years, that the principle of *caveat emptor* does not apply, for the mass of the people do not know coffee from chicory. For many years our most respectable grocers refused altogether to trade in chicory. But if the State specially opens the door for fraud, there can be no surprise that amongst the large number of retail dealers the lowest of them will take ample advantage of it. If the mere affixing outside the packet of a notice that its contents are a mixture complies with the law, then an ounce of coffee to a pound of chicory is within the law. Is that what the people of this country desire? The best solution of this question is this, and I commend it earnestly to the consideration of the Government. The last Adulteration Act has been found faulty, inasmuch as its wording and effect seem to have pressed very hardly on the food distributor without reaching the wholesale adulterator; if the nation is to derive a real benefit from its operation it must be amended, and when that is done, I recommend that a clause should be inserted compelling the sale of coffee and chicory under their respective names, and without admixture; and in so saying I speak in the name of every merchant and respectable grocer with whom I have ever been brought into contact. With good coffee we shall then compete with beer and spirits. Chicory can never do so. It is true that those who have naturally strong digestive organs may get hardened to its use; but it is no food. A man cannot work upon it; it undermines his health, and he seeks by a large consumption of alcoholic liquor to supply, but indifferently, that vital power which his life of labour requires. I am far from depreciating the judicious use of wine, spirits, or beer; but when I know that so large a portion of our nation is sunk in vice and misery mainly by the abuse of these, and neglecting the one food whose employment would have greatly prevented that abuse, I can but arrive at the conclusion that it is not the people who are in fault, but the Government, who by forcing upon coffee a noxious adulterant has poisoned the food. And this has also indirectly tended to produce a general unskilfulness in the manipulation.

In conclusion, I thank you for the attention you have given me. I have had for many years a predilection for the study of this important food product, and I have endeavoured to the best of my ability to give you reliable and practical information. My desire is that my observations may be regarded as a starting point for the more extended use of coffee in this country. I commend the subject to your further attention; it is one which involves the prosperity of the empire and the welfare of our people.

Decennial Table of Consumption of Coffee in the United Kingdom.

	Duty Paid.	Population.	Average Consumption.
1847	37,441,373 lbs.	27,105,022	22 oz.
1857	34,352,123 "	28,278,000	19 "
1867	31,567,760 "	30,151,084	$16\frac{3}{4}$ "
1869	29,109,113 "	30,541,606	$15\frac{1}{4}$ "
1873	32,329,920 "	.. ..	$15\frac{3}{4}$ "

Present Consumption of Coffee per Head per Annum in some other Countries compared with the United Kingdom.

United Kingdom	$15\frac{3}{4}$ ozs.
France	$2\frac{1}{2}$ lbs.
Germany..................	4 lbs.
Denmark	$5\frac{1}{2}$ lbs.
United States	6 lbs.
Switzerland	6 lbs.
Belgium	$8\frac{1}{2}$ lbs.
Holland	10 lbs.

DISCUSSION.

Mr. P. L. Simmonds said he had listened with much pleasure to this paper, as it was on a subject to which he had paid great attention, both from having been a grower of coffee in the tropics, and from having published several works on the subject. Coffee was a very important product, being very largely consumed on the Continent, if not in England; but even here he believed the demand was slightly increasing. No doubt it had declined, owing to its adulteration by chicory; but he believed if the public could get pure coffee, they would be glad to drink it. Some perhaps might prefer a little chicory with it, but it was principally used for the sake of cheapness. On the Continent chicory was largely used, both pure and mixed with coffee, but in England it was very largely sold as coffee, though it did not cost one-fourth of the price; and this ought to be forbidden, for all adulteration of articles of food or medicine which affected the healths of the people ought to be prevented. Every part of the coffee tree might be utilised; even the leaves had been made use of, but not to a great extent, because the berries were more profitable, and if the leaves were stripped as well, the plant would be injured; but probably the pulp might be rendered useful. There were many islands in the West Indies where very fine coffee could be produced if it were not for the difficulty of obtaining labour, but taking all things into consideration, India seemed the most promising field for its cultivation. One advantage of coffee over tea was that it would keep good much longer if not roasted. He did not think it was quite correct to attribute the want of stamina in the French to the drinking of chicory, because they drank a great deal of wine, which would counteract its effects in that way. No doubt it would be much better for the English labouring classes to drink more

coffee instead of so much tea, but there were great deficiencies, generally speaking, both in the roasting and making of coffee in this country. It was curious to notice that the use of chicory was extending to the colonies, for it was now largely grown in Australia; and as the inhabitants of that region were favourably situated for obtaining pure coffee, it could not be from necessity that they used chicory, but it must be from choice. He believed that the consumption of coffee in England had lately shown a slight improvement, though it was still far behind other countries. The United States showed about the largest consumption, viz., 7 lbs. per head, but as the greater portion came from Brazil, and was not so good as Ceylon and Indian coffees, it did not perhaps represent quite so much as the same weight per head in Europe. There was no doubt that if coffee maintained its price, producers would go on extending the area of land under cultivation, and expend capital on the necessary machinery and appliances; and some of our colonies might take it up. It had been tried in Natal, and had been said to be not very successful, and various samples of soils, and barks of the coffee tree had recently been sent to him for analysis, to ascertain the cause of failure. It was very evident, however, that the planters had neglected to manure the ground, to clear away the too luxurious vegetation which absorbed the nourishment of the soil, and to give the plants the care and attention which was requisite, all which matters required to be carefully attended to, because coffee was an exhausting crop, and if the ground were not properly manured, good returns could not be expected. In conclusion, he desired to express his opinion of the great practical value of the paper.

Mr. Holm said he had given a great deal of attention to this subject, and believed coffee to be most valuable as an article of food, but, at the same time, it might be abused. For instance, it was very largely used in Sweden, and he had recently been informed by a Swedish physician that the prevalence of hæmorrhoids in that country was in great measure attributable to the excessive use of strong coffee. He by no means defended the practice of mixing a large quantity of chicory with a small quantity of coffee, and selling the compound as coffee or a mixture of coffee and chicory, but at the same time, the instincts of mankind seemed to point to the combination of a certain quantity of chicory with coffee, probably from the feeling that coffee itself required something in the nature of a diluent. He was not prepared to speak of the physiological properties of coffee, but he had never heard before of its weakening the vital stamina, and if the French were deficient in this respect, the same might be said with equal truth of the Turks, who used large quantities of pure coffee. He had been informed by a medical friend that a large part of the out-patient practice in connection with the Westminster Hospital consisted in advising the old women patients to leave off tea; but the alkaloid principle of tea was the same as that of coffee, so that the excessive use of the one must be as bad as the other. No doubt the value of coffee depended mainly on the process of roasting, but no reference had been made to the great loss of caffeine during that process. He understood that chemists obtained caffeine by collecting and condensing the vapour from the roasting coffee, and this alkaloid, which had lately been used as a remedy for sick headache, was of some value commercially, so that it seemed a question which coffee roasters should endeavour to deal with, now this valuable principle might be preserved. With regard to the use of the hollow axle in the coffee roaster, he believed his late partner Mr. Dunn, long before the date mentioned, invented a roaster which was still in use, combining with a hollow axle an arrangement by which the condition of the berries could be examined during the process of roasting. But the preservation of the aroma of the coffee depended very much upon the the process of cooling, and in this respect the French were sadly deficient; they were accustomed to spread it out too much for exposure to the air; on the other hand the coffee was spoiled if it were kept too much in bulk while cooling, but means might be adopted, by the use of metallic plates, to ensure a rapid cooling without too great exposure to the air and consequent loss of aroma. With regard to the practical value of coffee, he was enabled to state that Sir John Ross in his arctic expedition had found his men were better able to resist the effects of intense cold when drinking coffee than when supplied with spirits, thus corroborating the opinion of Captain Parry. He knew this to be a fact, because Sir John Ross on his return stated so to Mr. Dunn, expressing his great appreciation of the essence of coffee.

The Chairman said Mr. Branson had brought his paper forward as a practical one, in the true sense of the word, and he thought in a society like the Society of Arts especially, the practical application even of scientific knowledge should never be lost sight of. He would not criticise the science of the paper, as it did not profess to be scientific; but he thought it was time they should give up calling coffee a nourishing fruit, and speaking of it under the name of berries, because every one knew it was not a fruit, but a seed, and it ought to be so called. He had listened with considerable interest to the history of the coffee-growing countries, and it was most interesting to know that the great Indian possessions were specially adapted for the culivation of coffee, because it appeared that Ceylon could not produce much more than it did at present. He thought the statements as to the consumption of coffee appeared a little under-rated, though perhaps not very materially. With regard to the comparative consumption of tea and coffee, he could hardly think the statement in the paper that the consumption of tea was four times greater than coffee was correct, and he should like to know Mr. Branson's data for that statement. He should certainly not have estimated it at more than three times greater. He must also dispute the statement that the nourishing power of cocoa was equal to butchers' meat, although it was more of a food substance than tea and coffee, which were simply beverages. Cocoa was fattening to a certain extent, but he should be very sorry to have to depend upon it in the place of butchers' meat. Another statement made was that tea and coffee prevented waste of the body, and, therefore, served the place of food; that idea had prevailed for a long time, but the experiments of Dr. Edward Smith proved conclusively that such was not the case, and that the alkaloid in either tea or coffee, for it was substantially the same in each, did prevent waste. While not over-estimating the value of coffee, he emphatically agreed with Mr. Branson as to its value, and believed there was nothing equal to good coffee as a soothing, mildly-stimulating, and agreeable beverage. For the last twenty years he had maintained that chicory should not be mixed with coffee under any circumstances, and he thought that coffee mixed with chicory ought not to be allowed to be sold. If a person preferred a little chicory in his coffee he could get it separately and mix it himself. There was no doubt that persons could undergo an enormous amount of labour under the influence of coffee, as was shown by the rice planters in Sumatra, who worked up to their knees in water, and yet drank nothing but tea made from coffee leaves. He should like to see some large coffee shops opened where good coffee could be obtained with every comfort, and thought if this were done it would tend greatly to diminish drunkenness. In conclusion, he begged to propose a cordial vote of thanks to Mr. Branson for his interesting, instructive, and valuable paper.

The resolution having been passed unanimously,

Mr. Branson said he was much obliged for the criticisms which had been made on his paper. He had not read the whole of the book by Mr. Simmonds, but he had noticed a statement in it that coffee could be grown

in North Australia. Now if British merchants were to sink their capital in coffee growing, it was important they should choose the best countries, and from his knowledge of the coffee coming from various parts of the world, he was inclined to think that coffee could be best grown in the two belts, and that until they were thoroughly occupied it was not worth while going north or south of them, in a commercial point of view. With regard to the pulp of the coffee being utilised, an endeavour had been made to distil it into alcohol, but it did not pay, and was therefore abandoned. With regard to using the leaves of the trees, he might state that a far greater result would be produced by picking the berries than by picking the leaf and making it into tea; it had been tried over and over again, but was put aside as impracticable. Mr. Holm had rather criticised his laudation of the virtues of coffee, but he could not retract anything he had said, and if it did produce hæmorrhoids in Sweden it could only be from an abuse of it, and the fact tended to show its nourishing qualities. Mr. Holm seemed to be a great lover of diluents, but if his food had to be diluted, he preferred doing it himself. The English people prided themselves upon being honest in trade, and he thought they should put down any practice which defrauded the public, and discountenance any dilution of goods, which could be done much better by the consumer than the seller. Then it had been said that the consumption of coffee in America, as it was principally Rio coffee, did not represent the same consumption as here; but that was a mistake, because the Americans classed the coffee which they used under two names, "Rio" and "mild," so that the conclusion was that Rio coffee was strong. Therefore the consumption in the United States, whether 5 lbs. or 6 lbs. per head, was equivalent to the same consumption anywhere else. Mr. Holm had referred to a machine invented by his late partner, Mr. Dunn, but he (Mr. Branson) had searched the Patent-office, and found no mention of any patent except the one he had referred to, of Mr. Richard Evans, in 1824, which patent was worked for many years, so that he thought no one had a prior right to use the hollow axis. It was quite certain there was a great era opening for the planting of coffee in British dependencies, and very large fortunes might be made in it. To prove this, he might mention that a gentleman with whom he was acquainted some years ago came into possession of a coffee plantation in Ceylon, worth about £5,000; he spent £10,000 upon it, and after waiting five years, he received upon the capital of £15,000 a net income of £5,000 a year, and the estate was afterwards sold for nearly £40,000. The consumption of coffee was rapidly increasing, and this he thought was a great inducement for capitalists to go into the cultivation.

Virginia and West Virginia have seventeen coal mines open or nearly ready for working, while seven iron mines are in operation or about to be.

Twelve iron furnaces have been built or projected within the last two months in Virginia, which will probably produce 120,000 tons of pig-iron annually, and consume 1,000,000 tons of coal.

An American paper says that the latest use to which petroleum is applied, is in heating the street cars of New York. The Fourth Avenue cars are being supplied with little stoves which use petroleum for fuel, and keep the passengers comfortably warm.

The number of American manufacturing establishments in 1870 was 252,148, in 1860, 140,433; hands employed in 1870, 2,053,996, in 1860, 1,311,246; capital in 1870, 2,118,208,769 dols., in 1860, 1,109,825 dols.; wages in 1870, 775,584,343, in 1860, 378,878,966; value of raw materials in 1870, 2,488,427,242, in 1860, 1,031,605,092; value of products in 1870, 4,232,325,443, in 1850, 1,885,861,676. Thus while the gain in population has been 23 per cent., the increase in manufacturing capital has been over 100, in the value of goods produced, 125 per cent.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

OPENING OF THE EXHIBITION.

On Monday last, the 6th inst., the Exhibition was opened to the public. As last year, there was no formal ceremony, the doors being merely opened for the admission of the public. As has generally been the case, many parts of the Exhibition were in a backward condition. The exhibition of foreign wines, in the vaults of the Albert Hall, cannot be got into a fit state for public inspection until the 1st of next month. The Indian, Colonial, and French Courts are still completely empty, while in other parts of the building the exhibits are hardly yet complete. The machinery department is not quite in working order, and though on the opening day many of the machines were finished and at work, some little time must yet be allowed to pass before all can be complete. The various classes of the year are not such as to lend themselves readily to a large show of machinery, while in the one department in which machinery might naturally form an important and interesting element, that of lace-making, there are obvious difficulties in the way. To set up a complete lace-making machine is a very costly and troublesome matter, and the splendid machine now exhibited is perhaps as liberal a contribution to the section as could be expected. It is of itself sufficient to exemplify the entire process of lace-making by machinery. Though of course there are machines connected with most of the other classes, they are not of a sort to attract much general interest, and the consequence is that the machinery gallery suffers, while the other portions of the Exhibition gain.

When the buildings for the experimental treatment of sewage are quite complete, they will bring before the public, in a practical way never before attempted, the actual processes and results involved in the great sewage question. Those interested in the disposal of sewage, in towns or in the country, can come and compare the different systems to be adopted. Even the general public can have the matter brought clearly before them, so that something may be done towards forming that general *consensus* of public opinion which must be formed before any large or extended action on the subject can be hoped for.

Most of the other sections were tolerably complete on the opening day. The show of building materials, of sanitary apparatus, and architectural models, &c., was large. The collections, too, of lace, saddlery, and specimens of bookbinding were probably nearly as large as they ever will be. That of lace will probably be one of the main features of the Exhibition, as it has been very largely helped by the liberality of owners of specimens who have readily lent many valuable specimens.

In the section devoted to Scictific Inventions, the principal novelties promised are all in position, the diving apparatus and Gramme's electric light apparatus being perhaps the most conspicuous.

In the Ethnological part, Dr. Leitner's Indian Collections make a large show, but this section, too, will probably be expanded.

The Fine Art portion of the Exhibition is tolerably complete, except the French contributions. Belgium is here largely represented.

Before very long the School of Cookery is to be re-opened in the same position as last year, and probably on a somewhat extended scale. The Commissioners also have it in contemplation to arrange for series of lectures in connection with the different classes.

Such is a brief sketch of the present state of things at South Kensington. As each section will be treated separately hereafter in the pages of the *Journal*, it has not seemed worth while to dwell with any detail upon the special parts of the Exhibition.

The Committee for Wine held its 9th meeting, 1st April, 1874, in the Royal Albert Hall. The following gentlemen were present:—Sir Daniel Cooper, Bart., Mr. H. Matthiessen, M. C. L. de Luc, Mr. H. G. Smith, Mr. R. Gray, Mr. John Corlett, Mr. C. H. Kayser, Mr. Gorden W. Clark, Mr. E. Apps Smith, and Mr. Yeatman. Lieut. H. H. Cole, R.E., attended the Committee. A resolution was passed recommending her Majesty's Commissioners to postpone the opening of the wine cellars to the public until the French and Portuguese Governments had completed the arrangements for exhibiting the wines of their respective countries.

EXHIBITIONS.

Sanitary and Educational Exhibition.—At the last meeting of the Executive Committee of Council of the Social Science Association, it was resolved that an Exhibition of Sanitary and Educational Appliances, such as that at Leeds in 1871, and at Norwich last year, during the period of the Congress in those places, should be organised to take place in connexion with the annual meeting of the Association, to be held in Glasgow in the autumn. In furtherance of this object, a Managing Committee was appointed to make the necessary arrangements. The object of the exhibition is to bring under the notice of the public generally, and particularly those who are interested in social, sanitary, and educational questions, the latest scientific appliances for improving the public health and promoting education. Among these may be mentioned all matters relating to architectural and sanitary engineering, warming and ventilation, heating and cooking, water supply, sewage and drainage, food, disinfectants, hygiene in clothing, and things relating to the prevention of disease; school furniture, and other articles used in teaching; and all sorts of appliances appertaining to the advancement of sanitary science, the promotion of education, and the improvement of the health and domestic comfort of the community at large.

PUBLIC MUSEUMS AND LIBRARIES.

The following returns of the numbers of visitors for March have been received up to the present date:—

	Number of Visitors.
British Museum	(no return)
National Gallery (Trafalgar-square)	73,334
Kew Gardens and Museum	26,048
South Kensington Museum	63,329
Bethnal-green Museum	46,200
Geological Museum, Jermyn-street	
Patent-office Museum	
Edinburgh National Gallery	6,371
Edinburgh Museum of Antiquities	4,516
Edinburgh Museum of Science and Art	17,659
Royal Dublin Society:—	
Natural History Museum	5,542
Botanic Gardens, Glasnevin	9,796
Dublin National Gallery	
Zoological Society, Dublin	9,046
Museum of Irish Society, Dublin	
Tower of London	6,871
Royal Naval College, including Greenwich Painted Hall	26,099

PUBLIC MUSEUMS AND GALLERIES.

The *Daily News* of Saturday last has the following remarks in reference to the proposal that a Minister of Education should be appointed, with control over our public museums. After giving a sketch of the origin and progress of our present Government machinery for educational purposes, the *News* continues:—

"It is not our purpose here to recapitulate the various changes which the Education Department has undergone since its first establishment. In the course of its existence it has attracted towards itself—or had thrust upon it—a variety of duties. It has witnessed the rise of Art schools, springing out of the Great Exhibition of 1851, and gradually expanding from the School of Design into the Department of Practical Art, at first placed under the wing of the Board of Trade, and finally became the Science and Art Department, under the always energetic, if not always prudent, direction of Mr. Cole. It has supported Mr. Cole in many of the schemes which many laughed at as visionary, but which, nevertheless, are producing good results throughout the country. It has fostered scientific training, has been the remote cause of the present prosperity of the Museum of Practical Geology and School of Mines, though the name of its real founder, Sir Henry de la Beche—its first Director—should never be forgotten, and at this moment it is gradually absorbing the work of the Endowed Schools Commission, which under the cold looks of the present Government is evidently condemned to die, like much that is now so bright around us, in the coming winter. But, in addition to the foregoing establishments, the Vice-President of the Council has under his supervision, and more or less control over, the various Schools of Science and Art throughout the Kingdom—the Geological Survey; the Edinburgh Museum; the Royal Dublin Society; the Museum of Natural History, Dublin; and the Royal College of Science, Ireland. Outside these departments and societies there are a host of others over which the Vice-President has no control, and yet which are all more or less co-operating towards the scientific and the art education of the nation, or are offering, in a small and unsatisfactory degree it is true, that endowment of meditative research, the political advantages of which are so patent to the few, and so unintelligible to the many. Public money is voted every year for the British Museum, the National Gallery, the National Portrait Gallery, the learned societies, the University of London, besides the Corporate Establishments in Scotland and Ireland. In the expenditure of the grants for these institutions no one is particularly responsible to the House of Commons, and the accounts are rendered by a heterogenous body of trustees, directors, and others, far beyond the reach of Parliamentary control. Surely such anomalies require a thorough and complete remedy, and it seems to us that no simpler remedy could be found than in the appointment of the long-expected Minister of Education, who would represent in Parliament all the interests of education, science, and art, and be responsible for two millions and a half which Parliament is now asked to furnish for these purposes. In many cases it would, of course, be necessary as well as advisable to retain the existing trustees, whether family or official, as advisers of the Minister of Education—in the same way as the Indian Council is supposed to advise the Secretary of State—and to consult with him on the details of his measures. But for the general conduct and supervision of all these branches of instruction we regard the appointment of one directing head as most urgent. We have often been told of the advantages of centralisation—as advocated by the Conservative party—and have frequently found ourselves opposed to their views on the subject; but in the matter of the consolidation of all the branches of education under one head we are ready to give a hearty acquiescence. Experience has shown that in all classes in this country there is a demand for education and instruction in things beyond the three R's, and that large numbers in all districts—urban, suburban, and purely agricultural—are ready to profit by the modicum of art and scientific training which has been placed within their reach. The results of recent International Exhibitions have shown to what extent this country has profited by the Art education provided for it, and those results ought to be sufficient to convert the most stubborn opponents of State protection. We cannot, therefore, but think that, if scientific and technical education were fostered in like manner, the country in a very few years would more than recover the amount expended in the establishment of the necessary schools. The success of Owen's College at Manchester is exceptional, but the lesson to be derived from such success is, not that such matters should be left to private enterprise, but that an imperative need of such training is widely felt. It seems to us illogical to argue that the State is interested in teaching its population the elements of learning, and then is bound to limit all access to the higher branches of knowledge to the select few who are able to pay for their admission within those sacred precincts. We do not mean to argue that it is the bounden duty of the State to provide gratuitous scientific and technical instruction in every national school, but we think that a judiciously applied system of grants might afford aid to such self-constituted schools as showed a desire for such help. Above all, there should be in Parliament a Minister whose function it would be to prescribe a uniform system, and to answer for the satisfactory working of the machinery over which he presided."

During two weeks in February no less than 1,234 applications for patents were received at the American Patent-office.

CORRESPONDENCE.

MANUFACTURE OF COCOA.

Sir,—It would appear that none of the writers or speakers upon this subject at the Ordinary Meeting held on Wednesday evening, March 11th, were practically acquainted with the habits and customs prevailing in the eminently cocoa-consuming countries of Spain and Italy, for if they had been they would not have introduced the term beverage as applied either to cocoa or chocolate. Iced drinks are infinitely more common in those warm climates than warm decoctions, with the exception of coffee, which, however, is taken concentrated and in very diminutive cups, never as a drink for thirst, but merely as a refresher and invigorator, a tumbler of cool water being usually supplied with it, or ready if called for. Chocolate is invariably so accompanied, as also with sponge cakes in lieu of spoons.

The way chocolate is managed in private houses is this. A large pot, perhaps holding a dozen cups, is kept hot night and day, but never boiled, and when one or more cups are called for, the same number of cups of warm water are replaced, together with a corresponding quantity of chocolate paste, and so on from year's end to year's end, the pot being thus kept permanently full. They say, moreover, that a truly fine cup of chocolate cannot be produced until this process has been carried on for three or four weeks.

The manufacture of chocolate is a very simple affair, and is carried on openly like every other business in the towns and cities of Italy. The cocoa beans are first lightly roasted, in large iron pans pierced with holes, over a charcoal fire, and when sufficiently done, the filmy covering is blown away by tossing and winnowing in the wind. The roasted beans are then picked and taken to a sloping curved marble slab, with a pan of lighted charcoal under, and ground with a cylindrical muller into a semi-fluid paste, which hardens when pressed into the moulds. I have myself bought a few pounds of raw cocoa, and had them roasted and ground while waiting. The price of chocolate is ruled in some measure by the cost of the flavours, some being very expensive, for nothing else is added to or subtracted from the native article.

Cocoa, considered in the light of a substitute for a warm drink, is utterly useless in every point of view, and "patent soluble cocoa" is nonsense; but I have no doubt that Chinamen could make excellent tea from the leaves of the tree, as is the case with the coffee tree leaves.—I am, &c.,

Henry W. Reveley.

Reading.

NOTES ON BOOKS.

Practical Suggestions to Inventors. By Julius Hall.

The object of Mr. Hall's little work is to assist inventors with hints as to what to invent, how to procure patents for their inventions, and in what way to realise profit from their patents. Instructions are given as to the cost of British, foreign, and colonial patents, and the method of obtaining them. There is a chapter on registration of designs, and other information intended to be useful to the class addressed.

In Birmingham the number of steel pens made weekly is about 98,000 gross, or 14,112,000 separate pens.

The extent of railway opened in France at the close of 1873 was 11,603⅛ miles. Of this aggregate, 453⅛ miles were opened in the course of 1873. The amount of revenue collected upon the French railways last year was £32,064,351, as compared with £30,726,763 in 1872.

GENERAL NOTES.

Japanese Silkworm Trade.—Letters received from Japan state that the new Minister Iwakura is about to grant permission to dealers in silkworms' eggs to travel without hindrance into the interior of the country, that they may trade directly with the cultivators. They add that it is thought this measure will have a beneficial effect on the silkworm trade, and will attract the attention of European merchants and manufacturers.

Channel Passage.—A "Dicey twin-ship" is now being built on the Thames by the Thames Ironworks and Shipbuilding Company, under the special survey of Lloyd's, and is so far advanced in construction that she will be launched in April and ready for the service in June. The vessel is 290ft. long, with an extreme breadth of 60 ft., with the small draught of water of 6ft., so that she can enter the ports on both sides of the Channel at all times of the tide. She will afford accommodation for upwards of 600 passengers, with first and second class saloons, ladies' and private cabins, and a sufficiency of closets; and over the saloons a fine promenade is arranged. Excellent refreshment-rooms are provided, and the comfort of the passengers is in every way studied, so as to insure the success of the undertaking.

Price of Bread in Italy.—In these days of high prices it will not be uninteresting to know what is being paid for the first necessaries of life in other countries. From a report recently published by the town council of Milan, it appears that the price of bread in that city is 62 cents. per kilog., though one bakery belonging to a limited company is selling at 60 cents. In the suburbs, beyond the limits of the octoi, the price is 58 cents. per kilog. At Venice, the price is 66 cents.; Mantua, 64; at Florence, the best bread is sold at 63 cents., whilst that of 2nd quality at 57; Brescia, 60 cents.; at Genoa, the price, generally speaking, is 62, though some bakers, under engagement to the municipality, charge only 58; at Rome and Naples, fancy bread is sold at 65, white bread 57, common 47; at Surin, the price is 55 for best, and 50 for 2nd quality.

NOTICES.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque, Post-office order, or Cheque Bank cheque, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

The following arrangements for Wednesday evenings have been made:—

April 15.—"On Symbolism in Oriental Ornament." By W. Simpson, Esq., F.R.G.S.

April 22.—"On Progress recently made in Ornamental Processes connected with Metallic and other Industries." By W. C. Aitken, Esq.

April 29.—"On some Recent Inventions and Applications of Lambeth Stoneware, Terra Cotta, and other Pottery for Internal and External Decorations." By John Sparkes, Esq., Head Master of the Lambeth School of Art, and of the Art Department of Dulwich College.

May 6.—"On Timber Houses." By Frank E. Thicke, Esq.

May 13.—"On the Importance of a Special Organisation for the Diffusion of Sanitary Knowledge." By Major-General Synge.

The discussion on Mr. G. C. T. Bartley's paper, "On Thrift as the Outdoor Relief Test," will be resumed on Friday morning, the 24th April, at 12 o'clock. The Right Hon. the Earl of Shaftesbury, K.G., will preside.

Indian Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

April 17.—"On the Indian Famine, with Especial Reference to the Means which should be Adopted for Preventing or Alleviating Famine." By General Sir Arthur Cotton, K.C.S.I. On this evening Sir Charles Trevelyon, Bart., K.C.B., will preside.

May 1.—"On the Ruins of Cambodia, and the Antiquities of Indo-China." By H. G. Kennedy, Esq.

African Section.

These meetings are arranged for Tuesday evenings, at 8 o'clock, and the following arrangements have been made:—

April 14.—"On Trade in Western Africa with and without British Protection." By Andrew Swanzy, Esq.

April 28.—"On the History, Progress, and Prospects of South Africa." By Col. J. C. Gawler.

Chemical Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

April 10.—"On some Recent Processes for the Manufacture of Soda." By C. W. Vincent, Esq., F.C.S. On this evening Dr. J. H. Gladstone, F.R.S., will preside.

April 24.—"On Pyrites, as a source of Sulphur, Copper, and Iron." By Dr. C. R. A. Wright, F.C.S. On this evening Dr. Frankland, F.R.S., will preside.

May 8.—"On Sugar Refining, with special reference to Finzel's Sugar Crystals." By Dr. Griffin.

May 22.—"On the Manufacture of Chlorine." By W. Weldon, Esq., F.C.S.

Cantor Lectures.

The third course will be by Professor Barff, M.A., "On Carbon and Certain Compounds of Carbon treated principally in reference to Heating and Illuminating Purposes."

The object of these lectures is to explain the scientific principles involved in all heating and illuminating processes, and to apply those principles to practical purposes. The absorbent properties of carbon will be briefly noticed.

Lecture I.—April 13.

Carbon: the different forms in which it is found in nature; its properties as a disinfecting and decolorising agent, &c.

Lecture II.—April 20.

Compounds of carbon and oxygen, carbonic acid, carbonic oxide.

Lecture III.—April 27.

Gaseous compounds of carbon and hydrogen, marsh gas, and olefiant gas.

Lecture IV.—May 4.

Liquid compounds containing carbon and hydrogen, and fuel.

Lecture V.—May 11.

Coal gas, its composition and purification, and its illuminating properties.

Lecture VI.—May 18.

Heat of combustion; how heat is communicated, and how quantity of heat is determined.

Lecture VII.—May 25.

Consideration of furnaces, stoves, lamps, &c., in which the principles stated in the former lectures will be applied.

All the above Meetings and Lectures are open to Members, each of whom has the privilege of introducing two friends.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Mon. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Professor Barff, M.A., "On Carbon and Certain Compounds of Carbon treated principally in reference to Heating and Illuminating Purposes."
Society of Engineers, 6, Westminster-chambers, S.W., 7½ p.m. Mr. George G. Andrews, "The Ventilation of Coal Mines."
Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Discussion on the paper by Mr. R. W. Clutton, "The Self-sown Oak Woods of Sussex," and on that by Mr. D. Watney. "Timber;" and time permitting, a paper by Mr. W. J. Crawley, "The Forests of England."
Royal Geographical, 1, Savile-row, W., 8½ p.m.
Medical, 11, Chandos-street, W., 8 p.m.
Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m.
London Institution, Finsbury-circus, E.C., 4 p.m. Prof. Bentley, "Elementary Botany."

Tues. ... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (African Section.) Mr. Swanzy, "Trade in Western Africa, with and without British Protection."
Royal Institution, Albemarle-street, W., 3 p.m. Professor Rutherford, "On the Nervous System."
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m.
Photographic, 9, Conduit-street, W., 8 p.m.
Anthropological Inst., 4, St. Martin's-place, W.C., 8 p.m. 1. Captain S. P. Oliver, "On non-Historic Stone Relics of the Mediterranean." 2. Mr. H. H. Howorth, "An Ashanti Fetish paper or curse: with description."

Wed....SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. W. Simpson, "On the Symbolism of Oriental Ornament."
London Institution, Finsbury-circus, E.C., 7 p.m.
Meteorological, 25, Great George-street, S.W., 7 p.m.
Geological, Somerset-house, W.C., 8 p.m. 1. Mr. T. F. Jamieson, "On the last Stage of the Glacial Period in North Britain." 2. Mr. J. F. Campbell, "About Polar Glaciation." 3. Dr. Ferdinand Stoliczka, "Note regarding the occurrence of Jade in the Karakash Valley, on the southern borders of Turkestan."
Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.
Royal Colonial Institute, 15, Strand, W.C., 8 p.m. (At the Pall-mall Restaurant, Waterloo-place). Mr. William Walker, "On the Forests of British Guiana, and Communications from Tasmania on the Timber and other Economic Resources of that Colony."

Thur....Royal, Burlington House, W., 8½ p.m.
Antiquaries, Somerset House, W.C., 8½ p.m.
Linnæan, Burlington House, W., 8 p.m. 1. Mr. H. N. Moseley, "On the Botany of H.M.S. *Challenger*." 2. Dr. Hooker, "On the Discovery of *Phylica arborea* in Amsterdam Islands.
Chemical, Burlington House, W., 8 p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Mr. W. Noel Hartley, "On the Atmosphere and its Relations to Life."
Zoological, 11, Hanover-square, W., 4 p.m.
Numismatic, 13. Gate-street, W.C., 7 p.m.
Royal Society Club, Willis's Rooms, St. James's, S.W. 6 p.m.

Fri.......SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Indian Section.) General Sir A. Cotton, "On the Indian Famine, with Especial Reference to the Means which should be Adopted for Preventing or Alleviating Famine."
Royal Institution, Albemarle-street, W., 3 p.m.
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Mr. Spottiswoode, "On the Composition of Colours by Polarised Light."
Philological, University College, W.C., 8 p.m.

[The Editor will be glad to receive notices of papers for insertion in the above list.]

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,117. Vol. XXII.

FRIDAY, APRIL 17, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

MARRIAGE OF H.R.H. THE DUKE OF EDINBURGH.

The following letter has been received by the Secretary, in answer to the Address presented by the Society to his Royal Highness the Duke of Edinburgh, on the occasion of his marriage :—

Clarence-house, St. James's, S.W., March 30th, 1874.

Gentlemen,—I have had the honour to lay before his Royal Highness the Duke of Edinburgh the Address which you have forwarded to him upon the occasion of his marriage, and I am desired to express the sincere thanks of his Royal Highness for the congratulations and good wishes which it contains.

I have the honour to be, Gentlemen,
Your most obedient servant,
W. J. Colville.

The Members of the Society for the Encouragement of Arts, Manufactures, and Commerce.

ECONOMICAL USE OF FUEL.

The Committee met at the Testing Houses, Western-avenue, International Exhibition, South Kensington, on Wednesday, April 1, at 10 o'clock. Present—Major-General F. Eardley-Wilmot, R.A., F.R.S. (in the chair), General Eliot, Dr. Mann, Dr. David S. Price, and the Rev. A. Rigg.

The Committee also met at the Testing Houses on Saturday, the 11th April, at ten o'clock. Present—Major-General F. Eardley-Wilmot, R.A., F.R.S. (in the chair), Mr. F. A. Abel, F.R.S., Dr Mann, Dr. David S. Price, the Rev. A. Rigg, Captain R. Scott, R.N., and Major Webber, R.E. Mr. P. Le Neve Foster and Mr. S. W. Davies attended both meetings.

INTERNATIONAL EXHIBITION OF 1874.

The Council have resolved to offer the Society's Gold and Silver Medals in connection with the International Exhibition of 1874.

A gold and a silver medal is offered in each class, and these medals will be given for any object exhibited which, in the opinion of the Council, shows paramount or very great excellence, whether in respect of the final result, the machinery, method of production, or novelty.

PROCEEDINGS OF THE SOCIETY.

DEPUTATION TO MR. SCLATER-BOOTH.

On Tuesday afternoon a deputation from the Council waited upon Mr. Sclater-Booth, M.P., President to the Local Government Board, with reference to an improved water supply for the metropolis, as a means for preventing the spread of fires, and other purposes. The following gentlemen constituted the deputation:—Colonel Marcus Beresford, M.P., Major-General F. Eardley-Wilmot, R.A., Mr. P. McLagan, M.P., Mr. W. Gordon, M.P., Captain Ritchie, M.P., Mr. E. Chadwick, C.B., Lord Alfred Churchill, Mr. Seymour Teulon, Mr. Robert Allen, Mr. Augustus Beddall, Mr. Robert Cox, Mr. Frank Baker, Dr. Jones, Mr. G. F. Judge, Mr. William Shears, Mr. Charles Waghorn, Mr. H. Blandford Sandall; with Mr. P. Le Neve Foster, Secretary.

Col. Beresford, M.P., in introducing the deputation, said his attention had been specially drawn to the fire and water question by two very important circumstances in his own borough, one in the year 1861, when not an ordinary fire, but a combination of fires of an enormous character took place, and several wharves and a large amount of water-side property were destroyed, while the low tide rendered the supply from the river impracticable for working the engines. Being an occupier of a considerable amount of water-side property, he examined into the street supply of water, which he found to consist of the most inadequate mains, two or three inches in diameter. He therefore, in conjunction with a few neighbours, laid down separate pipes and erected hydrants, which had since been found of the greatest possible advantage. Again in 1872, what was known as the water famine occurred in Bermondsey, as would no doubt be in the remembrance of Mr. Booth. A large portion of this enormous parish was literally without water, many of the people using the water for washing purposes two or three times over in the course of a day, from the extreme scarcity. At the former period he had not the honour of being a member of Parliament, but he subsequently took steps to bring the matter before the House, and in the first week of last session of Parliament he gave notice for a select committee on the subject, which was appointed for that day month, and during the interval he occupied himself in looking up the proceedings which had taken place. He thereupon found that no less than seven committees of the House of Commons and five of the House of Lords had been appointed, and three reports had been made by the Board of Trade. They all tended to one result, namely, the necessity for a constant supply. Unfortunately all this inquiry had hitherto resulted in nothing practicable. At the time of the water famine in Bermondsey, a great many statements and conjectures were put forth in the newspapers, showing how utterly at sea were the various authorities as to the question of the expense of affording a constant supply. In one paper he saw an estimate that no less than eight millions would be required for this purpose; besides that, all engineers seemed to be in utter confusion, and no one seemed to agree upon it. In this state of circumstances the Society of Arts appointed a committee to go into this question, and to investigate the requirements of the metropolis, both as to fire prevention and water supply. That committee had prepared a report, after going thoroughly into the question, and

some members of it would explain the advantage which would arise from the whole of the metropolis being placed under one management in the matter of water supply.

Major-General F. Eardley-Wilmot, R.A., said the committee referred to by Colonel Beresford had been at work for some time collecting information from all parts of the kingdom, and had also availed themselves of all the Parliamentary papers which had been printed, and they had agreed to a report, which he begged to hand in. He would not stay to read the whole of that, but simply the practical conclusions* appended to it. After reading these, Major-General Wilmot went on to say that it would be observed that the Society of Arts did not assume to give an opinion as to the details, but submitted the matter in its broad aspect to the department, hoping it would take the matter up. The four points arrived at might be shortly stated thus: first, a constant supply at high pressure; second, hydrants at frequent intervals; third, a consolidation of the eight Metropolitan Companies; fourth, the appointment of a Special Commission to carry out the work. They had just received a letter from Mr. Berry, the manager of the Manchester Water Works, which was so important that he would beg leave to read it.

"I think the supply of water to London for all purposes demands the serious attention of all the inhabitants of the metropolis. The fact that three and a-half millions of people have an intermittent supply of water of often only an hour or less per day, while so many large towns—such as Manchester, Glasgow, and others—have a constant supply at high pressure and upon very reasonable terms, with the imperative necessity of an instant supply in cases of fire, should cause the prompt action of the public to remedy this disgraceful state of things with you, or some frightful calamity to life and property will certainly be the result. I should think there is not another place in the United Kingdom besides London, where the old wooden fire-plug in the mains is in existence, and where such unnecessary delay takes place in obtaining water when fires occur.

"It seems to me the height of absurdity that the engines should have had to wait half an hour for water in the mains, as described in the London papers, at the commencement of the fire at the Pantechnicon; if such had not been the case, the fire might have been immediately extinguished. The plan suggested, of placing stand pipes with hoses at limited distances under the charge of the police, is in my opinion admirable, and would tend to prevent numbers of fires extending from small to large proportions.

"If the same system were introduced as in Manchester—where fire engines are rarely used—an immediate supply of water could be obtained before an engine could possibly arrive; and if your plan as mentioned in the former part of this communication were introduced, as to the placing of stand pipes with hose ready for use, two-thirds of the fires could be at once extinguished before they assumed serious proportions; but whatever is done, unless the water is constantly on in the mains, all plans are useless, and this great necessity must be insisted upon, or a calamity will some day arise, the proportions of which are fearful to contemplate."

Mr. McLagan, M.P., said he had probably been asked to take part in the proceedings from having been a member of the Fire Protection Committee of the House of Commons in 1867, which committee was appointed for the purpose of investigating into the existing means for preventing injury to life and property by fire. One important recommendation which was made in that report was, that there was a persistent evasion of the Water Clauses Act in Bills introduced into Parliament, one of which was that as far as practicable the water supply should be constant and at high pressure. But it appeared that many Bills were introduced into Parliament, and unless they were challenged by some individual they were allowed to pass without that clause being carried out. One part of the investigation which was then made bore particularly on the subject of to-day, namely, the number of fires which took place in the metropolis, the causes of which were unknown. On investigating into those the causes of which were known, it was found that about four-fifths took place on property which was insured, leading the committee to the conclusion that many of them arose from incendiarism. They were further of opinion that there was great encouragement given to this crime from the causes of so many fires not being discovered; and that if such a scheme could be carried out as was now recommended, the unity of action of all the water companies and a constant high pressure, so that whenever a fire took place the water would be immediately available, and the fire could be soon got under, those who wished to set their houses on fire in order to cheat insurance companies would find their malpractices would be discovered, and this would tend vastly to decrease the number of fires which took place, because wherever there were any suspicious circumstances the criminal would be discovered and punished. This was a matter of great importance, because he remembered Captain Shaw giving distinct evidence, that if there were sufficient means of putting out fires at the commencement, not nearly such a large quantity of water would be required, and small fires would not grow into large conflagrations. He had not been able to attend the meetings of the committee of the Society of Arts, but he thoroughly concurred in their report and the conclusion to which they had arrived.

* These will be found in the last number of the *Journal.*

Mr. Edwin Chadwick, C.B., said his attention had been first called to this question more than a quarter of a century ago as a member of the General Board of Health, which body was charged at the time with an examination of the water supply of the metropolis. As one result of their investigations they urged the necessity of a constant supply. It was not necessary to inquire why that recommendation had not been carried out in London, but it had been adopted in all the great centres of population, in Manchester, Liverpool, Glasgow, and others, so that it was no longer a matter of hypothesis. But this question of the constant supply of water was then, with regard to the prevention of fire, inquired into as an incident to the main question referred to them, viz., the application of a constant supply for domestic purposes, in order to insure cleanliness and health. On the present occasion the Society of Arts Committee had gone still more completely and specially into the application of this constant system to the prevention of fires than had been done before, and they had arrived at some real advance in the science of the question. For instance, it was now established, which had not been done before, that waste of water was a lowering of force. In London, under the intermittent supply, the average was 33 gallons per head per diem; but in Manchester, though the supply was about one-third less, they really got one-third more force for all purposes, thus showing that stopping the waste continually going on increased the power. On the whole, then, the adoption of the constant system of supply would in the metropolis give an enormous addition to the force, proportionately of course dispensing with the necessity for engines, which were required on account of the pressure being insufficient. On one point the statements of the committee had been challenged, viz., the saving obtainable by the constant supply. At the time he referred to, the saving was ascertained by determining the waste, gauging the sewers on those days when the intermittent supply was on, and again gauging them in dry weather when it was off, when it was quite clear that the waste approached to one-half. Now some good authorities, such as Mr. Quick, who understood the subject in the metropolis as well as any one, reckoned the waste to be certainly above one-third, and Mr. R. Rawlinson, C.B., an officer of the Board, also made the same estimate. His belief, therefore, was that if the statements put forth in the report were re-examined and thoroughly gone into, they would be found to be rather understated than the reverse. By the constant system, therefore, there would be an enormous saving in water, but there would also be a great saving in other ways, for instance, in the administration. In the records of the department he believed would be found statements showing the amounts derivable by consolidation, and they were assured by Mr. Quick, and the other officers of the companies, that the proportion of separate and unnecessary expenditure had been increasing since the time those estimates were made. They therefore believed

they were fully authorised in assuming that £100,000 could be saved in that way.

Mr. Sclater-Booth asked if that figure had been made on the basis of the report of the General Board of Health.

Mr. Chadwick said it was at that time derived in point of fact from the chairman of two companies, and it had been independently verified. The statements of Mr. Quick and the other gentleman tended to show that the proportion of waste from separate management had been augmented rather than diminished since that time. The items of expenditure had been varied; on some they had been reduced, on others it was stated they had augmented. He remembered very well that one item of saving by the consolidation in the collection of the rates was put at something like £15,000 a year, and there were a great many minor expenses to which the companies were put which would not be necessary under a public authority. Another point was, as had been stated in some of the papers, that the public could prevent waste when companies could not. Individuals who paid their water rates refused to allow the officers of the company to go over the premises, saying that they paid for the water and would use as much as they liked; but in other places where changes had been effected, as at Manchester, and particularly at Liverpool, great economy had been effected, an officer in uniform going round from house to house and inspecting the fittings. One plan he had formerly proposed to facilitate that was, that there should be a reduction, perhaps to the extent of one-fourth, in the water-rate of all those who showed that their fittings were in the best order, and that there was no waste. However, this was no longer hypothetical, because a great saving had been accomplished in the places he had referred to by the public authority, a saving which could not be accomplished under private companies. There was also one point of importance with reference to the compensation to be given to existing interests. They had had an opportunity of speaking with two companies, who admitted that the terms proposed were fair and equitable and they would make no opposition to them, namely, security for existing dividends. They had not communicated with other companies, not from seeing reason to believe that they would be of a different opinion, but simply because it did not seem to them, having settled, as they considered, the engineering and mechanical points, to be necessary to go into that detail with the separate committees. They hoped, however, that the Local Government Board would take steps to investigate this matter by means of its own officers, and it was believed there would be a considerable willingness to approach this question fairly, and not to interpose any such opposition as had been previously formed. He believed the opposition to the first measure arose from there being no provision inserted in the Bill for paying compensation to office bearers, leading them to believe that the economy spoken of was to be obtained by the abolition of their offices without making them any compensation. On this occasion, however, that difficulty would be entirely obviated. He might be allowed to mention one point for the information of gentlemen present representing different parishes, that one advantage of putting this system on a public footing would be, that there would be an additional supply of water for public purposes at a much cheaper rate. These matters were at present constant subjects of disputation with the companies, which only dealt with them on a trade footing, but when the matter was put under a public authority, the cost of the service only would have to be borne. Some parishes paid at a rate of 6d. a thousand gallons, and others at the rate of 1s. for watering the streets, but under the system proposed, the cost of the service would not be more than 2d. a thousand, and thus the parishes would gain largely. On the whole it might be stated that under the measures now proposed the hydrants might all be provided, and the houses of the poorer classes might be put into a condition to receive a constant supply, without any additional expense, simply out of the economies effected by the unity of management. In private houses also there would be a great deal of economy by removing the necessity for maintaining expensive cisterns; and what, as a sanitarian, he considered even more important than the saving of expense, the abolition of cisterns would do away with a great source of impurity which now existed from cisterns being often placed over cesspools or drains, thus becoming a great source of danger to health. In conclusion, he urged that the cost of delaying this matter had hitherto been a great number of houses burnt every year, and a waste of money to the amount of something like a quarter of a million. The difficulties which stood in the way of the previous Government taking up this question had now been largely cleared away, and he hoped the subject would now be approached practically, and a comprehensive measure passed. The cost of delay was two-thirds the average loss of life, two-thirds the present destruction of property, great waste, and impending devastation. The measure was therefore of great urgency.

Mr. Seymour Teulon begged leave to add one or two facts from his own experience, to show the defects of the present water supply. For some dozen years he had been one of the directors of the South Eastern Railway, at a time when they had only one terminus, that at London-bridge. The supply of water from the Southwark Water Works was of only such a low pressure that they were obliged to build large cisterns under the arches of the railway, and to employ steam engines for raising the water to the level of the rails. The same thing occurred at the terminus of the Brighton railway, and in other large establishments in and about London. Again, with regard to the Charing-cross Hotel, last year; they consumed 4,657,000 gallons of water, but in order to obtain a sufficient supply for the building, they had to employ two steam engines, and to form large tanks at the top of the edifice; for although they were supplied by the New River Company, which had the highest and best supply of any, they could not give them anything but a low pressure supply, except at such an enormous cost that they found it more economical to put up their own steam engines. He mentioned these three instances out of a large number which must occur in London, to show the necessity for a change, especially now that the erection of high buildings was becoming more common. It was of the greatest importance to have a constant supply of water always at hand, and on this point he might mention that the South Eastern Company had hydrants placed on their premises, and shortly afterwards a fire occurred at the terminus, when although the engine station was only in the street below close to it, the fire was put out before the engines arrived.

Mr. Edwin Chadwick said it had been clearly shown that there would be a saving of at least twenty minutes in the supply of water if hydrants were erected in the streets.

Dr. Jones said the advantages arising from a constant supply of water were so obvious, that it was really wonderful it had not been adopted before in a City of such wealth and magnitude as the metropolis. In his own case, immediately on going into his house he went to the water works and had a supply from the main, which had been most advantageous in his own neighbourhood in immediately putting out small fires. In other cases also he had noticed how readily fires were put out when a large number of persons were on the spot and had facilities for getting water, and he could therefore easily imagine where the houses were of greater size, and where the water was not easily accessible, a conflagration of serious magnitude would occur. So impressed was he with the importance of this, that in the various bodies

with whom he was connected—for instance, the Central London District School—they had hydrants erected on each floor, and a continuous supply of water and engines constantly going for many hours each day. Again, at the Newington Infirmary they had hydrants on every floor, and in order to obtain a constant supply of water they had sunk an artesian well, and kept engines constantly in operation. With regard to sanitary questions, there could be no doubt that the present storage of water was very adverse to health, as must be evident to any one who noticed the want of care evinced with regard to many of the cisterns, which remained uncovered except with a film of filth; and the *debris* at the bottom of them was very often something considerable. There could be no doubt, therefore, that a constant supply would have the most beneficial results. In fact, in many neighbourhoods he could mention, the discomfort and misery arising from the want of water had been something hardly creditable; indeed, so glaring was this, that in many of these localities the water companies had recognised the necessity of making a change, and had removed the water-butts and put on a hydrant supply, and wherever this was the case, a more healthy and more moral population resulted. He spoke especially of the districts in the neighbourhood of the Westminster-road, the Waterloo-road, and Gravel-lane.

Mr. Sclater-Booth said that no allusion had been made to the Act passed in 1871, which laid down regulations under which a constant supply should be furnished. Was it the opinion of the committee that no good had been accomplished by that Act?

Colonel Beresford said his own opinion in the borough of Southwark had been that the Act was quite inoperative. The forms necessary to be gone through in order to get the slightest attention paid to it were so cumbrous, that people had given it up in despair.

Mr. R. Rawlinson, C.B., engineer to the Local Government Board, said he had in his hand the return made to the department monthly by Major Bolton, the water examiner, which gave month by month the additions made to the constant service. This showed that in the east of London there was the greatest extent of mains on constant service. With regard to the fire service, that Act provided that hydrants or plugs might be put on, and the company might do certain things if certain conditions had been fulfilled, but the end of it was that the fire plugs or hydrants if required, must be furnished by the Metropolitan Board of Works, in other words, the ratepayers. Thus the ratepayers were bound to find the fire appliances that were to be put on the company's service; but how a private individual could meddle with the pipes of the company he could not understand. In Liverpool and Manchester, and in every other town, he knew the fire services were the property of the persons owning the water supply.

Mr. Sclater-Booth, in replying, said—Gentlemen, I have listened with great attention to the observations which have been made, which come, I need hardly say, with very great authority, and I have also had, through the kindness of Mr. Foster, the opportunity of reading, before you came, the report settled by the committee of the Society of Arts. I have also had some previous knowledge of this subject, having served on one of the numerous committees to which my friend Colonel Beresford has alluded. I think, perhaps, justice has hardly been done to the intentions of the Legislature in passing the Act of 1871, because certainly it was intended that that Act should make some advance in the direction which you, and every reasonable man, must have in view, namely, to provide a constant supply of water for the metropolis, in order, first, that the poorer classes may be provided with so great a necessary of life; secondly, to make better provision for the extinction of fires, and thirdly, to get rid of what is undoubtedly a great source of nuisance, badly kept and badly cleaned cisterns in the dwellings of all, and especially of the poorer classes. These are three objects as to which there can be no two opinions. I entirely agree in their importance, and I shall be very glad if it is in my power to further your views in the matter. But then when you come to suggest that the eight water companies of the metropolis should be dealt with in a comprehensive way, there are of course very great difficulties. It is a very large question, and even if my own mind were made up as to its feasibility and desirability, I could not undertake to commit the Government to such an enterprise without consultation with them upon it. But all the observations that you have been good enough to lay before me shall be submitted in the proper quarter, and they shall have consideration. My own experience as a member of Parliament, now of some years' standing, leads me somewhat to deprecate schemes which are of a comprehensive character. I should have thought that a portion of these companies might be dealt with more easily than the whole of them, but that is only an opinion I have formed at the moment, and I may come to a different conclusion. Mr. Chadwick has alluded to a report which has led to an estimated saving of £100,000 a year by substituting one management for the eight companies now existing; but if that estimate is the same as that which was framed by the General Board of Health some years ago, I may point out that there would be great difficulty in relying upon that estimate, because a very large portion of the saving estimated to be effected at that time was based upon the supposition that the whole of the water from the Thames might be taken in at Eel-pie Island, Twickenham, instead of at the various sources above the locks, which are now made use of for the purpose. We must all feel that in these days it would be quite impossible to propose taking the water from the Thames below Teddington-lock. I mention that to show that the matter had received some consideration here. An estimate, again, has been made of the saving of from £15,000 to £20,000 in the cost of collection. That has a very plausible appearance, but I doubt very much whether so large a sum as is represented by that amount can be collected by any authority, even a Governmental one, without costing a considerable sum. Therefore, I think the collection of rates must cost a considerable sum, although perhaps not quite so much as they do now. Of course, I am not in a position to enter into details on this matter, for I cannot be expected to inform myself sufficiently on the subject. I can only say I recognise the great importance of it, and shall be extremely glad, if it lies in my power, to make any advance in the direction which we all wish for.

Colonel Beresford having thanked Mr. Sclater-Booth for his courtesy, the deputation withdrew.

CHEMICAL SECTION.

A meeting of this Section was held on **Friday, April 10th**, Dr. J. H. Gladstone, F.R.S., in the chair. The paper read was—

ON SOME RECENT PROCESSES FOR THE MANUFACTURE OF SODA.

By C. W. Vincent, F.C.S.

The object of this paper is the comparison of the principles involved upon which Le Blanc's, our present mode, of soda making is founded, with those of the more important processes designed to supplant it; and in addition, to point out to chemists and inventors generally, by the example of this industry, that scientific correctness alone is insufficient to secure success.

The failure of only too many chemical processes arises from the want of technical skill on the part of their devisers, and also frequently from the abundance of technical skill bestowed on the operations they are desired to supersede. This is emphatically the case with those processes which have been designed with the view of replacing our present mode of soda making.

There are some few remarkably brilliant exceptions, but as a rule the chemist misses his mark when he goes beyond the principles of a process, and endeavours to plan the apparatus and plant by which it is to be carried out on a large scale. Mechanical facts and economic facts are just as true as chemical facts; where the three fit together the structure is firm and strong; if they do not fit—and in the hands of unskilful builders this is always the case—the result is merely a jumble of materials which the first shake reduces to ruins.

The labours of the technologist are apt to be overlooked, though not in this Society, which has ever done honour to those who successfully perform, as well as to those who successfully plan.

A scientific principle is of immense value. To use the language of Dr. Tyndall, "The man who has thoroughly mastered a scientific principle holds a key which opens many locks." And here we must distinguish between that which is a true scientific principle and that which is mere theory. A theory rests upon isolated and scattered facts; remove one, the theory falls to the ground. But a scientific principle is founded on a mass of facts tending to one common centre; the observer may stand with security on the summit of such a pyramid, and rejoice and profit by the more extended view he obtains. But who collects the facts? The experimenter. The mighty intellect grasps and arranges, but the skilful hands execute science. So also in the arts; science, whether chemical or physical, while never losing sight of details, merely uses them as so many means to an end, views them as the many leaves of a tree, important as a whole to its life and well-being, and distinctive of its species, but individually of little worth. Technology, on the other hand, spends its entire energies on perfecting details; not a leaf of the tree must be neglected, but each must be tended and cherished so that the tree may be the best of its kind.

The importance of a technical education is now being estimated at something more nearly approaching its true value, and much of this is undoubtedly due to the action of the Society of Arts, which, amidst the many outcries as to what should and what should not be the course pursued, has laid down a simple system that cannot fail to be successful, because it is true to the end to be accomplished. The examinations are threefold. 1st.—In those branches of science, a knowledge of which is requisite as a foundation for technical instruction. 2nd.—The technology of the manufacture in question, *i.e.*, the special application of the various branches of science to it. (We are too apt to call ourselves technical chemists because we know the look of the apparatus used in a factory and know the chemical theory of the process, but we ought also to know the physics of the process, and the mechanics of the plant). 3rd.—Practical skill in the manufacture itself.

Technical education to be valuable must cover a wide range of subjects. No trade contains within itself the means of development and extension; as soon as a need is felt—and appreciation of the need is the mark of the inventor—he must seek outside the trade itself, in other arts and amongst other principles of science than those already involved, for the means of supplying that need. Those trades stand still which do not take advantage of such things in other trades which have a bearing on their own business.

The technologist should have a knowledge of every practical art. This is of course impossible; but that which is possible, that which should be put within the reach of every one, is a complete knowledge of the fundamental laws of mechanics, physics, and chemistry, as a foundation upon which to build all the special knowledge bearing upon the special pursuit to be pursued.

The prosperity of the iron trade is due to technology, as distinguished from chemistry.

The immense advances that have been made in smelting iron in the blast furnace may be taken as entirely due to the improvements in the appliances used. Dr. Schweinfurth writes that savages in the heart of Africa make iron equal in quality to our best forged iron, the difference being that they make by pounds while we make by tons. But are our workmen much better instructed as to the principles of the process? It is only of late years that our iron masters have penetrated into the arcana. The late researches of J. Lowthian Bell and C. R. A. Wright show how very far from accurate was the explanation of what took place within those igneous mountains.

The alkali trade owes its existence to the chemist, and its continued prosperity to his continuous oversight of the processes involved. The utilisation of the waste products which began with the conversion of the hydrochloric acid into bleaching powder, and has continued, step by step, until even the peroxide of iron in the burnt ore is rendered a valuable product, is entirely due to the close attention which has been paid by chemists to every reaction taking place amongst the constituents of the new material. Hence the great esteem, the high honour bestowed on chemistry in the alkali trade. But this is only part of the truth as regards the success of this vast industry. Had not the chemistry been aided at each step of each process by technology, the vast progress made would have been impossible.

The chemical interchange which takes place when coal, lime, and sulphate of soda are roasted together, was recognised by Le Blanc, and worked out by him on what was considered a commercial basis; but so inefficiently were the mechanical and physical wants of the reaction supplied, that for a time the process was laid aside, its inventor subsisted on the charity of the English (to him a foreign) Government, and eventually died in a hospital.

Chemically, the process was entirely successful, the demand for soda was very great, and the price high; but the chemist was then unaided by the technologist.

Little more than half a century ago the manufacture of soap and glass, the fictile arts, as well as those of bleaching and dyeing, the production of paper, were dependent upon the soda derived from

soda-yielding plants, such as barilla and kelp, for their successful prosecution.

The kelp from Scotland alone was estimated at more than 15,000 tons annually; and even as late as 1834, barilla to the amount of 12,000 tons was imported annually from Spain.

The price of kelp containing an average of 3 per cent. of alkali was, at the close of the last century, £11 per ton. This price would render a ton of soda ash worth £180—evidently a very large premium for the introduction of a new process.

The present price of soda averages £8 per ton, and economy in manufacture has been so studied in every branch of the process, that the premium for a new method is so small as to constitute one of the greatest difficulties that those reactions proposed to supplant our present mode of soda making have to contend with.

The only method employed, as late as a hundred years ago, in bleaching the British-made linens and calicoes, &c., after boiling them in leys from kelp, was to saturate them with sour milk, and expose them for long periods to the action of the air; but, on account of the uncertainty of the climate, it was necessary that the best cloths should be sent to Holland, and, after a summer's absence, they were returned for use in England.

Writing paper was made from the whitest rags, and the cost of the alkalies was as great as that of bleaching.

Both at home and abroad the demand was so great that there was an absolute necessity of obtaining artificial soda. France being then at war with almost every other Continental nation, all her external supplies of potash, soda, and nitre were cut off. Under these circumstances, in 1792, an inquiry was instituted by the Government as to the best method of manufacturing soda from common salt.

The idea was not a new one. Nearly all great discoveries have to be shared amongst many investigations; the greatest honour being given to that man who from the first crude imaginings and imperfect workings, elaborates a really practical plan.

From a very early period it was found that common salt, sodium chloride, Na Cl., was too stable a compound to be directly attacked by carbonic acid. Sodium chloride was, however, easily converted into sodium sulphate by sulphuric acid; and the sulphate being a more manageable body was, so early as 1777, looked upon as a possible source of soda carbonate by Malherbe.

In 1781 Mr. Brian Higgins decomposed common salt with oil of vitriol, roasted the dry sulphate with one-eighth of its weight of coal in a reverberatory furnace, until the sulphate was reduced to sodium sulphide. Iron, lead, or other metallic oxides were then introduced, and caustic soda was obtained. It may here be remarked that patents for this process have been repeatedly taken out within the last few years.

The employment of metals or metallic oxides presented so many difficulties that no great commercial success was possible. It was at this crisis that Le Blanc, by substituting lime calcic oxide for the other metallic oxides, converted Malherbe's and Higgins's process from what was little more than a chemical curiosity into what has since become a great industry.

It was about this time that vitriol began to be manufactured on a large scale. Sulphuric acid had hitherto been made by distillation from copperas, iron sulphate. Chemistry devised a reaction by which sulphurous acid from burning sulphur should be oxidised to sulphuric acid by nitrous fumes.

Mixed sulphur and nitrate of potash suspended on an iron tray, in large wide-mouthed glass globes, partly filled with water, were set fire to by a red hot iron, and the mouth was then closed. As soon as the charge was burnt out, another took its place, till the acid was found to be sufficiently strong, when it was removed into a glass retort, and concentrated much in the same manner as at present. This acid was sold for 2s. per pound, and was in much demand, on account of its purity, for several years.

This is all that chemistry has done for vitriol making, with the exception of substituting pyrites for sulphur.

The technologist has to be credited with the next steps, which were, the substitution of leaden chambers for the glass globes, burning the sulphur and the nitrate of potash outside the chambers, and sending in steam, instead of depending on the layer of water.

These changes apparently involve little genius or inventive skill, but without them the present eminence of vitriol making, and through it of the alkali trade, as a commercial industry, could never have been attained.

As already stated, sulphate of soda is formed by the action of sulphuric acid upon common salt, but this does not express the whole reaction. The first product contains much acid sulphate, and part of the salt escapes being acted on. This was probably one of the great rebuffs Le Blanc had to encounter. The reaction is—

$$2\,NaCl + H_2SO_4 = NaCl + NaHSO_4 + HCl.$$

In order to completely convert the salt into neutral sulphate it has to be heated strongly, when—

$$NaCl + NaHSO_4 = Na_2SO_4 + HCl.$$

And the second equivalent of hydrochloric acid is set at liberty.

The apparatus for making salt cake has been very troublesome to adjust. At first a reverberatory furnace was used for the whole process. Then a division was made, each decomposition being made separately, that in the wet way in a lead-lined pan, the products being afterwards transferred to a brick bed for roasting. Lastly, a concave iron pan was substituted for the leaden one, with great diminution of expense, enabling stronger acid to be used, and preventing the formation of so much bisulphate of soda.

These furnaces are usually set in pairs. The flues pass over and under the salt-cake pans and beds, but not through them.

When a demand arose for bleaching powder, the hydrochloric acid, which up to that time had been allowed to escape into the air, became valuable, and had to be condensed. The chemist supplied the means with which he was most conversant, a series of Woulfe's bottles on a large scale. A technologist, however, was at hand, one who was not only a thorough chemist in the fullest sense of tho word, but also a mechanician and a physicist. I mean Mr. William Gossage, of

Widnes, of whom it may most truly be said, as regards the alkali manufacture :—

"Nihil erat quod non tetigit; nihil quod tetigit non ornavit."

Mr. Gossage, with that keen insight which eminently characterises him, saw at once, that which it has taken many subsequent years to impress upon the scientific world at large, that the individual molecules of gases act independently of each other, and that if attacked in mass, only those on the outside are affected. He therefore conducted the hydrochloric acid from the salt cake pots to the base of towers filled with coke, from the top of which a stream of water was allowed to trickle slowly. The gas and water meeting, each in a fine state of division, complete condensation takes place, the independent molecules of water and of gas come into close contact, and in consequence, a stronger acid is obtained than would otherwise be possible on so large a scale of working.

If the towers are of sufficient height, two only are requisite to effect the complete condensation of the acid, but three or more are connected together if necessary.

Having obtained the sulphate of soda, technically known as salt cake, the next and most important process is entered upon—its conversion into carbonate. The sulphate is crushed into small fragments, mixed with its own weight of limestone or chalk, and half its weight in small coal. We have here—

Sulphate of Soda.	Chalk	Coal.
$Na_2 SO_4$	$Ca CO_3$	C

which are fused together. This reaction has been variously represented by chemists. According to Dumas—

$$Na_2 SO_4 + Ca Co_3 = Na_2 CO_3 + Ca SO_4$$

The sulphate of lime in contact with incandescent carbon, yields its oxygen and carbonic oxide is evolved, leaving proto-sulphide of calcium in admixture with the carbonate of soda.

Other chemists look upon the reaction as proceeding by two successive stages—the reduction of sulphate of sodium by carbon to sulphide of sodium, which is afterwards carbonated at the expense of the limestone.

In my opinion Mr. Gossage's view, communicated to the British Association in 1861, is most in accordance with the facts, and certainly represents most accurately the resulting compound. His equation is—

$$2\, Na_2 SO_4 + 3\, Ca CO_3 + 9\, C = (2\, Na_2 CO_3 + 2\, Ca S + 1\, Ca O) + 10\, CO \text{ evolved.}$$

The compound substance within the brackets is known as black ash.

The furnace employed is of the ordinary reverberatory type. The charge is introduced at the end furthest from the fire; when hot throughout it is removed to the fluxing bed, a fresh charge being at the same time introduced. As soon as the mixture becomes soft, and forms clots, it is turned over with an iron oar, until the whole has the consistence of dough. Jets of inflamed sulphuretted hydrogen and carbonic oxide then begin to issue from the mass, a sign that the reaction is complete, upon which the charge is withdrawn from the furnace into iron barrows, each barrowfull constituting a "black ash ball."

Recent researches have abundantly confirmed the old maxim of black ash men, that the more porous the black ash, the more easy the extraction of the soda. It is therefore bad working to let the fluxing process go far enough to produce a close heavy black ash. Black ash, of course, contains many accidental impurities, but the greater part of the mass consists of carbonate of soda, sulphide of calcium and lime.

Sulphide of calcium is insoluble in water, lixiviation is therefore easy, but to secure the whole of the alkali is by no means easy, and the services of the technologist have been exceedingly valuable to the soda maker in this stage of the process. It is essential to dissolve the whole of the alkali, and yet to use as little water as possible, in order to save fuel in after concentration of the liquor. This could not be done by one washing, however long the water remained in contact with the black ash.

The apparatus at present in use consists of a series of vats with perforated false bottoms, upon which the roughly broken black ash is laid; a pipe runs upwards from the lower space of the vat which leads into the upper part of the next vat. This is in a like manner fitted with a communication between its false bottom and the upper part of the succeeding vat, and so on. When in regular use, the vats contain black ash at various stages of lixiviation diffused in their corresponding liquors, one being filled with fresh black ash, the furthest off in the series containing residuum, all but deprived of its soluble matter. A supply of warm water is run upon the nearly spent vat; this, after permeating the residuum, and becoming impregnated with alkali, rises through the pipe from the false bottom, and flows into the upper part of the second vat, through which it passes, takes up more alkali, and goes to the third, and so into the fourth, where it meets the fresh balls. When the black ash in the first vat is exhausted, it is shut off from the series, emptied, filled with fresh balls, and becomes the fourth of the series.

The liquor from the black ash vats is run into tanks and concentrated by the waste heat from the black ash furnaces; the crystals as they are deposited are fished out, and roasted in a reverberatory furnace, termed the finishing furnace. The product of this furnace is commercial soda ash, of 52 to 54 per cent. Soda crystals of commerce are formed by the solution and crystallisation of soda ash. Bicarbonate of soda is made by treating the crystals with carbonic acid.

So well have technologists exercised their skill that for seventy years has Le Blanc's process been worked, and, though attacked on all hands, has nevertheless survived all its opponents, and appears likely to be able to fight its battle against any yet remaining in the field.

I use this phrase advisedly, for it is a sober fact that, with the exception of a few processes dealing with materials too expensive for commercial use, none of the so-called new processes but are founded on old and well-known reactions.

Considering the threefold reaction involved in Le Blanc's process, the question however arose, Cannot the chlorine in salt be replaced by carbonic acid or oxygen in some more direct way?

The use of litharge and zinc oxide were proposed by Scheele. He found that by triturating either of these substances with salt and water, the salt was decomposed and caustic soda formed. This process

fails chemically, so that we do not need to take technology to task for not having done more with it. From time to time modifications of the reaction have been devised, but always with the same result, viz., that 90 per cent. of the soda in the common salt remains unconverted.

The mutual decomposition of carbonate of potash and common salt, was at one time made use of for the production of carbonate of soda and chloride of potassium. Here was an interchange of values, and when the potassic chloride fell in price, through abundant and cheaper sources of supply being discovered, the process came to a natural death.

There is one direct process which, however, technology may one day bring to the front, a reaction first discovered by Sheridan, and afterwards improved upon by Swinburne. When steam and common salt are brought together, at a very high temperature, the oxygen of the water combines with the sodium, producing caustic soda, and hydrochloric acid is set free. The process is long, and there is much difficulty experienced from the corrosive action of soda upon the retorts at the high temperature required. This difficulty was to some extent overcome by Powers and Dale, by mixing the salt with scrap iron and passing over it superheated steam whilst heated to redness; but better and more efficient apparatus is required before this process can compete commercially with Le Blanc's method.

Blanc, Bazille, and Tilghman have endeavoured to overcome the action of soda upon the apparatus by presenting to it at the moment of decomposition a body capable of combining with it. Blanc and Bazille use silica for this purpose. A mixture of salt and sand is heated to redness in an iron cylinder; steam is then passed over it, the temperature being kept up, the hydrochloric acid being conveyed away as fast as it is formed. When the process is complete, neutral silicate of soda remains, which is mixed with two-thirds of its weight of carbonate of soda, and heated to redness in a furnace. The resulting mass is dissolved in hot water. Carbonic acid is next passed into the liquor, when a gelatinous precipitate of silicate acid is thrown down, and carbonate of soda remains in solution.

Another process, the successful working of which depends entirely on the ingenuity and skill with which the plant is constructed, is that patented by Dyer and Hemming as long ago as 1838. When commercial carbonate of ammonia, which is really a mixture of carbonate and bicarbonate, is added in a state of fine powder to a solution of about the same weight of salt in three parts of water, the mixture being well stirred, in a few hours a white crystalline precipitate of bicarbonate is formed, chloride of ammonium remaining in solution. The solid bicarbonate is collected and separated from the mother liquor by squeezing it in a press, whilst the chloride of ammonium is reconverted into bicarbonate by evaporating it to dryness, and treating as in the ordinary mode of preparing carbonate of ammonia.

The difference in value of soda as carbonate and bicarbonate is very great; the carbonate containing about 52 per cent. of soda and the bicarbonate about 38 per cent., are of about the same value.

The chemistry of this process leaves little to be desired. The reaction is perfect and complete, and the whole of the salt is converted into bicarbonate.

The point on which, according to Dr. Hill, the chief interest should centre is, whether the bicarbonate can be obtained sufficiently free from alkaline chlorides to render it capable, by the removal of these hygroscopic substances, to enter the market as bicarbonate.

The grand stumbling-block which, in spite of the many fascinations attaching to this plan of decomposing salt, has hitherto prevented its achieving success, is the great difficulty of avoiding the loss of ammonia during the process, and of recovering it completely from the chloride of ammonium to renew the reaction. This is wholly and solely a question of apparatus. The patents for supposed perfection in the arrangement of modes of working have been very numerous, but as yet none have stood the test of continuous competition with Le Blanc's process. The difficulties should not be insuperable, but require to be viewed from the three points of view of the chemist, the engineer, and the mechanician. Individually each has been unsuccessful, but by combined action they would probably render this mode of carbonating salt one of our great industries.

The latest patent is one taken out by Mr. James Young (so well known for his connection with the manufacture of paraffin). As well for the chemical skill as for the ingenuity displayed in the arrangements for working, this patent has enlisted strong sympathies in its favour.

Of the plans which have been proposed for obtaining soda by the decomposition of salt by oxalic acid, boracic acid, and phosphoric acid, it is unnecessary to speak, the reagents employed being far too costly to sustain the losses they must necessarily undergo in carrying out a manufacture on a large scale.

Sulphate of soda is but very slightly acted on by lime. Dr. Hill, who has recently made many experiments, never succeeded in obtaining more than 1 per cent. of the soda in the sulphate, as caustic soda. When heated under steam pressure, the reaction is somewhat more complete. At the Jarrow Chemical Works, with a pressure of 40 lbs. per square inch, about 6 per cent. of the soda was causticised, and with a pressure of 200 lbs., maintained for some hours, 13 per cent. was obtained as caustic. Manifestly these amounts are far too small to augur any advantages from further research in this direction.

Caustic baryta, on the other hand, decomposes solutions of sulphate of soda of any strength, equivalent for equivalent; so that no concentration of the liquors is necessary, and the sodium is at once obtained as caustic soda; but the sulphate of baryta cannot at present be recausticised except at so great a cost as to render its use commercially impossible. If, however, any chemist should hereafter arrange a cheap process for preparing caustic baryta, the black ash furnace and the subsequent troublesome manipulations will speedily become things of the past.

Dr. Hill, in 1865, found that by boiling a mixture of carbonate of baryta with lime, in equivalent proportions, in solution of sulphate of soda under pressure, he obtained a complete decomposition, getting all the soda as caustic without a trace of sulphate, whereas if carbonate of baryta alone is

used, as proposed by Köbunter, only 75 per cent. of the sulphate is causticised. But, as he remarks, though this process does away with the difficulty of obtaining caustic baryta, it is questionable whether the recovery of the carbonate of baryta from the mixture of sulphate of baryta and carbonate of lime, would be any cheaper than attempting to recover baryta in the caustic state from the sulphate.

Many of the rudimentary processes when practised with modern apparatus yield far better results than in the hands of the original inventors. As a last instance, I cite the process for making salt cake (sulphate of soda), by roasting together common salt with an excess of pyrites. This process was known as Longmaid's, and was patented by him in 1842, but had been in use on the Continent many years previously. This process being unprofitable, the next step taken in the direction was to pass sulphurous acid from the pyrite burners, together with air and steam, over common salt and oxide of iron. This was by Mr. Robb, in 1853. Four years later Brooman took out his patent which dispenses with the oxide of iron. This process has in it the elements of success; it is at present being carried on on a large scale at the Atlas Chemical Works, Widnes, by Mr. Hargreaves. The salt, which may be crushed rock salt, is mixed with sufficient water to be moulded into bricks, and is then piled up in heated chambers, into which sulphurous acid, steam, and air are passed. Hydrochloric acid is evolved and condensed in the usual way. Mr. Hargreaves states the amount of fuel used to be one-third of that required by the sulphuric acid process, as the gases are passed into the chambers directly from the burners at a red heat, whilst the heat developed by the reaction of the sulphurous acid upon the salt also assists in maintaining the temperature. No nitrate of soda is required in the process, and thus a very costly item in the manufacture of soda is removed. The temperatures at which the materials are to be maintained do not exceed from 800° to 900° F. and are therefore not high enough to cause much destruction of the apparatus. In fact the wear and tear is quite inappreciable.

The alkali trade still awaits the coming man, and if one may venture an opinion, it is not a new process that is required so much as improvements upon the old. The by-products of the Le Blanc process have attained such importance that they constitute distinct manufactures in themselves, and if, instead of being by-products, they had to be purposely made, their cost would be much added to. The grave defect of the Le Blanc process is the great loss of available soda. Taking the best commercial sulphate of soda to contain 97 per cent. of pure sulphate, the amount obtained in the soda ash fall very far short of that indicated by theory. According to Mactear, this loss throughout the alkali trade averages 13·75 per cent. I am informed that on the Tyne it is never less than 10 per cent., and more frequently 15 per cent.; and, more than this, that makers find it at times a matter of very great difficulty to produce soda ash of 54 per cent. alkali. This serious loss of soda is due to several causes, but, as might be expected, it is in the treatment of black ash that the greatest loss occurs. Of necessity some soda must be lost by retention in the waste, and also by careless manipulation of liquors and salts, or by imperfect lixiviation; but all losses through these causes fall far short in well-conducted works of the large amount to be sought for, an average of 13·75 per cent.

Scheurer-Kestner was the first to discover the real cause of the evil. By close examination and analysis of vat waste, he was led to the conclusion that at least 5 per cent of the loss, and frequently very much more, is due to insoluble compounds formed by the soda being kept in prolonged contact with water and the sulphides of the waste. If this cause be a true one, it is manifest that the lixiviation must be greatly accelerated. Further investigation proved decisively that in addition to this a further cause of the loss is the presence of an excess of chalk in the black ash mixing, which is converted into lime in the furnace. When water is added, the hydrate of lime reacts upon the carbonate of soda, and renders part of it insoluble. Black ash obtained on the large scale from 100 sodium sulphate and 95 limestone, left a tank waste containing on the average 0·39 per cent. sodium, whilst a product made from 100 sulphate and 112 limestone, left 1·36 per cent. sodium in the waste. This average was not appreciably affected by using sometimes a mixing coal, having 18 to 20 per cent. of ash, and sometimes one having 10 to 12 per cent. ashes. The natural inference is that the quantity of limestone in the mixture for soda ash ought to be reduced to the lowest point consistent with the quality of the ash.

It has become the fashion of late years to speak of the present mode of manufacturing soda as a round-about process, but fairly looked at I must say —though I risk bringing a storm of negations upon my head from the favourers of all the so-called direct processes—that in a great measure it derives this character from the vastness of the connected processes.

To make the sulphate, sulphuric acid has to be manufactured on a gigantic scale, but the surplus acid is in itself a source of profit. The cheapest sulphur is found in pyrites containing copper. In order to save carriage it is found profitable to smelt the burnt ore to a regulus containing 10 to 12 per cent. of copper, another manufacture, and another profit.

By the action of the sulphuric acid on the salt, hydrochloric acid is set free. Here is another profitable product. A small part of the acid is used to act on limestone to furnish the additional equivalent of carbonic acid required to convert carbonate into bicarbonate of soda; part is sold, but by far the larger portion is run upon binoxide of manganese, and supplies the chlorine for bleaching powder making. Of late an additional process has been added, for Mr. Weldon has pointed out the means of recovering the manganese, so that it can be used over and over again with but a small percentage of loss.

All these varying industries proceeding together, upon premises nominally for the manufacture of soda only, give to the Le Blanc process an air of complexity with which it should not justly be credited. Indeed, the true effect of this is that so many additional profits are brought in, that the cost of soda making proper is reduced far below what it appears to be. Not in our day do I even hope for its being as a whole replaced, however much it may be modified.

Thus far chemistry; but though so important that these are called, *par excellence*, "Chemical Works" it does not stand alone. Engineering, mechanics, and physics, each have a great share in the successful carrying on of the works. Every part of the great whole must be fitted with due consideration to its performing its duty at the smallest cost of time and labour. I think it was in alkali works that the waste heat of the smelting and other furnaces was first used upon steam boilers; of course to furnish the steam for the vitriol chambers and other purposes about the works. Steam cranes and ingeniously devised tramways for unloading and loading the raw materials; most careful adjustment of the various houses, so that nothing has to be carried a yard out of its way; skilful adaptations of each piece of apparatus to the end it has to fill, all these and many more such things testify to the grand importance of technology to the alkali maker.

Science and technology here go side by side. The chemist has sketched out a process by which certain results can be obtained. That they are obtained, and profitably obtained, is entirely due to the technical skill that has been from time to time brought to bear upon every piece of apparatus in the works, under that keen supervision of the chemist and physicist which has so thoroughly secured its conformity with natural laws.

Nothing in the universe stands by itself, all things are interdependent; and it may be taken as an axiom in the arts also, that no process can be improved, no branch of industry advanced, no new invention become prosperous, except by aid brought to it from without.

DISCUSSION.

Mr. Kerr said he had been connected for some time with both Mr. Gossage and Mr. Longmaid, whose processes had been referred to. Mr. Gossage took out a patent for the use of his towers for converting the liquor into peroxide, and his first experiments were made at Plymouth, where he (Mr. Kerr) was superintendent at the large works belonging to Mr. Gill, for the manufacture of soap, soda, and alkali. But previous to Mr. Gossage, Mr. Longmaid was engaged at the same works, and he there discovered his means of utilising the iron pyrites by burning them in a furnace for the purpose of manufacturing sulphate of soda direct from common salt. As had been said by Mr. Vincent, the burning of iron pyrites with common salt was no new idea at all to produce sulphate of soda, but the patent which was granted to Mr. Longmaid was simply for using salt in excess of the pyrites, because in all former process the pyrites had been used in excess of the salt. This process did not pay, but it was supposed the other one would. Unfortunately it failed in this way, that it required too great a consumption of fuel, because the process required six days to complete. Mr. Longmaid mixed his charge of pyrites, ground into small particles, with common salt, and put that at the extremity of the furnace, where it remained for 24 hours. Having been partially oxidised, it was then passed further on in the furnace, where it remained another day, and so on, taking the whole week to complete the process, the result being that the consumption of fuel was so great that it overcame the advantage produced of getting rid of the sulphuric acid process. He got rid of the ammonia and sulphuric acid, and he produced one of the most beautiful and enduring paints, the peroxide of iron, which having been subjected to the action of chlorine, would resist anything whatever afterwards, but unfortunately he produced more of this than was required, and the cost of fuel was too great to render the process economical. Coming next to Mr. Gossage's process, when he (Mr. Kerr) went to the works, in 1856, he found in the stores some 200 tons of soda quite red. Of course nobody would buy red soda for washing purposes. On considering how this arose, he arrived at the conclusion that Mr. Gossage must be introducing too much oxygen into the towers. When the crude carbonate came out of the black ash furnace, it went into the vats in the shape of black ash, and the crude liquor was pumped up to the top of a tower 50 or 60 feet high, then the steam was passed under that tower for the purpose of driving up the oxygen of the atmosphere to deoxidise and convert the protoxide. But in carrying up too great a stream he converted it into peroxide, which made its appearance in the soda, giving it a red colour. After experimenting upon it himself for three or four days by reducing the quantity of oxygen, he was enabled to produce a white soda. Of course this did not in any way detract from the merit of Mr. Gossage's method. He had hoped to have heard a little more of some of the latest inventions for the production of soda, but the result of the paper seemed to be that manufacturers were practically in the same position as before, and that there was no process likely to be introduced to supersede the old ones. He did not quite agree with that view, because, though he had not been connected with this manufacture for some years, he had made some few experiments, and was rather of opinion that a more direct process might be introduced.

Mr. W. Weldon said he might supplement, to some extent, the lecturer's remarks on the only two remaining processes proposed by way of improvement which were at present exciting any serious attention. It might be interesting to some to know that Mr. Hargreaves' process had already achieved a considerable amount of success, for at that moment it was within his own knowledge that six of the largest alkali manufacturers in the country were each expending £10,000 in putting up plant for the process. In one respect, however, Mr. Vincent had done more than justice to that process, because he said that the consumption of coal was only one-third of that required for making the salt cake by the ordinary process. That was formerly claimed by Mr. Hargreaves; but only a week ago, having been over the Atlas works with him, he showed him the figures representing the actual result of working, from which it appeared that the consumption of coal was about the same. True, only three cwts. of coal was required per ton of salt cake by this process, but then for the subsequent treatment of the salt cake in the cast iron cylinders, in which it was treated with a mixture of sulphurous acid gas, steam, and air, a further consumption of seven cwt. was required for preparing the salt and supplying steam for the process. With regard to the ammonium process, he rather gathered from Mr. Vincent that it had not met with much commercial success, but the fact was, it had been at work for the last seven years in Belgium, at Mr. Soldet's works, near Charleroi, and that gentleman claimed that he was now making there more that one-fourth of the total amount of soda consumed in Belgium, viz., 15 tons per day. At the recent International Exhibition at Vienna, Mr. Soldet was awarded a gold medal, Mr. Kuhman proposing it on the faith of three statements made by Mr. Soldet; first, that he manufactured 15 tons per day; secondly, that his loss of ammonia, which is a very important question, was only two per cent.; and, thirdly, that he was paying his shareholders a dividend of 100 per cent. He (Mr. Weldon) did not believe, for reasons it was unnecessary to state at length, that there was any prospect of the ammonia process coming into immediate use, but there was no doubt it was being worked much more profitably in certain districts than tho Le Blanc process. Not only in Belgium, but in three small works in Germany it was used, and a very large establishment was now being

built in Alsace, whilst Mr. Mond, a gentleman well known in connection with the recovery of sulphur from alkali waste, was commencing to work the process at Northwich, in Cheshire. Mr. Vincent had referred to the patents taken out in connection with this process by Mr. James Young, the originator of the paraffin industry, and if the ammonia process had any chance of competing with the Le Blanc process, he thought it would be mainly by the aid of the method patented by Mr. Young. At present the chloride of sodium was decomposed by bicarbonate of ammonia, producing a precipitate of bicarbonate of sodium, and a solution of chloride of ammonium. The latter was decomposed by boiling it with caustic lime, thus producing caustic ammonia, which had afterwards to be re-converted into bicarbonate. Now to do that two equivalents of carbonic acid were required, and the question was, where were they to come from. It was perfectly certain you could not get them in the manner in which carbonic acid was ordinarily manufactured, viz., by the re-action of hydrochloric acid on calcium bicarbonate. If they were to be produced from the products of combustion or from limestone, you must of necessity get the carbonic acid largely diluted with other gases, and therefore converting the ammonia into bicarbonate you must work in open vessels, the result of which was a considerable loss of ammonia. Mr. Young endeavoured to avoid this loss of ammonia, and had succeeded in rendering it possible to work the process without any loss at all. His own *modus operandi* consisted in the substitution of carbonate of lime for caustic lime in the decomposition of the chloride of ammonium, and he found by a particular method of working that he could, by simply boiling the chloride of ammonium in solution in water with calcic carbonate, distil off a normal carbonate of ammonia; and the second equivalent of carbonic acid, from the bicarbonate of soda produced from the previous operation, served to convert this normal carbonate into bicarbonate, so that the whole carbonic acid required to be supplied to the process was got from native carbonate of lime. This was an improvement of such importance, that if it were not for the extreme slowness of the ammonia process he should expect to see it very shortly supersede that of Le Blanc. It could not, however, do that unless the loss of ammonia were prevented. If the loss were really not 2 per cent., as Mr. Soldet said, but which he believed to be nearer the truth about 8 per cent., it would require, according to his calculation, very nearly if not the whole of the ammonical liquor produced by all the gas works in Great Britain to furnish it. If, however, the loss of ammonia could be reduced to nothing, or nearly nothing, the process might have an immediate chance of being adopted, if it were not for its extreme slowness. Mr. Kesner, who was an eminent manufacturer as well as chemist, formerly had his works in France, but they were now in Germany, and were situated in a locality in which it was not possible to sell much bleaching powder, and therefore his production of soda had hitherto been limited by the quantity of hydrochloric acid which he could sell. That he formerly sold in France pretty readily, but there was now a duty on its importation, and though he could sell his soda in Germany, there was not a demand for this hydrochloric acid, and he was therefore particularly desirous to find, if possible, by the ammonia or some other process, a mode of manufacturing soda without producing hydrochloric acid. He had therefore paid the £600 which Mr. Soldet charged for admission into his works, and had received all the information that gentleman could give him, but after carefully considering the matter for himself, he had come to the conclusion that the ammonia process, if you could leave out of account the question of apparatus, would present an immense advantage over the Le Blanc process; but on the other hand it was so slow, and the apparatus required was so expensive, that, in his opinion, these considerations would more than counterbalance the advantages of the process. For his own (Mr. Weldon's) part, he was extremely sorry that this was the case, because the ammonia process was a very charming one, being beautifully simple, yielding an exceedingly pure produce of a perfectly white colour, in fact superior to anything which could be produced by the old process; above all, it produced no nuisance. However, as he had already said, he feared its slowness would keep it out of use for a long time to come.

Mr. Kerr thought one important object had been overlooked, namely, the utilisation of the muriatic acid gas.

Mr. Tribe said some years ago he was asked to make a laboratory experiment on the amount of bicarbonate of soda that could be obtained by acting on a saturated solution of common salt by ammonium bicarbonate in powder, and if he remembered correctly he found the theoretical quantity would be about 30 per cent., and from the calculations of a friend who was interested in the manufacture made at that time, he came to the conclusion that this process would be of no commercial value. He also, at the same time, thought it would be interesting to try the action of ammonium bicarbonate upon chloride of potassium, and found that although one might saturate the potassium chloride with the ammonium bicarbonate, yet there was no remaining bicarbonate precipitated, but by the addition of a small quantity of spirit a considerable percentage of bicarbonate of potash was formed. On calculations being made, however, it was found that this process would not be commercially profitable.

The Chairman hoped that these discussions would tend to practical benefit, for it was well to look at all these matters from a mercantile as well as from a scientific point of view. For instance, in the manufacture of soda from common salt there were a great many processes which would look very well if put down on the black board, but which were impracticable anywhere else. Then again there were many other re-actions which appeared very satisfactory not only on paper, but also in the laboratory, but still when they came to be applied commercially were not sufficiently economical. As Mr. Vincent had observed, not only chemistry, but also a knowledge of physics and mechanics was required for the commercial success of any of these processes, and it was in that point of view that these discussions were likely to be of value. He was not aware that he had anything to add from his own knowledge of the subject, as it was one rather foreign to the particular line of his own studies. But it was always interesting to go into any of these works and see the great primary industry carried on, and the various smaller secondary interests surrounding it which might be called the children of the soda manufactory as Mr. Vincent had described them. Possibly if the ammonia process were pursued, as they had heard from Mr. Weldon it was being on various parts of the Continent, it might turn out that secondary processes might attach themselves to it as kindred processes did to the old method, and it might in that way attain considerable magnitude even in our own day.

Mr. Vincent, in replying to the observations which had been made, congratulated himself on having called forth such a clear and lucid description of the ammonia process from Mr. Weldon, who he was glad to find agreed with him in looking upon that and the process of Mr. Hargreaves as the most promising of the new methods. His main objects in this paper had been to show that a large amount of technical skill, as well as chemical ability, was requisite in order to bring to perfection any of these great chemical processes, and in fact that this technical ability to adapt apparatus to the ends in view was of far more importance than chemists and inventors were often disposed to think.

A unanimous vote of thanks was then passed to Mr. Vincent, and the meeting terminated.

AFRICAN SECTION.

A Meeting of this Section was held on Tuesday evening last, Vice-Admiral Erasmus Ommanney, C.B., F.R.S., in the chair, when a paper was read—

ON TRADE IN WESTERN AFRICA WITH AND WITHOUT BRITISH PROTECTION.

By Andrew Swanzy.

It is quite clear that the Ashantee War, now so happily terminated, will not pass away without results eminently beneficial to the natives of West Africa, and extremely favourable to the extension and security of our commerce with them.

Founded on conquest, maintained by war, and governed by bloodshed, the Ashantee system appears to have been planned with the object of causing the greatest misery of the greatest number. Unlike other conquerors, the Ashantee kings have too frequently followed up their victories by the wholesale slaughter of their enemies either on the field of battle or in the bloody shambles of Commassie, preferring to strengthen their kingdom by the annihilation of their neighbours, rather than by including them in their own dominions; thus districts once populous have been left to the hyena and the leopard, and have been gradually reclaimed by nature and merged in the vast forests of tropical Africa. But a heavy blow has been struck at this gigantic destroyer; the career of Ashantee conquest has been suddenly arrested, and surrounding tribes have a breathing time allowed them to consider by what means they may either free themselves from the Ashantee yoke, or compel their master to lighten its weight; let us hope they may use their opportunity with effect. After the defeat of the Ashantees at Doduah, the Assins deserted them and have never since returned. The King of Adansi has signified his intention of joining the Protectorate; I trust his example may be followed by others, and then, humbled by defeat and weakened by desertion, King Cofee Kulkalli may be led to reflect on the expediency of preserving peace and retaining the fidelity of his remaining subjects, by measures calculated to promote their general happiness. It will be the duty of her Majesty's Government to exert its utmost influence to diminish and finally abolish human sacrifices in Ashantee, and I look with confidence to the success of its efforts in that direction. Travellers in Dahomey tell us that the present king is personally opposed to these horrors; and while the prestige of our capture and destruction of Commassie is still fresh in his mind, but little pressure would be required to induce him to follow the example of the King of Ashantee.

Turning from the political and social consequences of the Ashantee war to its probable effects on trade, we may fairly expect that the great proof of our power, evinced by our complete success over the most warlike state of Western Africa, will deter other chiefs from incurring our hostility by the plunder or ill-treatment of our traders. But one great advantage has already resulted from this war, inasmuch as the attention of the public and the Government has been directed to our relations with the Gold Coast settlements, hitherto but little known, and entirely neglected; and it is to the credit of the Society of Arts that it has taken the initiative in acquiring and publishing information, not confined in its scope to the settlements, but extending to the whole of the vast continent of Africa, and available alike to those who may desire to further the interests of science, and to those who, by fair and legitimate trade, seek to develop the resources of vast districts, capable, as I believe, of producing those necessaries of civilised life now found in every cottage and in every mansion. It is from a desire to assist the Society, as far as I can, in this praiseworthy object, that I venture to place at its disposal such experience as I have gained by a long residence and still longer commercial connection with Africa.

Those who remember, as I do, the security and peace which prevailed throughout the settlements during the presidency of Mr. Maclean, will be struck by the painful contrast exhibited of late years under the expensive but ineffective system which followed.

An allowance of £4,000 a year, and an *ad valorem* duty of a half per cent. on all imports, sufficed for all the expenses of the Government. The services of the whole European community were at the orders of the President; my brother Frank, for instance, kept the old British fort of Dixcove in perfect order for twelve years, without any change in the Government, acting as commandant, collector of customs, and, in short, as the sole representative of the Government in that district. He received all import dues, fines, &c., and after providing for the small local expenses, remitted the balance to Cape Coast Castle. Similar offices were performed by other gentlemen in other parts of the settlements, and under this simple *régime*, trade rapidly increased, and the well-being of the nation progressed; but, in an evil hour, her Majesty's Government, at the instigation no doubt of some of those gentlemen and ladies who take a sincere, but injudicious, interest in our coloured brethren, sent out a Commissioner to inquire into the nature of the treatment their *protégés* were receiving from Mr. Maclean. This gentleman accordingly proceeded to the Coast, and the following extract from a letter from Mr. Maclean to the Committee of Merchants, will enable you to judge of the experience he gained during his stay on the Coast. And yet this gentleman unhesitatingly expressed opinions wholly at variance with those of the residents there; and when told by them that British law was not applicable to the state of the settlements, satirically asked whether Russian or Turkish laws were administered.

4th May, 1841 —*Extract of a letter from "Maclean."*

Dr. Madden was unfortunately too ill during four or five out of the six weeks of his residence here to be able to make himself, in any degree, acquainted with the real state of the colony; indeed, to actual personal inquiries, he was not able to devote more than six or seven days. The colony will not, therefore, I fear, derive so much benefit from his labours as I had confidently hoped it would.

On the report of Dr. Madden, her Majesty's Government resumed direct control of the settlements, and from time to time introduced British laws, which have indeed proved, as the merchants in 1841 said they would, wholly inapplicable to the social state of the Gold Coast.

In consequence of the greatly increased expense attending this change, it became necessary to provide an increased revenue, and among the first schemes for attaining this object was a poll-tax of one shilling a head, and as the population of the protected territories was estimated to be 400,000, an income of £20,000 was expected from this source. This tax, imposed in 1852, lasted but a short time, as it proved a failure.

Then an *ad-valorem* duty of two per cent., shortly afterwards raised to three per cent., was levied on all imports.

The details of this customs ordinance clearly proved the utter absence of commercial knowledge in those who framed it. The value for duty on all imports was held to be the cost price at place of shipment, say for instance in England, with ten per cent. added for freight charges, &c., and it was competent to the customs officers, when not satisfied with the value as declared by the importer, to pay him 10 per cent. on the value declared and sell the goods on account of the Government; and, whereas the freight in a large proportion of articles shipped to the coast exceeds 20 per cent. on their value, and in some instances 100 per cent., it follows that the importer of such goods is liable to have them seized for deficiency in valuation, and to be paid very much less than their actual cost, and this although he strictly complied with the rules laid down.

But a clause was introduced into one of the many customs ordinances which I believe to be unequalled in its tendency to injustice and wrong. It was provided that all seizures effected and fines inflicted were to be divided into three equal parts, one part went to the Crown, another to the informer or seizer, and the remaining third to the governor's private purse; the consequence of such an opportunity in the hands of an unscrupulous man must be obvious to all. Happily this clause lasted but a short time; and I never suffered from it, although some friends of mine in a neighbouring colony were not quite so fortunate.

For years, merchants trading beyond the settlements, as well as within them, were prevented from landing goods in bond at the British ports, and were not even allowed to tranship goods from one vessel to another in British waters; this was, of course, done with the view of extorting the duties on goods intended for sale beyond the Protectorate. The consequence was that my firm, among others, were prevented from shipping such goods by steamers, and the utility of Cape Coast, as a depot, was destroyed. On my urgent representations, a change was made in this rule, and merchants importing a certain amount were allowed to enter goods in bond, while small traders were deprived of that privilege; but although this unjust concession afforded me a great advantage over my fellow traders, I continued to protest against the entire system, and finally succeeded in opening the British ports as receptacles for bonded goods.

Such are some instances of the ignorance in commercial matters displayed in attempts to raise a revenue. However, after many years' trial and much correspondence, a specific tariff was established, which requires but little alteration to work well. But the direct control of the Imperial Government proved not only much more expensive but much less efficient than that of the Committee of Merchants. In 1865, Col. Ord was asked by the Committee of the House of Commons, "Was the respect paid to the English name greater or less in the time of Mr. Maclean than it is now?" He replied, "I fear it was greater in Mr. Maclean's time;" and at the commencement of 1873 that respect was less than it was in 1865. During the life of Mr. Maclean commercial frauds or direct plunder were absolutely unknown; Europeans were always respectfully saluted in the streets, and those who have lived in Africa know the importance of such outward marks of respect. The decisions of the English magistrates were implicitly trusted, because they were founded on native law modified by English notions of justice and humanity, and punishment both prompt and severe was dealt out to the wrong-doer. Traders and travellers in the Protectorate were then as safe as in an English turnpike-road, and peace was effectually maintained.

In those days the ordinary course of business was as follows:—The English merchants on the Gold Coast were supplied on credit with such goods as they required by their London correspondents, principally by the well-known firms of Messrs. Forster and Smith and Messrs. W. B. Hatton and Sons, and as the transactions were very considerable and attended with much risk, great care was necessary in selecting the persons to whom advances were made, the consequence was that the resident English merchants, though few in number, were generally men of education and ability; and, acting as magistrates and civil commandants in the districts in which they resided, they exercised a great and beneficial influence over the natives. The native traders purchased their goods from these gentlemen, and also from Bristol and Hamburgh trading-ships, generally on credit, as they possessed but little capital, and they paid for the goods so advanced to them in three or four months, according to the state of trade. During my six years' residence on the Coast, from 1844 to 1850, such debts were fairly met, and a very large business thus carried on; indeed, our outstanding accounts, due by the natives of Dixcove and that neighbourhood, amounted generally from £12,000 to £15,000.

Gradually a number of partially educated natives were admitted to the same advantages as the resident English traders, and received their supplies direct from the London firms. These men, instead of exchanging all their goods for produce, built houses, bought slaves, and, surrounding themselves with a large retinue of relations and servants, expended a great deal of the means entrusted to them in extravagance: and many of them, unable to estimate the cost of their goods, drove the European merchants from the trade by ruinous competition, and finally passed through the Bankruptcy Court. There were, of course, some exceptions, and the widow of one of them, the late Mr. Henry Barnes, is about the only native at Cape Coast who trades on her own capital.

And here it becomes necessary to show that these events were to some extent attributable to the introduction of English laws not adapted to the state of society in the settlements. Experience of the native African has convinced me that at present he requires a more stringent rule than the

European; detection in dishonesty or crime leads to punishment in both cases, but in addition to physical suffering, the European is conscious of the contempt of his fellow-countrymen, and is in truth distrusted and despised by them. Not so the African; released from prison, he appears to have no sense of shame, nor indeed does he seem to be the less respected by his neighbours; hence laws which are sufficiently severe in the one case, fail in their deterrent effect in the other.

It is clear, if my opinion is correct, that a bankruptcy act, resembling that in force in England, could be no protection to the creditor, but on the contrary an encouragement to fraud and dishonesty on the part of the native debtor; and so the result has proved.

In an able letter, written in 1865 for the information of the West African Committee, Mr. Matthew Forster says:—

"Mr. Maclean applied the rules of equity more than the rules of English law in cases where the natives were concerned, and he adopted the native law where he found it equitable and just; and native law, though rude and simple, is not ill-adapted to their condition, and a Bankruptcy Court has been established at Cape Coast which is doing great mischief. The natives having no capital can do no trade without credit to go into the country to collect produce. Since the Bankruptcy Court has been established they have learned to leave the property entrusted to them in the interior, go back to the Coast without produce, and pass through the Court with impunity, a lessen in fraud taught them by the existence of the court. It may be said, don't trust them, but that is to say that no business can be done. To overgovern such possessions is a great mistake."

The native African invests a large proportion of his wealth in slaves, and although slavery has always been tolerated in the British Protectorate, the local Courts of Justice ignore its existence, and do not meddle with the slaves of a bankrupt; thus a fraudulent debtor retains the property he most values. As Mr. Forster truly implies, the native trader advances goods to natives in the interior, and after passing through the court, recovers a large proportion of the amount advanced. No books are kept, and after an immensity of trouble, the assignee may perhaps recover sufficient funds to pay expenses and a shilling or two in the pound. Such is generally the effect of the Gold Coast Bankruptcy Act, itself the offspring of official inexperience, and the parent of commercial ruin.

As to any assistance afforded to English merchants in recovering debts, it is notorious that such assistance is grudgingly given and is rarely effectual. Any excuse is sufficient to enable the debtor to obtain time, say from three to twelve months, and the result is generally a release on payment of a small percentage of the amount due.

These and other circumstances arising from mistaken legislation have led to a total change in the system of trade. The large trade previously carried on between the Gold Coast traders and the Bristol ships has entirely ceased; in fact the Bristol merchants avoid the British colonies and settlements, preferring to trade with native states. The London and Liverpool firms no longer advance goods to resident traders, but consign them on their own account to agents, who are paid either by fixed salaries, or salaries and commission, and hence it follows that the European residents with few exceptions are paid agents and not principals. As to the native traders, there is little chance of their acquiring capital to any considerable extent, and thus the hope so frequently expressed by African philanthropists—African trade carried on by African capital—has been for the present destroyed.

I fear time will not permit me to relate some occurrences which happened within the settlements during the last two or three years, and which prove most clearly that no efficient protection is afforded either to the resident trader or to his customer from the interior, but I must distinctly affirm that no such protection exists.

I now come to our operations beyond the Protectorate. Commencing at Grand Bassam and Assinee, my two most western stations, I must observe that when my factories were first established at these places, the whole district, to the extent of forty or fifty miles of coast, was under French protection. The French officers were however aided by Amatifou, King of Kinjabo, in maintaining control over the people of Assinee, and in protecting the persons and property of the two firms trading there, Messrs. Verdier Frères, and ourselves. The French commandants levied a small export duty on the gold and produce shipped from their settlements, and French ships of war occasionally visited the ports or forts.

In 1870, the officers and men of the forts were withdrawn by the French Government, and my agent agreed to rent the fort at Assinee at 300 francs per annum. A naval officer calls at that place to receive the rent and pay Amatifou a small subsidy for maintaining the peace of the country. Our operations at Assinee are thus practically carried on under the protection of this chief; and both before and after the departure of the French commandant my people and property have remained in perfect safety, no violence having ever been attempted, and in case of theft every effort has been made to detect and punish the thieves.

On the other hand, we are almost compelled to make advances to the king, who is generally in our debt to the extent of £250 or £300, and we occasionally make him small presents; but we no longer pay export duties, and we can easily estimate the losses which may arise from our dealings with Amatifou. Nevertheless these losses are not incurred in the British settlements.

But at Grand Bassam we are practically without protection—that is, without official protection—either European or native, and yet we have had during the last three years a considerable amount of property in store at that place, where my firm is the only European trading establishment. From Grand Bassam we carry on, by means of steam launches, an extensive trade on the lagoon stretching about 90 miles west of that place, and I may mention that the water of this lagoon, unlike almost all waters of similar form on the Coast, is quite fresh and clear; it varies from 2 to 10 miles in width, and from 3 to 15 feet in depth. At Toupa, about 60 miles west of Grand Bassam, we have a vessel stationed to receive goods for sale and produce in return. The native towns and villages are, as far as we can judge, independent of each other. The inhabitants live in the most primitive state, and, until we commenced barter with them, wore little or no clothing, and yet we have never been seriously molested by them. One chief alone raised an objection to our passing

beyond his town; but this was soon overcome, and we now penetrate to a great distance without much danger. In case of accident to our boats, a small present secures the assistance of the natives in recovering the boats and their contents. At Grand Bassam we pay no duties. We have the countenance and support of the principal native trader, John Blay, and, judging from experience, we require no other aid. Our trade in palm oil at this place has rapidly increased; but our plant is costly and our expenses heavy.

The landing at these places is particularly dangerous, especially in the months of July, August, and September, and at the full and change of the moon, owing, no doubt, to tidal influences. All our goods have to be landed in canoes, mostly English built, and our losses arising from this danger are very frequent. We employ a number of that useful tribe of sailors, the Kroomen, at all our stations.

Eastward of the British settlements we have, or had, factories at Quittah, Porto Seguro, Aghwey, Little Popo, Grand Popo, and Whydah, each of these places being politically independent of the others. Quittah formerly belonged to Denmark, and was ceded to the British in 1850; but it has not since been occupied by an English officer, and we have paid a small export duty to the native chiefs for protection. On the 24th September, 1873, our factory at Quittah was burned down, and a large proportion of our property there plundered, but the principal chief succeeded in recovering for us our iron safe; and the contents, including about £200 in cash, were untouched. We also recovered a large amount of the property. The great drawback to trade at all these places, except Whydah, is the inveterate dishonesty of the natives. They lose no opportunity of pilfering; from the moment goods leave the ship's side till they are handed over to the purchasers they are never safe. In case of discovery, the European and native traders severely punish the thieves, often flogging them and putting them in irons, but the propensity appears unconquerable. The greatest caution is requisite in giving credit in these towns. Native traders will pay small amounts; but once allow them to exceed a certain sum, and they cease to pay anything further.

In the event of shipwreck at any of these places, the stranded vessel is plundered of everything moveable, as in the instance of our ship, the *Bentinck*, lost at Grand Popo on the 24th May, 1872. She had goods on board of the value of £13,000; the whole were landed and taken away in broad daylight by the natives. The sailors, on landing, were partially stripped of their clothes, and a canoe, in which the master had placed his chronometer, nautical instruments, &c., was deliberately upset by the natives. No notice has been taken by her Majesty's Government of this incident, and the people of Grand Popo have been allowed to enjoy their plunder in peace and safety. As a matter of course, proceedings of this kind would not be allowed within the British Protectorate.

At Whydah our trade is carried on under the protection of the celebrated King of Dahomey, next to his neighbour of Ashantee the most powerful prince of West Africa; and as my firm is the only English house there, I will enter into greater detail respecting our business at Whydah. A very large proportion of the king's revenue is derived from trade, and in the palmy days of the slave-trade his income from that source was very considerable. The Spanish and Portuguese slave merchants were scarcely less powerful and influential than the king himself; they lived in splendour and luxury, in well-built and capacious residences, the remains of which alone attest the former importance of Whydah. The resources of Dahomey are, however, very great; the country is covered with the oil-palm, and if the slave labour, formerly exported, but even now very considerable, were employed in developing these resources, the Dahomans might become the greatest commercial nation in West Africa. But a great change in the government of the country must be effected before such a desirable result can be attained. As long as the persons and property of all Dahomans are at the mercy of the ruler, it is not politic, it is not even safe, to acquire wealth and thus attract the covetous desires of the king. My friend, Mr. Skertchley, gives us a most favourable account of the present king's ability, and speaks even more highly of his successor; but, even if he desired to do so, Gelele could not suddenly change the present system, and thus there is but little hope of present improvement in the condition of the people or of increase in the productive power of the country.

Heavy port charges are levied on every ship anchoring and landing goods at Whydah; they amount to about £45 on each two-masted vessel, a three-masted vessel paying much more, consequently a barque of 250 tons would pay more than a brig of 300 tons; but these charges are in lieu of duties on goods. This system prevents anything like a small trade being transacted from a trading vessel, as the percentage would be too heavy.

But the impediments to trade do not arise from any regular charges or duties on goods, which are at present moderate enough, but rather from rules enforced by the king, which are very disadvantageous to the trader.

In the first place, no goods landed in Dahomey can be re-shipped without a special permit, rarely granted, and always heavily paid for; it follows that when the demand for certain goods landed at Whydah has ceased, these goods cannot be used to supply the most urgent demands elsewhere.

Secondly. The king's trader selects from fresh importations such goods as he deems suitable to his master, and the importer is compelled to keep them during the king's pleasure. It often happens that, after they have been detained for a considerable time the king refuses to take them, and in the end they have to be sold at a loss, owing to subsequent importations of similar goods.

Thirdly. The King of Dahomey rarely pays ready cash or produce for his purchases, and he is generally a debtor to my agents of from £200 to £400. Occasionally we refuse to deliver goods specially imported for him until the payment, usually so many measures of palm oil, is received; but no attempt has ever been made to obtain forcible possession of such goods, although my agents would be powerless to resist it.

Fourthly. We are compelled to sell goods to the king at lower rates than to his subjects, and

thus we have two distinct trades, the king's trade, and our ordinary business, and occasionally some of the royal ladies induce the king's trader to include some of their transactions with those of the king. I believe, however, this has occasionally been followed by serious consequences.

Again, the agents of the European houses are summoned to Agbomé about once a year, to be present at the king's customs. This entails considerable expense, as, in addition to the cost of travelling, the agents are expected to take with them handsome presents for the king and his leading chiefs. The European visitors are detained from six to ten weeks, during which they are nominally fed by the king, but in reality have to provide for themselves, as they can rarely eat the food furnished to them. In return for costly presents given to the king, they receive one or two slaves, which are of course useless to Europeans, and perhaps some mark of rank equally valueless.

But not content with these sources of gain the king—who has been greatly impoverished by the abolition of the slave-trade—presses his Whydah officials for presents, and these men, to satisfy his demands, invent some cause of complaint against one or more of the traders, who are accordingly fined, and in one or two cases have been ill-treated to enforce payment; but generally European merchants positively refuse to pay the fine, and the officials, after some "palaver," accept a small portion of the amount, say 1-5th. They never attempt to take away the goods of the merchants by force, and it is a question of tact and management. Complaints to the king are useless and lead only to fresh "palavers."

In Whydah, as indeed all along the Coast, advances to native traders should be limited to a sum which they will readily pay rather than lose the advantage of further supplies. When applied to for assistance, the king retains half of the amount recovered, and he has supreme power in cases of debt, occasionally ordering the debtor and all his family to be sold into slavery; but this is rarely done, and never in my experience as regards native Portuguese, who constitute the great majority of the Whydah traders.

The king's men occasionally seize all the palm oil brought to market and pay the owners a very low price in return. It is needless to say that such injustice prevents the people from producing more oil than they require. I believe no complaints are made of the regular export duty levied on each measure of palm oil, which may be considered a fair means of raising a revenue.

Such is a short and plain statement of my experience of trade in native states. At present the British merchant receives no aid or countenance from his Government when trading in such places as Dahomey, the theory being he ventures in such enterprises at his own risk, and must not expect any assistance in case of ill-treatment. It has been very generally supposed that the goods supplied in barter to the natives of West Africa are worthless in kind and inferior in quality; and many persons still think that we exchange common glass beads and empty bottles for pretty nearly their weight in gold. I can only say that I have never had the good fortune to share in such profitable transactions; and I now propose to show you some of the articles which my firm sends to the coast. Many of my friends consider that I am incurring some risk in thus letting you into the secrets of the trade, but I feel no alarm on that head, and at all events I cannot allow such considerations to deter me from fulfilling to the utmost of my power the task I have undertaken.

About sixty per cent. of our shipments to the Coast consist of cotton manufactures, chiefly of Manchester make, but including some few fabrics from Switzerland and Belgium, of finer colour and quality; and you will observe how singularly the names still used in the trade remind us of the time when India supplied a large proportion of our cotton manufacture samples. I believe I may say that my firm clothes the inhabitants of a district as large as England, but, of course, that district is thinly populated, and the people more thinly clad; indeed, in most parts, the children of both sexes, up to the age of seven or eight, dispense with any other covering than that of a slight coating of tallow to prevent their skins from cracking in the sun. We trade along a line of coast nearly 500 miles in length, and our goods are carried many hundred miles into the interior. An instance of this occurred some years ago. My old friend, Mr. McGregor Laird, had brought me a sample of cotton cloth from the Upper Niger, that is above its junction with the "Binue," asking me where he could purchase similar goods. I recognised a curious pattern designed by myself, which I had shipped twelve months before, and which I knew was then confined to my own trade. Of course we have competition along nearly the whole line of Coast, but I estimate our proportion of the trade to be equal to the extent of district named.

Cutlery and hardware form a considerable item in our trade, and include knives of every shape and size, matchets or cutlasses, brass pans, pewter basins, &c. Common earthenware helps, when needful, to fill up our ships; and, as a proof of advancement in the comfort of the natives, I may say we ship large quantities of chairs, and occasionally other articles of furniture. Common mirrors from Germany are also sold to the native traders.

All the women of West Africa wear girdles round the waist, generally consisting of two or three strings of beads, in fact, a row of beads constitutes the first approach to dress on the part of the female children; moreover, beads are much sought after as ornaments for the wrists and neck, and therefore we ship to the coast great quantities of beads. It is a singular fact that beads have been at various times found in the West Coast similar in pattern, form, and colour, to those that are found in Egyptian mummy cases, thus showing either that communication existed between the people of East and West Africa, or what is less probable, that their manufacturing skill and taste were identical; at all events the most skilful workmen of Venice have not succeeded in making beads of the same quality, but vast quantities of Venetian beads, some of them very costly, are annually sent from Venice to London and Liverpool for the African trade. They are, I believe, all made by hand, and the colours worked under a powerful blowpipe. Coral, varying in value from 5s. to £4 or £6 per ounce, is also imported by many of the African tribes.

A large number of sincere and sensible men have protested against the trade in spirits with uncivilised people, some of them considering that trade not merely objectionable, but criminal. But after all the consumption of alcoholic liquids by the natives of West Africa is not by any means large in proportion to their numbers. With the exception of a little palm wine, they have nothing to drink but most unwholesome water. Their food consists principally of a sort of pudding made from the plaintain or maize, and re-dressed with messes of half-putrid fish; and until something better can be provided for them, I believe they are none the worse for a little spirit. The few cases of drunkenness which I witnessed on the Coast arose from excessive indulgence in palm wine, and, indeed, the quantity of spirit taken at one time is usually very small. As to quality, the Geneva we generally ship is the same as that sent to Australia and Canada in immense quantities. At all events, I for one am ready to hear any arguments against this trade, and to listen to any proposal that may be brought forward with a view to its cessation.

I have now arrived at the most important question which has, up to the present time, been brought to the notice of this Section of the Society of Arts—that of the supply of firearms to the natives of Africa. All those who have hitherto alluded to the subject appear to have arrived at the conclusion that the trade in guns and gunpowder should be prevented, but no one has suggested a plan for carrying out the idea. Now I feel sure I do but express the feelings of all the merchants connected with the African trade when I say that we would gladly join in any scheme which would effectually stop this trade. We know well enough that, with the exception of a few skins and perhaps a little ivory, no diminution in the productions of West Africa would follow such a step; but we do not see in what way this trade is to be prevented. Individual efforts would be of no public good, but would certainly involve heavy individual losses.

We cannot do better than consider this question with reference to the Gold Coast and Ashantee. Including Assinee and Grand Bassam, the Gold Coast settlements extend along the shore for a distance of about 350 miles, and with the concurrence of the French Government the sale of munitions of war might be effectually prevented on this part of the coast; but unless her Majesty's Government compelled the native independent towns east and west of the settlements to join in the prohibition, one of two results would follow—our old enemies, but new friends and hoped-for customers, the Ashantees, would be either fully supplied with guns and gunpowder, or annihilated by their neighbours, and especially by the Dahomans. As for the protected tribes, unless we armed them at our own cost, they would fall an easy prey to their better equipped neighbours. In short, any partial plan for disarming the natives of Africa by a process of exhausting present supplies must prove either unjust or impracticable, and so far from diminishing war and bloodshed, it would, I believe, tend to increase these twin evils. As to any general plan extending along the whole line of Coast, say from the Gambia to the Gaboon, it is of course possible, with the concurrence of all European Governments and the assent of the natives, but not otherwise. But I am most anxious that this question should be thoroughly ventilated, as, I repeat, it is one of the very greatest importance, involving consequences which can hardly be foreseen.

At the commencement of my trading operations the returns were principally in gold dust, which is found both on the Coast and in the interior, but of which by far the larger quantity comes from Ashantee, where I believe considerable mines exist. Nearer the Coast it is procured chiefly by surface washings, although some years ago we supplied to some of our friends heavy hammers for the purpose of crushing quartz for gold. The quality varies from 203 carats to standard, silver being almost always found in alloy with it. About the year 1820, it was estimated that 100,000 ozs., = £360,000, were exported from West Africa, but the exports do not I believe exceed 15,000 ozs. per annum (value of £60,000.)

The quantity of ivory bought on the Gold Coast has diminished; it never has been of any importance, but I am unable to state the exact amount.

Some 15 years ago I imported 600 or 700 black monkey skins, and sent them to Messrs. Bevington and Morris, to ascertain if they could be made useful; they remained in their hands for many months, and most of them were made into rugs, which I presented to various friends, but a few of the best were reserved and made into muffs, which at first met with no sale, but after a time became fashionable, and finally the price for each good skin rose as high as 12s. 6d.; they have since fallen, and now vary from 3s. 6d. to 1s. 6d. each. The trade is of very little importance, and my people have had whatever advantage arose, as I do not trouble with it.

Formerly, I imported a few cargoes of maize, as in prolific seasons on the Coast the prices are very low, but recently my ships are laden with more valuable produce, but even now I believe maize would occasionally pay well.

But palm oil* forms by far the most important article of trade from West Africa, and even in the Protectorate exceeds in value any other export. From the year 1790 the gross export from West Africa has increased from a few tons to the enormous quantity of 50,000 tons, but during the last twenty years the increase has been very slow, and in some years the production has decreased. I have, however, opened up several new places of trade, and the natives seem desirous of obtaining the goods we offer them. The palm forests at the back of the Coast line between Cape Palmas and Elmina are practically inexhaustible, but the population is limited and indolent. The method of making palm oil is extremely simple. The *Elais guineensis*, or oil palm, produces a large cone about the size of a man's hat, covered with long spines, and the nuts, each about the size of a large olive, grow between and are protected by these spines. When ripe they are gathered and rubbed between two stones, and the pulp placed in boiling water; the oil floats, and is then skimmed off into earthern pots, and is generally sold on the spot to carriers, who bring it down to the Coast for sale.

Formerly, when the outside of the palm nut, of which the oil is made, was removed, the nut itself

was thrown away as useless, but for the last ten years a very large trade has been carried on in what are now known as palm kernels—the nuts—which vary very much in size and form, are extremely hard, and are broken, generally by women and children, by a blow with a large stone. The quantity produced by this simple means has gradually increased, and now reaches 40,000 or 50,000 tons. The kernels are pressed by powerful machinery, and produce a valuable oil, much resembling cocoa-nut oil, and the residue is used for feeding stock. I may say that, years before palm kernels became an article of trade, I imported about 19 tons, and tried to introduce them to the notice of oil crushers, but failed.

I think it will be admitted by all that the trade I have described deserves and requires encouragement and protection; the question is what form of protection is most suitable to the social and commercial condition of the people with whom it is carried on. I allude particularly to the Gold Coast settlements, and I turn for counsel and advice to the opinions of those who proved by successful management that they understood how to govern and civilise the protected tribes.

In the first place, let us consider the consequences of a total abandonment of the Gold Coast settlements. In a letter to Lord Russell, dated 13th April, 1841, Mr. Maclean writes (in reply to Dr. Madden's report that the local Government exercised jurisdiction over a large extent of territory not claimed by England):—

"Were this Government not to exercise control over the adjoining districts, the labours of many years would be overthrown in one month, and consequences would ensue too horrible to be contemplated. The forts would become isolated; trade and communication with Ashantee and the interior would cease, oppression, rapine, murder, and human sacrifices would take the place of that peace, good order, and security of person and property which we have, with so much labour and pains, established throughout the country."

The force of Mr. Maclean's language remains undiminished, and his opinions on this point as applicable in 1874 as they were in 1841. To my mind it is clear we cannot entirely abandon the Gold Coast settlements.

In support of Lord Grey's opinion that it is not advisable to turn the Protectorate into a colony, I beg most respectfully to remind those who will have to consider this question, that any such step must lead to one of two results, either the total disruption of society within the colony, or the disregard of one of the fundamental principles of British law—that every man living within British territory is free. When, in 1841, Sir John Jeremie attempted to proclaim the abolition of domestic slavery on the Gold Coast, he was met by the urgent remonstrance of all, merchants and natives alike, and had to withdraw the proclamation. I do not suppose Parliament would sanction the expenditure of £300,000 or £400,000 for compensation to those who had to give up their slaves, and on the other hand it would hardly be just to deprive heads of families of what they consider their most valuable property by liberating all slaves. I may here say that domestic slavery is not by any means a serious evil, and a domestic slave would be very much surprised if you were to tell him he was an ill-used man. The fact is, the objections to the plan of forming the Protectorate into a colony are almost insuperable, although the present time is most favourable for carrying out any important change.

Sir B. Pine, in his evidence before the Committee in 1865, expressed an opinion that the judicial assessor administered justice too much in the Queen's name, and not as the representative of native authority, and went too much on the principles of English law, ignoring the native law; and I expressed the same opinion, an opinion which I still hold, for I consider existing English law wholly inapplicable to the people of West Africa; and I have no hesitation in saying that the gradual destruction of all native authority has tended more than any other cause to the utter degradation of the natives of the Protectorate.

It is extremely difficult to devise a plan for the management of the Gold Coast settlements, which will on the one hand maintain internal tranquillity and external peace, and at the same time diminish the responsibility of the English Government; the success of any such plan must depend mainly on the man appointed to work it out. Such men as Rajah Brooke and Maclean are rare, but I believe there are many to be found, firm of purpose, just in principle, and fertile in resources, who only require a little experience to enable them to establish in the Gold Coast settlements a centre of progress and improvement, from whence may ultimately radiate the civilisation of tropical Africa.

It will be necessary to have the general assent of the native chiefs from Assinee to Quittah, and as far north as the borders of Ashantee, to any plan that may be devised; such consent will be gladly given. It will be necessary to settle any disputes as to rights of territory, &c., such as that now existing between the chiefs of Appolonia and the Ancobra district, and these preliminaries arranged, the whole of the protected tribes could be formed into one Confederation, represented by a General Council.

But at present, and for many years to come, this Council would need the services of an able Englishman to preside over and guide it, and the principal difficulty lies in the appointment of this officer. Will the Crown undertake that duty on behalf of the native chiefs—and I see no reason to the contrary—or can that appointment be vested in a committee of gentlemen, not as before wholly composed of merchants, but appointed partly by the Crown and partly by the native chiefs? I repeat this is the main difficulty, because for years to come the officer, whether styled Chief Commissioner or Political Resident, would have paramount influence and power in the settlements. He would reside either in Cape Coast Castle or Elmina, and would represent the British Government to the extent of preserving its rights over the various forts scattered along the Coast.

The principal resident should have the assistance of a secretary and a collector of customs at head-quarters, and of deputy-residents or commissioners at each of the principal towns along the Coast, commencing at Appolonia or Assim and ending at Quittah. These gentlemen would collect import duties and act as justices of appeal in matters of small importance, referring all appeals involving large amounts or heavy sentences to head-quarters. The appointment of these gentlemen must neces-

sarily be made by the same authority as that appointing the Chief Resident or Commissioner.

The General Council would decide all questions of territorial right, and would also have the right of deciding in what way and for what causes any one of the confederated chiefs should be deposed; also what subsidies or salaries should be allowed to each, and how many armed men each should contribute for the general defence. It would be necessary to form a Legislative Council in which the mercantile interest should be fairly represented. It would arrange all questions of trade, customs duties, &c., but its decisions would be subject to the aproval of the General Council.

In cases in which natives alone are concerned, the right of jurisdiction should be vested in the native authorities in the various districts, with right to appeal to the local residents; but cases in which Europeans and natives, or in which Europeans alone are interested, should be decided by the Chief Resident or Commissioner, who should be, in fact, the highest judicial authority.

In order to provide the funds necessary for carrying out this system, the tariff in force in 1872 might be continued or revised as required, and the collection of import duties would devolve on the local residents at the various outposts, who would each require an assistant, who should be an educated native when possible. I am of opinion that a sum of at least £50,000 might thus be raised without any injury to commerce, and that this sum might be greatly increased in a few years.

The first change in the revenue would be the salaries of the Resident, at least £2,000 per annum, with liberal pay to all his assistants. Subsidies should be paid to the native chiefs, but all fines and charges paid by litigants should be remitted to the public treasury, and not retained as formerly by the chiefs sitting as judges.

A modification of native law might be gradually effected to meet the requirements of justice and humanity, but any rash interference with domestic slavery would be very unwise.

A small steam gunboat, about 80 feet in length, and carrying one small gun, would add greatly to the strength of the Government, and would be very serviceable in conveying officers to and from their respective posts, and by occasional visits to the outposts, would aid in collecting and raising the revenue.

No European Government can be expected to protect its subjects when trading in uncivilised and unhealthy countries as thoroughly as in its own colonies, but in cases of gross outrage inflicted on English traders the interference of her Majesty's Government appears to me a duty which it cannot neglect. The ill-treatment of an American trader or the plunder of an American ship are very rare occurrences, as the natives know they cannot insult the American flag with impunity; but the same feeling does not generally prevail as regards the English flag, and I believe English merchants owe their comparative safety in native states rather to interest, than fear of punishment. The danger to the life and property of the trader in native states arises chiefly from the absence of sufficient power on the part of the native authorities to control their unruly people, and in some cases the native chiefs would gladly accept the aid of one of her Majesty's gunboats in inflicting due punishment on such of their people as may assault or plunder her Majesty's subjects. I do not know if such assistance is permitted, but in dealing with such people as the natives of the Coast between Quittah and Whydah, a little protection would prove of great service.

DISCUSSION.

Mr. Collins asked what had been the effect of the Ashantee war on the palm oil trade?

Mr. Swanzy said none at all. It appeared that the trade had been on the increase; but, on the other hand, the exports of gold had been rapidly declining of late. Of course, if the Government were to withdraw all protection, intestine wars would spring up, and trade would be destroyed for some time; but very little protection indeed was necessary in order to encourage trade. In some parts, where there was no representative of the English Government beyond a consul, the merchants got on very well.

Mr. Consul Petherick remarked that the traffic in beads was of very ancient date, for he had met with them in the interior of Africa precisely similar to those found in the mummy cases at Thebes. He had taken specimens to Venice, and had them manufactured of the same pattern, and had done a large trade with them in the interior. With regard to the importation of firearms, it was difficult to say what should be done. It was very difficult for traders to proceed into the interior, and as there were also many obstructions put in the way of native tribes coming down to the Coast, it was no wonder that they complained of the decrease of trade from the interior, or of its small value. Consequently they contented themselves with the palm oil trade, and maintained that that was the only trade of the country, but this he did not agree with, and believed that if the trade were pushed a great deal might be done. It was quite true that it would not do to have a store with only a few articles, for a merchant in Africa must have every thing the natives required, and no matter how many stores there were in a particular place, a native trader would visit every one before he made up his mind which he would patronise. The only way to secure trade was to go after it, and his own experience had shown him that the natives in the interior were only too glad to see European traders coming amongst them. The first thing he required, of course, was food, and that was always abundantly supplied, but when he inquired for ivory, he found they did not know the value of it. Though they were in the habit of hunting elephants for their flesh, the tusks were thrown away. As soon, however, as they understood that it was of any value, they soon produced large quantities. Of course it was expensive work going into the interior, because a considerable number of men was required, both to insure safety and to carry the goods. He must say, however, the cases of assault were very rare, and any one with good management could overcome the indisposition of the natives to allow traffic. He had found a deal of honesty and good feeling on the part of the natives, and had established eight or ten different depôts in various parts, 500 or 600 miles apart from each other, leaving twenty or thirty men in each, with a variety of stores, and visiting them every year to obtain the produce. On the other hand, where the trade was not sufficiently lucrative to warrant the creation of a depôt, he had intrusted the goods to native chiefs, and had never been deceived by those he had placed confidence in. It was, however, the case that where the natives came in contact with white men they often become demoralised, as they adopted bad habits sooner than good ones.

The Chairman asked if there were any prospect of establishing commercial intercourse with Ashantee?

Mr. Swanzy said he had already expressed an opinion in that room to the contrary. He did not think there was any prospect of doing a trade with the interior of that part of Africa. In the first place, the difficulties of transport were very great, and he did not know of any produce which would pay for the expense of carriage. Mr. Petherick had referred to many which no doubt would pay for carriage for a long distance, but that occurred in a different part of Africa, and he knew of nothing of corresponding value on the West Coast. His experience was that natives made the best carriers. In Mr. Petherick's case, too, he believed a great portion of his journeyings was performed by water, and where this was available, as upon the Niger, it had been developed to a considerable extent, but on the Gold Coast there were no facilities of this kind. The only thing which could be expected from the interior was gold, which possibly the natives of Ashantee might send down in large quantities, but it appeared they did not desire to part with it, and though they would travel any distance to obtain goods which they wanted, their wants were so limited, they did not care to part with their gold. His opinion therefore was, that the English merchants would do better to confine their operations to the Coast.

Mr Petherick said the native traders in the interior were not able to go beyond their own territory, and it was a very rare occurrence for an inhabitant of one tribe to pass his own boundary, and he thought it would be necessary, if trade were to be opened, for some neutral party, like Europeans, to go through the whole string of tribes. It was not the carriers which formed the chief obstacle, though no doubt this was an element to be taken into consideration. He had always been able to obtain labourers of this kind, in some instance those who would go with him the whole distance and return; at other times he could only prevail upon them to go to a certain point, and at other times again he had gone considerable journeys with carriers engaged day by day for one day's march. Even in this case, however, it was very seldom he had been detained a day waiting for carriers to go further on.

Mr. Swanzy said that although they did not themselves penetrate into the interior, their goods went enormous distances, as was proved by the fact that when he designed a pattern of his own, especially for this trade, only about a year after the first batch was sent out Mr. McGregor Laird brought down a sample of it from above the confluence of the Niger, and asked him if he could supply it, thus showing what an immense distance these goods were carried. Any European goods which were found south of the great desert must, in all probability, have come from somewhere on the West Coast, and therefore there seemed no necessity for Europeans, at great risk to their health, and perhaps to their property, penetrating into the interior to carry the trade. They were always ready, however, to go anywhere were trade was to be done, but he believed it was best to leave the interior trade to the natives themselves. Wherever river facilities existed they were utilised to the greatest possible extent.

Mr. Hutchinson said he had been in hopes of seeing some practical result produced by these discussions. The question which occurred to his mind as of the greatest importance, was not so much the isolated trade of various ports, as what were the views of the merchants with regard to the method under which trade should be carried on in such ports, for instance, as Lagos. It would be well to know if there were any aggregation of capital in the hands of the natives, and any system for the utilisation of the capital; and the great question of domestic slavery was also one of great importance, in fact, he believed of late, the root of much of the difficulty which had been found to exist with regard to the trade in that part of Africa. He also was one of the trustees of the charity to which allusion had been made, but he certainly could not remember such a circumstance as Mr. Swanzy had mentioned, and so far from domestic slavery being such a light thing, he knew it to be a fact that when slaves who had escaped to Lagos were given up, four out of five had been put to death. That had caused a great outcry. Lord Kimberly had directed an inquiry into the matter, and he believed the whole of the matter would soon come before Parliament. This question, therefore, was really of more importance than had been represented by Mr. Swanzy and other gentlemen in the room. He quite agreed that the time was not yet come to deal with Ashantee as a British colony, for the reasons which had been named, and he had himself received information, not only from Abeokuta, but from the country to the east of Lagos, showing that the chiefs were apprehensive of the principles of British freedom being extended into the interior to the destruction of slavery. He ventured to say, without fear of contradiction, that an instance had never been known of any slave who had escaped from his master from Lagos voluntarily returning to him. He would also say that if anything could be done in establishing throughout all Africa a British influence of the kind exercised by the residents in India, a great deal would be done to open up the whole country; but he thought, from all the discussions which had taken place, that more combination was required among the merchants who frequented those parts if the results they desired were to be obtained. Until that combination was effected, and until the Government saw there was an intelligent body of men interested in the condition of Africa, and willing to promote its interests, they would listen very calmly to all the representations made by all the individual merchants, as to what they required for the protection of their own interests on the Coast. The Society which he represented had always kept in view the advancement of civilization, industry, and enlightenment, not only with regard to religion, but also to a participation in all the benefits of civilization and commerce; in fact the establishment of a cotton trade in Lagos, which in the year 1869 amounted to £76,000 worth, was due to the work of two missionaries, one a black man and one a white; the first cotton gin ever sent out there having been the gift of the Baroness Burdett-Coutts. He believed the African Section was not confined in its operations to the West Coast only, and he ventured to thing that the wants and necessities of the East Coast equally demanded attention. The great Livingstone had opened up to the commerce of England a region, the wealth of which, as far as production went, was something marvellous, and he had no doubt that commerce would meet with great development there if it were properly pursued as in other parts of Africa. He begged to say, in conclusion, that the lad who was bringing home the remains of Livingstone was a liberated slave who had been sent out under the Livingstone Search Expedition, and had been his faithful attendant ever since. He was now the leader of the party who had brought the body down to the Coast; he was coming home with it, and he would be the sole representative of Livingstone's native attendants at the funeral on Saturday next.

Mr. Rochussen begged to say, with reference to the question of exporting fire-arms to Africa, that in that country they were really a necessity of life. First of all, in the carrying on of war, which of course was as frequent there as amongst the civilised nations of Europe, they were very useful, and war was carried on much more humanely with fire-arms than with the old-fashioned bows and arrows, knives, and other instruments of cruelty. Secondly, fire-arms were ministers of pleasure, being always made use of to a great extent on every festive occasion to testify to the joyful feelings of the natives; and lastly, they were a necessity of life for the purpose of killing game of

various kinds. He wished also to say, with reference to insinuations which had been made that the fire-arms sent out were more dangerous to those who used them than to those at whom they were aimed, that however cheaply these guns were made in Birmingham or elsewhere, they were subjected to just as severe a proof as a Martini-Henry rifle. Some twenty years ago he had read a paper on Africa in that room, and the policy he then advanced he believed would still hold good, viz., that European influence should be maintained not by expensive military settlements, but by smart cruisers especially built for the trade, with lofty between-decks so as to carry a large complement of men, and afford good ventilation, and these would simply act as the police of the coast. The necessity for something of this sort was shown by the losses which had been referred to when vessels were wrecked, the whole cargo being carried off; and although Mr. Swanzy was a very large trader he was not the only one there, and therefore if the losses of all these sufferers were put together he thought they would go far to keep up a naval force which would prevent them. The question therefore rose, if this were not granted by Government, whether it were out of the power of merchants to do it themselves. Mr. Swanzy had some capital steam launches on the Grand Bassam, and with a smart engineer, a few Europeans, some trained kroomen, and a good six pounder in the bows, he thought they would be quite competent to tackle a native village or punish any plundering which might be attempted.

Mr. Trelawny Saunders said the tendency of Mr. Swanzy's paper and remarks was to show that English merchants must entirely confine their operations to the Coast, but he hoped a time would soon come when a new light would dawn upon them, for he did not believe those who had done so much good would remain indifferent, or incapable of perceiving the way in which this great work might be accomplished. The work of penetrating Africa had been put beyond question by Mr. Petherick, and therefore it ought to be followed up. After alluding, in rather strong terms, to the reports which had led to the removal of Mr. Maclean, he said he had no doubt if the policy inaugurated by that gentleman had been continued to the present time, the Ashantee war would never have occurred. It arose from ignorance on our part rather than from any misconduct on the part of the natives. And how could it be otherwise when men were sent out as governors without any experience, and as soon as they had time to turn round they were removed and placed somewhere else. It was really a disgrace to such a nation as England to endure such a state of things. One good result of the Ashantee war had been to awaken attention to this great subject. In one zone alone there were 90 millions of people, and Mr. Swanzy said they were beyond the reach of European influence, but this he could not believe. He agreed with him, however, from his experience in India and elsewhere, that if you wished to conduct carriage economically in foreign countries, it must be left to native agencies. But who could doubt the economy of establishing depôts for goods in the market where they were to be consumed, rather than have such a system as had been described by Sir Richard Macdonald, under which an enterprising native would come from some place a thousand miles in the interior to the banks of the Gambia, where he would hire a piece of land, the cultivation of which would yield a large return, 75 per cent. of which would vanish in one form or other before he could reach home. It appeared to him that 75 per cent. formed a sufficient margin even for an European merchant to work upon in the way of transport of goods. With regard to the obstacles which had to be encountered, he could not do better than refer to the work of Mr. Anderson, an educated black gentleman of Siberia, who had made a journey of eight days into the interior. It appeared that the chief obstacles were those thrown in the way of movement by the different tribes amongst each other; and the natives of various towns which he visited would have been only too glad if traders would establish themselves there with stockades just as was done by the Hudson's Bay Company, which would serve as permanent depôts for the reception and distribution of goods. And so far from there being any lack of ivory, he found himself exposed to constant inconvenience from the inroads of elephants, even in the immediate vicinity of the towns on his route. He (Mr. Saunders) had no doubt that many other products of considerable value would be discovered if once European intelligence were established in the midst of the dense populations of those regions. This was no sparsely populated country. He could not bring himself to believe that there was no trade worth European development to be obtained from 90 millions of industrious people. Mohammedans and Arabs could trade with them, and why not Christians and Europeans? If there was one lesson more than another to be gathered from English experience on the Gold Coast, it was that we ought to return to a form of government in which the interests of the merchants should be adequately and fully represented. No nation in the world could point to more striking examples of that principle, and he saw no reason why the great work which had been done in India should not be repeated in Africa. What was wanted was an African Company on the principles of the old East India Company, which would go at the same slow but sure pace. They wanted in Africa, not speculators, but honest, enterprising, old-fashioned English traders; and if it were only known that there was a gunboat or a few 6-pounders somewhere within call, they might easily penetrate anywhere into the heart of Africa. This would involve a system of government no more expensive than that of Mr. Maclean, and he had no doubt Macleans could be found even in the present day if they were wanted.

Mr. Swanzy said if Mr. Saunders would consider the great jealousies which all African chiefs had of goods passing through their own territories to reach those beyond, he would come to the conclusion that even 75 per cent. would soon melt away. He had read every work on Africa which was published, but was never able to discover what produce of any value was to be obtained from the interior. No doubt there was cotton, but that could be got from the Gold Coast too, if only labour could be obtained. Mr. Hutchinson said that two missionaries were the first to try this cultivation in West Africa, but this was not so, for nearly 40 years before that time his brother had commenced a large cotton plantation. The only difficulty was to get steady labour, and the difficulty still continued.

In reply to a further question as to the practicability of navigating the Volta, the Tando, and the Assinee,

Mr. Swanzy said a practical proof that he did entertain hopes of using the Volta as a means of access to the interior, was that he was now having a steam-launch built for the express purpose. On the Tando, it was very difficult, but they had lately heard that above Three Points it was possible to penetrate some distance into the interior. That was formerly Dutch territory, and not open to the English, but it was now free to every one.

A Member said he had navigated the Volta a considerable distance, and had made a chart of the river, which he had presented to the Royal Geographical Society. The water was very shallow, and in some parts only flat-bottomed canoes could be used.

The **Chairman** then proposed a cordial vote of thanks to Mr. Swanzy, which was carried unanimously, and the proceedings terminated.

Mr. Hyde Clarke writes:—"It is much to be regretted, in reference to the West African trade as to the trade of this country generally, that there is no high school of languages in London and Liverpool. Did such a school

exist a very small sum spent on a professor of West African languages would enable such languages to be taught at the Houssa, which is a means of commercial intercourse over a very large part of the interior. Thus the languages might be learned by young commercial men before proceeding to the Coast, while the attention of men of learning in this country would also be devoted to the subject, and keep up the interest in it. The want of regard for the study of languages in this country, and the cultivation of them by the Germans, had been very strongly pointed out in discussions of the *Times*. The Society of Arts, in its examinations, had endeavoured to promote the study for commercial purposes of several languages, including the oral use of languages.

EIGHTEENTH ORDINARY MEETING.

Wednesday, April 15th, 1874; Hyde Clarke, Esq., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Bell, J. Carter, care of S. Kipping, Kersal Clough, Higher Broughton, Manchester.
Brocklehurst, William Walter, 4, Leinster-square, W.
Caffall, Robert May, Alton, Hants, and 75, Fleet-street, E.C.
Chance, Henry, Sherborne-house, Warwick.
Clabby, Nicolas Frederic, 2, Derngate, Northampton.
Fordham, John W., M.R.C.S., 78, Mile-end-road, E.
Maybury, C. W., 90, King-street, Manchester, and Brook-house, Alexandra-park, Manchester.
Palmer, Charles M., M.P., 45, Grosvenor-square, W.
Rippingville, E. A., 118, Holborn, W.C.
Rothwell, Peter, 78, Hampstead-road, N.W.
Schlieper, Charles, 18, Sydenham-park, Sydenham, S.E.
Starnes, John Sampson, 13, Broad-street, Ratcliff, E.
Walker, William, 119, Bunhill-row, E.C.
Weldon, Walter, Abbey-lodge, Merton, Surrey.
Williams, Cyril Faithfull, Queen's Bench-offices, Temple, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Allen, Alfred H., F.C.S., 1, Surrey-street, Sheffield.
Armbruster, Charles, F.C.S., the Grove, Hammersmith, W.
Charles, Peter, Church-street, Stoke Newington, N.
Cockey, Henry, Iron Works, Frome, Selwood.
Cookson, Faithful, F.R.G.S., Teddington-hall, Teddington, Middlesex.
Field, Charles, Hither Green-lodge, Lewisham.
Gibbs, Thomas, Bede Metal and Chemical Company (Limited), Jarrow-on-Tyne.
Glover, Hugh C., the Gothic, Highgate-road, N.
Glover, John, 214, St. John-street, Clerkenwell, E.C.
Glover, Richard Thomas, the Gothic, Highgate-road, N.
Johnstone, John Brown, Hall Bank, Ladbroke-terrace, Kensington-park, W.
Knight, Frederick, 14, Rood-lane, E.C.
Knight, Jasper, 2, Great St. Helen's, Bishopsgate-street, E.C.
Langley, Leonard, J.P., Well Hall, Eltham, Kent.
Lloyd, E. R., Albion Tube Works, Birmingham.
Wagner, Henry, M.A., F.R.G.S., 16, King-street, St. James's, S.W.

The Paper read was:—

ON THE SYMBOLISM OF ORIENTAL ORNAMENT.

By William Simpson, F.R.G.S.

We may presume that the earliest style of ornament was somewhat similar to the notched wood which we find among the savage races of the present day. We have also the tattooed lines on their bodies, as another illustration of the same. That which was sought in this manner was only to please the eye by enrichment of forms. In all styles, and in all countries, the mere enrichment of surface by means of form and colour is to be found, and it must ever exist as one of the natural divisions of ornamental art.

Still it is low art in this walk. It only appeals to the eye. It was not till ornament became symbolic, that it appealed to the mind, and became in a sense high art. Symbolism no doubt began early, still not till a certain stage of civilisation had been reached; for it implies thought, and the development of abstract ideas. The poetic faculty is to be found in very primitive races. The expression of this faculty in words we may be sure came first; its expression in symbols indicates more mature powers, and that definite ideas had been reached. The existence of a symbol implies something like a system with durability, for it requires the understanding of it by many who are organised into some form of society to accept the signification which is meant. Without this condition no sign or symbol could exist; and they indicate that a state of progress had been reached by the human kind. As civilisation advanced, symbols seem to have multiplied with it, until a vast system came into existence.

It is only beginning to dawn upon us how wide and comprehensive this system of symbolism had become in past times. It seems to have embraced everything. The flowers of the field were all symbols; the trees of the forest had each some sacred meaning; the animal world figures largely in the old system; the stars are known to us from the zodiac or forms of living things, which are older than any history we possess; the world itself became only a symbol, and man was made in the image of God, thus completing this grand and beautiful system. The ceremonies of each faith were all symbolical, and the temples in which they were performed were constructed with a meaning in each of their parts. From the primitive grove mound up to the elaborate Gothic cathedral, symbolism is known to have been expressed. In the parables, myths, fables, and legends of the past we have put into words only another form of this symbolic tendency of the human mind.

The Oriental has at all periods been essentially a religious man, and his literature and art are all devoted to his faith. His art was employed in making figures of his gods, or images of them; hence ancient symbolism is nearly all purely religious in its signification, and the symbolism of art in those past times now holds the place of one of the branches of the new and important science of comparative mythology. The more minute study of ornament and its emblems is also becoming most valuable in the regions of archæology. The explorations and excavations now going on in the East are giving us many remains of past times, and our only means of knowledge, in many cases, as to their makers or their date, has to be derived from the art upon them. Art knowledge is thus a branch of archæology. I had a good illustration of this myself, which is worth recording, for it refers to an important point in history. When I

went to India, I had heard of the celebrated Gates of Somnath, and on visiting Agra I made it a duty to make sketches of them. I may explain that Somnath was a Hindoo city, in Western India, with a temple celebrated for its rich endowments. Mahmoud of Ghuznee made a raid into Hindostan in the 11th century, during which he took Puttun Somnath, and looted the temple, carrying back with him its beautiful sandal wood gates. When Mahmoud died, history says that the gates were placed on his tomb. When our army invaded Cabool, in the time of Lord Ellenborough, the ornamental gates on the tomb of Mahmoud, at Ghuznee, were brought back to India in triumph, and have been kept in the port of Agra. When I sat down to sketch these gates, it never occurred to me to doubt their historical reputation, but the operation of drawing soon produced scepticism, for there was no Hindoo art or symbol upon them. It was wholly Mohammedan in every detail, and I came to the conclusion, which amounted in my mind to a certainty, that they could not be the Gates of Somnath. I mentioned the matter to many in India at the time, including the Governor-General, Lord Canning; and all told me that there could be no doubt, and Lord Ellenborough's celebrated proclamation was in every case referred to. It was only on my return to England that Mr. Ferguson informed me that the wood had been inspected by a microscope, and this scientific test proved it to be of *deodar pine*, and not of *sandal wood*. Mr. Ferguson, at the same time, admitted that the ornament was in itself a sufficient evidence to prove that they could not be the original gates. I could not give you a better evidence of the value of this kind of art knowledge than by this illustration, that a style of ornament may be a more reliable authority than a historical state document. Although not the real gates, they are yet of great importance, not only in relation to events, but from their being very good specimens of ornament, and that, too, from a locality from which we have as yet but few illustrations in our museums. I may say in passing that they are all but lost to the world in the Dewan-i-Awm at Agra, and they ought to be brought to our collections at home, where their value could be appreciated. Some travelling in the East, extending now over a good number of years, and always with a sketchbook and a pencil in my pocket, has given me a slight experience of temples and the symbols relating to them; and I would suggest to all travellers that they might help in this matter by drawing, according to their ability, any forms or symbols they may come across. Everyone may add a stone to the cairn, and even national collections are now becoming most valuable in relation to this subject; and I must express my high satisfaction that we have now in South Kensington not only a model of the Sanchi Tope from Central India, but a perfect *fac-simile* of one of its gates. I visited this old monument in January, 1861, and spent three days sketching its details, and it presents us with some most important forms of Oriental ornament.

The lotus figures largely upon it, and if we analyse the signification given to this flower by both Buddhist and Brahmins, we find a key to much of the religious meaning of ancient symbolism. We have the lotus as an Egyptian ornament, and it figures in many ways in their system of decoration, but I am not quite sure whether our Egyptologists have exactly explained the signification of this beautiful flower. If they have not, the Buddhists give it a very definite character. It is the *Padmi* of their mantras, and according to the Brahminical form of expression, it is the *Sacti*, or a symbol of the female power of the universe. This very sacred character given to the lotus by both Buddhists and Brahmins, has made it perhaps the most prominent feature of their ornament. It became the throne of Buddha, and its petals may be seen on the base of every icon of this deity. The same form is repeated in the most of the Hindoo sculptures of their gods; and when lately in China, I was very much struck to find that this particular arrangement had been carried to that country, and was followed as the base of their architecture where marble or stone was used. Chinese bells are generally formed with representations of the lotus leaf round the rim. Here is a small bell such as the Buddhist monks use; there is no lotus formed round the rim, but it is repeated round the top, and the lotus petals are eight in number, which connects it with a certain great symbol in China formed of the same number of diagrams. If you look at the bell in the British Museum, you will find these eight diagrams on the lower part of it, and on each petal of the lotus leaf you will find one of these symbols. There are the same symbols upon each leaf here, not quite the same, but corresponding symbols. Round the rim are sixty-four symbols, being eight times eight.

We get the same thing repeated in the handle of the bell, so arranged that it will give the same symbol whichever way it is viewed. Again, the same thing is seen on the tongue of the bell. The Buddhist monks hold this as a sceptre, and ring the bell occasionally to give the perfect idea of the lotus. These three ritualistic instruments represent nearly all the things necessary in the Buddhist religion, and we in our ignorance call it a praying machine. I obtained this one when there, and will shortly describe it, because it is one which figures largely on the gateway of the great Sanchi Tope now at South Kensington. This has been called a wheel, and in old Buddhism was called "the wheel of the law," that is, the law of Buddha. We call it a praying machine, but it is really a praising machine, by which you declare glory to God in the highest. That is the nearest signification I can give to it. They whirl it round in what they call the way of the sun, and in doing so repeat a sacred sentence. There is a certain sacred word among the Buddhists, and some will not pronounce it, like the Jehovah of the Jews; some only think of it; and some hold their hands over their mouths whilst they name it. Many name Buddha as him who sits on the lotus; but while saying glory to him who sits on the lotus, they mean glory to the great power of the universe, whose great wheel circles in the heavens. It means the circulation of the minutes, hours, days, and years; the great circle of the universe which brings vegetation on the earth and all the changes of the seasons, and everything we depend upon for life, that brings our own life and takes it away. I do not know what an ignorant monk in Thibet thinks when he whirls this wheel, but that

is what it comes to when you analyse it. You will find the same wheel, though not quite in this form, in the rocky temples of India, and we have it referred to in the title of Buddha, who is called the king of the wheel. The pomegranate, the pine cone, and a number of flowers and seed vessels had all a similar signification to that of the lotus. The dress of the Jewish high priest was decorated with pomegranates and bells, and the temple had pomegranates and lilies among its ornaments. Rimmon is the Hebrew word for a pomegranate, and there was a Beth-Rimmon, telling us of a temple dedicated to this symbol. From this we can see how essentially religious the system of symbolism was.

The gateway of the Sanchi Tope gives us another very important symbol, and that is the trisul, or trident. I know of no symbol which seems to have been so widely used as this, and it was most sacred, for the sculptures represent it as being worshipped as the Deity itself. The Hindoos make this an emblem of Siva, and it is placed on most of the temples of that god. It was over the gateway of the Temple of Apollo at Delphi. In that case it assumed the form of a letter, and also as a letter of the Hebrew alphabet it was the symbol on the phylactery of the Jews. Some sectaries of the Hindoos have this symbol painted on their foreheads. Neptune is represented with the trident, and our own Britannia has it in her hand, under some supposition that it expresses her relation to the sea. The Royal Sceptre of England, as well as other kingdoms, is surmounted with a triple form similar to the *fleur-de-lis;* and the Prince of the Powers of Darkness in mediæval legends, also wields this piece of symbolism; to this it may be added that the episcopal benediction is given with the three fingers in this triune position. The *fleur-de-lis* is most probably only a variety of this form. Its shape in early times is simply that of a trident, and it is only recently that it was made into a lily or iris. These numerous illustrations, and many more could be given, of this emblem will give an idea as to how widespread it has been in ancient times. With such a variety of purpose as I have indicated in these, it is a little difficult to grasp at the meaning which could have been intended. Something triune is generally the first suggestion made in explanation, but as to this I have doubts. Duality was the ruling idea, and I take the trident to be formed from the crescent and a solar symbol combined. I know the usual origins given to the *fleur-de-lis*, but cannot accept them, and I believe they are also rejected by French archæologists. I have a work by M. de Beaumont, who shows that the *fleur-de-lis* did not originate in France, but must have come from the East. If it be, as I suggest, founded on the solar and lunar symbols which represented the supreme power of the Deity, then we have an explanation why it became a sceptre and emblem of royal power. I have no doubt but that the trident in Neptune's case is an emblem in this sense, and this is the same with the form as repeated in the figures of Britannia. In the case of the old gentleman who rules in the warm regions below, my boyish ideas made the trident with which he is usually depicted to be a toasting-fork, and that its purpose was to hold the more wicked class of sinners over the hotter spots as a means of punishment. As a sceptre and emblem of his power in the world of death we get an explanation much more in keeping with the ancient system of ideas. Here, and in many of the questions involved, there is much that can only be expressed by speculation. These symbols come down to us in most cases without any explanations, and it is only by minute and careful comparison that anything like reliable conclusions can be reached.

I have mentioned the episcopal form of benediction, and that reminds me of a very peculiar piece of ornament, which is the Sultan's cipher; it is called the "Toghra" amongst the Turks, and although a very fanciful piece of ornament, with no resemblance to anything in heaven above or the earth beneath, it turns out to be a hand. I have been anxious to see some of the intermediate links, to see which form of the hand it represents, but I have not had time to investigate the subject. If any one present can give me any information on the subject I shall be obliged. But I have no doubt the Sultan's cipher was a hand. I believe in old times the hand was called the hand of power, and you must look at it as the hand of God.

The crescent is a very old emblem, and is common to the whole East. We associate it in modern times as being only Mohammedan; but the Christian has it, and the Hindoo as well. The Russian Greek Church places the crescent under the cross, and it is usually understood that this was to symbolise the triumph of the cross over the crescent, or of Christianity over Mohammedanism; but this is not so, for this particular form existed before the time of Mohammed, and was well known to the oriental Church. The original signification of the cross is a subject which is being discussed in the present day. I have heard more than one theory expressed, but I would scarcely venture in the meantime upon an opinion. The question of the cross involves also the question as to the meaning of the letter T, which is a cross in most of the old alphabets. If this letter gets involved in this symbolism, it must necessarily involve the question of all the other letters, and we begin to see what a vast subject gets opened up for our study, and how little reliable authority we have to work upon. Letters have always been looked upon as having been invented for writing, at least all theories have assumed this view of the subject; but it has occurred to me, and I put it only as a guess, that letters existed first as symbols connected with worship, and became developed into phonetic powers. In addition to this we have words and sentences to consider as well, such as *Abracadabra*, also the words engraved on Gnostic gems. We have also the mantras of the Buddhists and Hindoos. The magical qualities given to triangles, circles, and other forms, would be in perfect keeping with this view; and at the same time we see in all these cases the connection they had in every country with the religious ideas of the people.

A most important part of this old system was the symbolism of colours. We have a very beautiful specimen of it in the way the old masters treated the Cherubim and the Seraphim. The Cherubim were red, to represent love, and the Seraphim were blue, to indicate knowledge, and the first were placed the nearest to God, to express that love is nearer to the Divine nature than wisdom. The

temples of Chaldea were painted upon a system of symbolism which referred to the seven planets, and in India each god is painted a colour with reference to his attributes.

The Mohammedan, with his iconoclastic tendencies, swept away all these, or at least nearly all these symbols, and reduced ornamental art to the condition which I have described as enrichment of space by form and colours; and the work which has been produced under this influence has certainly been very beautiful. One could have wished a touch of symbolism to give a finish to so much beauty of art. Perhaps the introductions of quotations from the Koran was the effort to give that expression of which symbolism is the natural form of speech, and giving us this higher tendency of making art appeal to the mind as well as to the eye. Perhaps this absence of symbolism may have led to that high perfection of form which it seems to have reached, for the ornament produced by the followers of the prophet may be declared to be the highest, in the sense of being beautiful, in the whole history of Eastern art. There are one or two things there which it is difficult to find words to express my appreciation of. Some of the ruins of Mohammedan art about Delhi are unapproachable in their beauty of design and exquisite finish of workmanship. Most people who go to Agra go to look at the Taj, and come back and rave about it, but it really belongs to the decadence of Mohammedan art; and the ornament upon it belongs to the lowest type. There has been some discussion as to whether an European architect was concerned in the building of the Taj, and I believe the grave of an Italian architect has been found at Agra; but be that as it may, it contains abundant evidence in itself of European influence, so that it forms a sort of hybrid. It is very badly designed, though most elaborately executed; and indeed, after the time of the Taj at Agra, Mohammedan art in India ceased to be art at all. If it were not for being such a splendid building, nearly the size of St. Paul's, formed of white marble, we should never have heard of it, for one of the old ruined tombs at Delhi is better worth attention than the whole Taj. It is the same with the Mohammedan Musjid in Agra; all its forms and lines are of the lowest type, it has lost all feeling of beauty, and I am told that an inscription upon it gives the number of lacs of rupees which it cost in building, so that it is one may almost say dedicated to mammon. Only the day before yesterday Mr. Ferguson was showing me some photographs from Ajmeer, where the same process was gone through; the Mohammedans seized upon an old Hindu temple, and built a Musjid upon it, the ornamentation of which is something exquisite. But what I call the finest mosque in India, is an old mosque in what is called the *Poranah Khilah*, near Delhi, the work upon which belongs to the finest period of Mohammedan art in India. I consider the specimens of this style left in India to be unsurpassed by that of any other part of the world, but you must go back to an early period to find this high quality. In the battle of styles, I have heard it put that one essential before we can get a new architecture will be a new religion; each form of faith has produced its temple, and until our new inspiration comes we must be content with the old. I cannot endorse this idea, and yet there is some truth in it. While we want ideas we must be dumb, and this must hold also as a rule in art. They tell the story in Rome of a rich American, who, when he had seen the Trajan column, went to a sculptor to order a monument, and as he had formed very decided ideas as to the design, he was able to describe his wishes. He wanted a column, and the bas-reliefs were to begin at the foot with a ragged boy on the street and not a cent to his name. All up the spiral form were to be the leading events of his life, and on the top he wished himself represented with his hand in his pocket holding there a million-dollar note. This is certainly a speaking design, and if the dollar is to be the great god of the future faith, this man wanted a fitting exprsssion of it.

Up to the present day our ornament has been only a jumble of old forms, repeating in many cases the old symbols without caring about any significations they may have had. Modern ornament reached perhaps its lowest degradation of meaningless forms in that style known as "Louis Quatorze," and which I trust we have seen the last of. Now the beginning of a new era is evident. I do not think that we will go back to the old. The rigid interpretation of the second commandment is not now accepted, and the forms of vegetable and animal life are to be seen in the new style. Nature is being carefully studied, and her forms are used instead of conventional types of the past. This new style is not symbolical, nor is it religious. It cannot be so till the battle of the faiths is settled. If we were more fully agreed in religious points, the faculty in the mind which is always tending to symbolism, would not be long in bringing forth fruit. The Mohammedan style of art might be called the *monotheistic*, for it resulted from the declaration that "there are no gods but Allah," and "thou shalt not bow the knee to any other god, neither shalt thou make any images of them." The Hindoo again might be called the *pantheistic* style, for their multitudes of gods led to a prolific mass of images and symbols. The tendency of our ornamental art in the present day is in this direction. As the religious element is left out, it is scarcely fit to call it pantheistic; but its constant reference to nature is directing it to a title to this division. A primrose by a river's brim is with it yet only a primrose. It is not the lotus of the old system. It was something more than a lotus to the mind of the Buddhist and Brahmin—to them it typified the creative powers of the Deity. I do not think that fault should be found with our young art for any shortcomings in this respect. The shortcoming is principally in the condition of our ideas; and if this slight notice of the old symbolism and its comparison of styles should help, however slightly, to give us clearer comprehension on the matter, my purpose will be accomplished.

DISCUSSION.

Mr. Hepworth Dixon said any one who had travelled in the East could not but have been struck with the symbolical forms observable in all monuments; no one could go into the bazaars in Jerusalem, Cairo, Alexandra, Stamboul, and other places, without being struck with what he might call the symbolism of the oriental world Mr. Simpson had told them that the chief symbol

beyond the Bosphorus were religious, but he thought there were symbols in no way related to religion, viz., the symbols of the subjection of women. He was afraid that was as much in the minds of orientels as the symbolism representing the high art. Rings, bracelets, collarets, and anklets were all forms of symbolism, for it was well known that a slave, whether caught in battle, or bought in the market, had a ring put on his leg, a collar round his neck, or a bracelet on his arm as a sign of subjection. He was afraid that ladies at the present time forgot that the beautiful symbolic art which tbey indulged in represented no other idea to the masculine oriental mind than that of having put a stamp or mark upon what he was pleased to think the inferior part of creation, and the gold chains only represented his own wealth. At the present time the origin of these things was forgotten, and instead of being now worn as symbols of subjection they were worn rather as emblems of triumph. He did not doubt that Mr. Simpson was quite right in saying it was a discovery of modern times that the form of ornament might be better taken as an indication of the period of its manufacture or construction, than even State official documents, but he should himself receive such evidence with caution. He did not know what documents were alluded to in the case mentioned by Mr. Simpson, the gates of Somnath, to which a particular period had been assigned by a high authority in consequence of the form of the ornamentation. At the present moment the Palestine Exploration Fnnd Committee had before them the question of the ornamentation of the Mosque of Omar, one of the most beautiful buildings in the Mohammedan world, but the date of which was uncertain. Some supposed it to be a Mohammedan, others a Crusader's, and others an early Christian building, as early as the time of Constantine, or certainly not later than Justinian. The particular date to be assigned to it depended somewhat upon the nature of the construction. This mosque had some of the most beautiful Saracenic ornamentation on it in the world; and there happened to be at the present time an awakening of the oriental mind to the extraordinary beauty of this building, such as that which occurred 20 years ago in the Spanish mind with regard to the marvellous beauty of the Alhambra, at Granada. The Sultan then sent a very clever Armenian architect, and a devout Mussulman to peel off the outer modern work of the Mosque of Omar, to discover the state of the stonework beneath. The portions covered up showed the date when it was constructed, and drawings which had been taken of it having been laid before high authority on the subject, who had been referred to, his first opinion was that it was built in the time of Justinian, but afterwards he attributed it to the period of the Crusades. He thought, in dealing with such antiquarian matters, fatal mistakes would be made if they trusted too completely to the indications which mere ornament or construction suggested to even the most cultivated minds, and the highest authorities upon such subjects. At the same time he did not deny that indications of ornament might fix the time of construction.

Mr. Sandy said he remembered meeting Mr. Simpson shortly after his return from India, when he expressed to him his conviction that the gates of Somnath were not what they had been described before he had seen Mr. Ferguson's book. With regard to the Mosque of Omar, he confessed himself overcome by Mr. Ferguson's arguments. He was glad to hear that the architects of the Sultan were peeling off the outside of the mosque so as to discover its original construction. Some time ago a part of the pillars was stripped off and inscriptions were found said to be taken from the Koran, but on being translated, they were found not to contain a word about Omar, but referred entirely to Jesus the Son of Mary. This rather showed that a knowledge of these matters was of importance in determining the date of an old building.

Mr. W. G. Trewby said, with regard to the Sultan's cipher, it had been stated that might be the representation of a hand. He thought this could hardly be so, because the Mohammedan religion forbade a representation of anything having life, and he was rather disposed to think the cipher was a combination of hieroglyphics representing the various titles of the Sultan, and that it varied with successive Sultans.

Mr. Edwin Lawrence said Mr. Simpson had alluded to letters being derived from symbolical forms, and not phonetic ones, and he might mention that about three years ago a Jewish astronomer published in the "Astronomical Register," a series of diagrams showing how the whole of the Hebrew characters might be derived from the signs of the zodiac. He himself did not believe in this theory, but the astronomer had been able from the stars to form nearly the whole of the Hebrew alphabet with scarcely any stretch of imagination. He regretted that the most ancient and curious astronomical symbol, viz., a 10 feet square ceiling of the Dendara Observatory, had been burnt by the Communists in Paris, and he believed that only one copy of that ceiling existed, which was at present in the museum at the Louvre. He had endeavoured to get a copy of it for the English museums, but had not as yet succeeded in doing so; and he thought that symbols of so curious a nature should not be in the care of one nation only, because if destroyed they would be lost to the world for ever.

Mr. Ash, referring to the Buddhist tope at South Kensington, said he believed the figures on the top bore banners with the St. Andrew's and St. George's crosses, but slightly altered.

Mr. C. A. Fennell thought symbolism in art was one of the vastest subjects a student could take up. In fact it covered the whole region of comparative mythology from the lowest form of fetichism to the most elaborate form of Christianity. This science was at present only in its infancy, but it was of great importance, and he believed would lead to many striking results. It appeared to him that symbolism did not attain any significant vitality until a union was brought about between the two main streams of religious thought, that one derived from the observation of external phenomena, which might be called the Aryan, and which developed itself in the form of elemental worship; and the other, the introspective form, the Semitic, which after passing through various stages, finally culminated in pure monotheism. The symbol attained its greatest perfection and deepest meaning when these two streams were united. With great deference, he ventured to question somewhat Mr. Hepworth Dixon's remarks with regard to the subjection of women, for he doubted if the bangles, anklets, and rings, which oriental women wore, were really emblematical of slavery. Some time ago he had occasion to criticise a statement of the same kind with reference to a Greek vase representing Lycaon on horseback, pursued by Achilles, and it was said that a ring on one foot of Lycaon alluded to his previous captivity. It appeared, however, on closer inspection, that Achilles had also rings on both feet, so that either the rings were not emblematical of captivity at all, or else they showed that Achilles had been made captive twice and Lycaon once.

Mr. Trelawney Saunders said symbolism was only one of the forms in which imagination took expression; imagination could only be exercised when man's wants were provided for, and yet the imaginative class were the most improvident. It was very interesting, therefore, to imagine what were the social and industrial organisations in India which produced these splendid temples which had ever since excited the admiration and wonder of all beholders. The same circumstances probably had led to the erection of our own cathedrals; he believed

both might be traced to the influence of monastic institutions, which, beginning with providing food for themselves, went on to supply it to the improvident who applied for help—their industry producing a surplus—and afterwards to provide sustenance for those who were not only improvident, but were enamoured of art, and whose labours were utilised for the erection of these magnificent buildings. He could not help thinking that more was to be expected from some such organisation of labour in the present day, than from any amount of money payment which could be offered.

Mr. H. T. Wood asked if Mr. Simpson could give any explantion of the meaning of a very common symbol, not only in the East but in all parts of the world, viz., the umbrella. He believed that this symbol was found in many pagodas in China, alternating with the figure of the Lingam, which was understood to represent the reproductive power of nature, and some authorities held that the umbrella represented the power of death. The umbrella in Africa was an emblem of sovereignty, as a recent circumstance had made matter of common knowledge, and he believed the same was true throughout the East. There was also certainly some religious meaning attached to the symbol. In one of the incarnations of Vishnu, the god was represented as going down to the infernal regions with an umbrella, and the same thing appeared in an old bas-relief, representing the Greek deity Dionysus or Bacchus on a similar journey.

Mr. Soares thought Mr. Dixon's intrepretation of anklets, &c., could hardly be correct, because there were many ancient monuments in existence, bearing representations of kings and conquerors wearing rich ornaments as emblems of sovereignty. He confessed to being somewhat surprised to hear Mr. Simpson deal so cruelly with the Taj, because when he visited Agra, he admired it exceedingly. He could quite understand that the ornamentation was in a low style of art, but in purity of form and outline he could he could not but consider it a noble building.

The Chairman, in proposing a vote of thanks to Mr. Simpson, referred to the question which had been raised with regard to the Toghra. It was quite true that this as used by the present and late Sultan differed somewhat from the Toghra in use in the last century, and it was not a development of a band, but in reality contained the name of the Sultan and a portion of his titles. The lines were arranged in a particular way to produce a given effect, but who designed it he did not know; it was in fact a part of the general system of what might be called symbolic signatures. The grand viziers had each a signature of a similar kind, though not so large, and so had each chief officer of state; one being invented for each minister on his taking office. It was connected with a Spanish practice, referred to in the course of the Tichborne trial, and adopted by the Spaniards from their eastern conquerors, of using a particular mark or flourish in connection with a signature. The same practice was observed by French notaries, more attention being paid to this flourish than to the signature itself. The Toghra of the Sultan was drawn by an officer of the Chancery, and then the Sultan himself with a reed pen added a small mark on which gold dust was put, thus producing a little spot, which sometimes looked like a blemish, though it was really the imperial signature. With regard to symbolism generally, he should be inclined to doubt whether it dated solely from an epoch of advanced civilization; he rather believed it went back to the very commencement of language, even to those times which were classed as pre-historic. And it was curious to remark that in such language you might find a whole string of words which expressed what in symbolism was called a Negative meaning discovered by himself; and even in modern language traces might be found of this ancient symbolism, which had no longer the same meaning. Such words were like pebbles which had been rolled by the sea of time, until their distinctive external features were lost, but yet on a careful examination their internal structure could be discovered. He did not think the principle of duality was always observed in symbols, because there seemed to have been a period in the history of civilisation, when what might be called a Trinitarian system prevailed, which impressed itself likewise upon the languages and the grammar. This was observable in our own grammar in Greek and many other languages with three numbers, three persons, three tenses, &c. All these questions were of great importance when properly studied, because each represented a particular epoch of thought. With regard to the gentleman who derived the Hebrew characters from the signs of the zodiac, it had been his fortune to meet with him many years ago, but he agreed with Mr. Lawrence, that the theory was not a tenable one; it depended in reality on the maps of the stars, which he need hardly say were quite artificial, and depended to a great extent on the views of the map-makers. He thought a sounder doctrine had been put forward by Mr. Simpson, that writing began with the adoption of ideographic characters, and the symbols first used for religious purposes were afterwards used for the expression of sounds. There were many remarkable circumstances connected with the use of colours in connection with symbols and words; for instance, in many of the pre-historic languages, the word for *Red*, and that for the No. 2 were identical. It had been supposed that the ancient dice were coloured, and that there were different colours for the various sides of the cube, though he could not see what connection there was between the word *Red* and the figure 2. The use of the word *Red* might however be accounted for in this way, that it belonged to a Negative series of words used to express what in symbolism, or comparative mythology, were regarded as negative ideas. Red was often synonymous with Blood, and as the removal of the blood from man or animals caused death, that might account for the word being treated as a negative one. The subject was so vast that it was impossible to deal thoroughly with it, but he might mention that only recently some of the monuments in the Indo-Chinese peninsula—in Cambodia and Pegu—had been found by himself to resemble greatly in form those of Mexico and South America, and at the same time strong affinities were discovered between the languages. He had just discovered also that there was affinity between the Akkad form of the earliest cuneiform inscriptions which remained even now almost without interpretation, and the Aymara, in Peru, thus establishing one historic chain from Babylon to the New World. New facts were constantly coming forward, and they all tended to illustrate the same interesting and important doctrine—the unity which there always had been in the human race, and the way in which progress had been carried onwards from one generation to another, for the building up of a system of civilisation, which, when properly applied, would contribute to the benefit of all. Researches like those of Mr. Simpson, however remote they might appear from practical effects, in the end tended not only to the advancement of knowledge, but, as a consequence, to the development of truth, and therefore to the advancement of civilisation itself. In conclusion, he begged to propose a cordial vote of thanks to Mr. Simpson, who had come forward at very short notice and prepared this very able and excellent paper.

The motion was carried unanimously.

Mr. Simpson, in reply, said he was obliged to Mr. Dixon for the observations he had made. The State document he referred to with regard to the gates of Somnath was the proclamation of Lord Ellenborough, well-known in history, which he issued at the end of the Cabool war, pointing out to the Hindoos that the English power was paramount in the East, as evidenced by these Somnath gates, which were originally Hindoo gates, though with Mohamme-

dan ornamentation upon them. That was put forward with a political object, but he himself, judging simply by the ornament, refused to acknowledge the suthority of that State document, and his opinion as an artist had sincc been confirmed by the acientific evidence to which he had already alluded. He therefore merely suggested that a knowledge of ornament and ancient symbolism was of importance, not only in comparative mythology, but also in the study of archæology. Of course it could not take the place of everything else, but in such questions every point ought to be taken into consideration. With regard to the Mosque of Omar, the curious point was, that before Mr. Ferguson was at all connected with it the ornamentation and art upon it had not been considered, but when this was paid attention to, he believed all were pretty well agreed as to the archæology point, which depended on art, and he thought those considerations had given more information than anything else. With regard to the toghra of the Sultan, he had spent a considerable time in Constantinople obtaining information upon it, and what he was told agreed pretty much with what had been said by the Chairman. It was explained to him that in olden times when the Sultan signed a treaty a sheep was killed, and the Sultan, putting his hand in the blood, impressed it upon the document, but afterwards, probably under religious influence, this hand was given up, and the present ornament took its place.

The Chairman remarked that after a document had passed through the hand of the Grand Vizier, the Sultan's signature was affixed by putting a red spot upon it, which might well be the relic of the old practice just alluded to of slaughtering a sheep.

Mr. Simpson added that with regard to the tope at South Kensington he thought the gentleman who put the question must be under a mistake, as he had never seen or heard of St. Andrew's or St. George's cross upon it.

The Chairman remarked that the Buddhist nations at the present day sometimes used a cross in dating documents, putting the week at the north, the fortnight date at the west, the month in the south, and the year at the east; showing, as they considered, the course of the sun.

Mr. Simpson said he had omitted all mention of umbrella symbolism, because it was such a large subject that it was impossible to go into it. There was no doubt it was sacred to Dionysus, and he believed it really represented the dome of heaven, and also probably the funeral pall. With regard to the Taj, he was sorry that he must still adhere to the opinion he had expressed. The building was certainly in good preservation, except where precious stones had been picked out of it, but fine marble did not make a fine building any more than fine colours made a fine picture, or splendid binding a fine book. The art upon it belonged to the decadence of Mohammedan art, and was not to be compared to the exquisite work done a century or two earlier, specimens of which were to be seen lying about in the ruins at Old Delhi. The subject of colours also he had been obliged to omit on account of the vast field it would have led him into; indeed, to thoroughly take up the subject of symbolism would take up a whole course of lectures.

VISIT TO THE BRIGHTON AQUARIUM.

On Friday last, April 10, a visit was paid by some of the members of the Society and their friends to the Brighton Aquarium, where Mr. Frank Buckland delivered the fourth of a short course of juvenile lectures, commenced during the last Christmas holidays. About 400 availed themselves of the arrangement and went down by special train in the morning to Brighton, returning in the evening in the same manner.

Mr. Buckland's lecture was delivered in the Aquarium building itself, where preparations had been made for the reception of the audience. He dealt on this occasion entirely with aquatic creatures, and pointed out the valuable help that had been lent by the erection of aquaria to the study of fish. After speaking of seals, turtles, and porpoises, and describing the uses and method of capture of the former two, he went on to speak of the availability of fish as a food supply. He noted specially the question of the supply of salmon as food, and expressed hopes that before long salmon would come down to sixpence a pound. He also described the octopus and its habits, and exhibited a model of a gigantic cuttle recently taken in Newfoundland.

After the lecture, prizes were distributed to thirteen young people who had written essays on Mr. Buckland's former lectures. Mr. Buckland and Mr. Henry Lee also pointed out many of the noteworthy features of the aquarium to the visitors.

It should be added that an excellent luncheon was provided by the Aquarium Company for the whole party of visitors.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

PICTURES AT THE INTERNATIONAL EXHIBITION.

First Notice.

Among the many interesting features of the London International Exhibition, the collection of modern pictures, strengthened by the works of deceased British artists, takes perhaps the highest rank. Owners of pictures, when appealed to for the loan of their property, have shown a large-hearted appreciation of the motive which has prompted this excellent addition to the works of living artists, English and foreign. A moment's reflection will reveal this motive in its integrity. It is simply to carry out that idea of art teaching which has always been prominent at South Kensington. No person endowed with the most superficial knowledge of art can fail to perceive the difference in educational power between a heterogeneous collection of pictures and one exemplifying the peculiar style of certain schools or of individual artists. This truth was recognised years ago in the Mulready and Etty exhibitions held at the Society of Arts, and was thrown into strong relief by the collected works of Philip and Creswick exhibited at Kensington last season. On that occasion, the works of two masters entirely dissimilar in aim and treatment, were shown in juxtaposition, and the glowing Spanish sun of Philip was admirably contrasted with the "glassy, cool, translucent wave" of Creswick.

In pursuance of this plan, a collection has this year been formed of the works of Wilkie, Egg, Constable, Cotway, Prout, and Daniel Roberts. The pictures by Wilkie and Egg afford admirable examples of the true English school of *genre* which may be said to have owed its revival to Wilkie. Originated it most certainly was by William Hogarth; but this great pictor of the lives and manners, follies and vices of the people among whom he lived, had no legitimate follower until "Blind Man's Buff" took place side by side with "A Modern Midnight Conversation," the "Penny Wedding" formed a fitting contrast to the "Marriage à la Mode," and the "March to Finchley" was supplied with a fitting pendant in "Chelsea Pensioners receiving News of Waterloo." It would, of course, be vain to compare Wilkie with Hogarth as a dramatic painter. The grim humourist who painted an epigram with the poor-box

covered with a spider's web in the church where the Rake is married, or with the file of unpaid bills carried by the old steward in the "Marriage à la Mode," had no true rival, and no successor, but as an observer of human nature in its kindlier moods, Sir David Wilkie ranks second to none. In him, as in all great masters of *genre* painting, was combined a faithful student of nature, and a lover of those incidents of everyday life which, far more than battles and sieges, compose the history of mankind. Maurice, Prince of Nassau, whilome Stadtholder of the United Provinces, and John Grahame, of Claverhouse, Viscount Dundee, have passed and gone. Niewkerke and Killiecrankie are shadowy names, but Dutchmen still drink beer, play at skittles, and embrace their buxom spouses; while Scottish peasants still retain their peculiar characteristics of shrewdness and *bonhomie*, and are as much addicted to piety and potation as their sturdy ancestors. Although the study of the Dutch school is apparent in tho early pictures of Wilkie, such as the "Blind Fiddler" (in the National Gallery), "The Village Recruit," and "The Village Festival," this influence becomes more apparent in what may be called his second period which intervened between his first visit to Paris in 1814, and his journey to Italy and Spain in 1825. During this period were painted the admirable "Penny Wedding" and the "Chelsea Pensioners," of which a small study is exhibited in the present collection. Wilkie's third period, dating from 1825, reveals not only another range of thought, but another and bolder style of treatment. On the merit of this third style opinions must necessarily be divided, as its inequality precludes either unhesitating praise or sweeping condemnation. "The Maid of Saragossa," "The Guerilla's Departure," and "The Guerilla's Return" bear the vivid impress of a careful study of Spain and Spanish art, but are hardly calculated to sustain the reputation of the painter of the "Penny Wedding." On the other hand, the noble picture of "Columbus in the Convent of La Rabida," explaining his new route to the Indies, and the magnificient "Confession," would induce the belief that Wilkie's last was his truest vein, were not this faith scattered to the winds by the unfortunate "Escape of Mary Queen of Scots from Loch Leven." Taken altogether, the free-handed brown style can hardly be regarded as a legitimate outcome of the genius of Wilkie. The artist was harrassed by difficulties of a pecuniary nature which prompted him to grasp at a rapid method of execution, and to disregard those Dutch studies to which he owed his happiest inspirations. Egg was a *genre* painter, who, although hardly of the first rank, yet made his mark in the short span of life allotted to him. Perhaps one of the best known engravings in England is that from Egg's "Scene from 'Le Diable Boiteux,'" where tho gull is treating to supper two ladies of rather free than elegant manners. In execution, this picture is remarkably good. The figures are well put in, and the colouring, although leaving something to be desired, is difficult to find fault with. Even in his short career the style of Egg underwent a considerable modification due to the influence of the then rising school of pre-Raphaelists. The influence of their teaching is distinctly traceable in tbe two scenes from "Esmond," in one of which Mistress Beatrix is knighting her adorer, and in the other attaching the famous scarf. Still more distinct is the pre-Raphaelite spirit in which the "Life and Death of Buckingham" is conceived. This, although an excellent specimen of the master, labours under the disadvantage of irresistibly recalling the "Death of Chatterton," which at once placed Mr. Wallis in the front rank of British artists. Curiously enough, Egg was an intense admirer of the "Chatterton," and was at one time reputed to have purchased the picture from the artist. As may be recollected by those who saw his terrible London "Trilogy," Egg possessed the faculty—indispensable to a *genre* painter—of telling his story clearly and distinctly, and, apart from a certain hardness of outline, realised his conception by careful and often admirable execution.

The work of John Constable marks an important period in the history of landscape painting, an art in which foreigners are compelled to admit the pre-eminence of the English school. Unlike Turner, who in the early and middle part of his career—before he dropped the rein and allowed his genius to career along uncurbed by conventionality—built largely on the traditions of Claude and Poussin, Constable drew his inspiration direct from nature, and by his fashion of painting "under" instead of before, behind, or at the side of the sun, interpreted English landscapes in a style which on its first introduction excited at least as much dislike as astonishment among the students of Claude and Cuyp, who never tired of denouncing his colour, forgetting meanwhile that different countries have a knack of presenting different aspects.

The azure skies and arid landscape of Italy and southern France have been matchlessly depicted by Claude, and the painters of his school. The muddy roads, the stagnant pools, and leaden atmosphere of Holland have been admirably interpreted by Hobbenir. Brown shaggy woods and rushing waterfalls have been superbly rendered by Rysdail. None of these magnificent painters however essayed to paint English scenery, so peculiar is its rich greenery, with its tearful April smiles, its tender melting showers and bright gleams of sunlight on diamond-dripping leaves. This weeping beauty found in Constable an ardent worshipper. Unlike another and a greater master, the matchless Rembrandt van Ryn, who is said to have acquired the broad effect of shadow, with which his name is associated, from early study in the interior of a mill, Constable, himself the son of a wealthy miller, adored the delights of an open-air existence. The rush of the mill stream was as music in his ears, and a life in a humid atmosphere, amid tender green leaves, waving rushes, and glassy pools, possessed for him an inexpressible attraction. By forsaking Dutch daintiness of finish, and adopting a large and grand treatment, he succeeded in achieving his main object—the accurate representation of that peculiar dewiness which is one of the chief beauties of spring scenery. This cheerful interpretation of the April humours of our climate was highly resented by the champions of the smoke-dried or treacle school of colourists. Fuseli, whose ideas of colour may be summed up in one word—liquorice—despised the painter of watery skies and coming showers, and asked the porter at the Academy for his umbrella, "as he was going to see Mr. Constable's pictures."

The storm of criticism which burst upon Constable's showery pictures was for the most part excited by his daring, in the teeth of treacly models, to paint green trees green. The people who thought it impossible to paint any but brown landscapes with a big tree in one corner and a little one in the other, became bilious at the sight of Constable's vivid green, and turned pale at his deep blue water, which, in the "River Scene," makes certain demands upon faith. Scarcely less indignation was excited by his later method of working with his palette knife, with a view of producing those broad effects which at the present moment are admired, imitated, and envied by the French school. Of this style of work two magnificent specimens are in this year's collection, "The Hay Wain," and "The Leaping Horse." The colour is piled on in huge lumps and masses, but produces nevertheless a realisation of air, water, and life, masculine and vigorous in the extreme. The horse, which gives the title to the last-named picture, is a mere patch of colour, but for all that the picture is intensely real. "Dedham Mill" and "A Romantic House at Hampstead" are smaller, but still charming specimens of Constable's work, and as truthful interpretations of English scenery, have probably never been surpassed.

David Roberts is a fair example of a man who ascended

the ladder of fame rung by rung. The apprentice house decorator worked up by degrees to the composition of a frieze or a moulding, forsook this humble walk of art for scene-painting, and finished by taking the first place among the architectural painters of his day. To his practice as a scene-painter much of his subsequent success is probahly due. His pictures are remarkable as exhibiting a singular completeness of idea and a knowledge of general effect, of which his rivals were curiously deficient. It is vain to urge that wholesale sacrifice of detail to oneness of effect is stagy, and therefore artificial. It may be stagy, but the method is nevertheless true. In the interior of the vast edifices which Roberts loved to paint, the eye disdains to linger on a fragment of tracery or the cut of a cardinal's robe. It is conscious of lofty columns, springing domes, and vast spaces glowing with colour, while processions of cardinals, priests, and worshippers shrink into mere patches of scarlet and gold. Of this broad and simple style the "Interior of St. Mark's, Venice," "Milan Cathedral," and "St. Peter's," with the Pope carried in procession, are admirable examples.

The screens in Room 6 are covered with water-colour drawings, which afford the visitor an excellent opportunity of contrasting the drawings of Roberts with those of Samuel Prout, who delighted in a similar class of subject, but varied widely from Roberts in style. Among Prout's drawings of quaint works and corners of Normandy towns, are several coast studies, including a magnificent "Indiaman Ashore." Cotman's knack of applying a broad style to humble subjects is also well shown in a rather numerous collection of his works.

With few exceptions, the pictures by living English artists demand but slight notice. Among these may be cited a "Woman and Child," by J. J. Hill, and Mr. Canty's "Drifting Away"—the "old love" watching the petals of a torn flower borne away by the stream, while the inconstant one is holding sweet converse with the "new" object of his adoration. It is perhaps rather hard on Mr. George Lucas that his "View in Surrey" should be hung near the "Storm in Harvest" of John Linnell, sen., whose cornfields set rivalry at defiance. One of the most rising colourists of the day, H. A. Burr, sends "Dora" and "Alfred." Clint contributes "Sunset—Stoke-on-the-Wey" and "The Lock at Wallingford-on-the-Thames," while Mr Burchett challenges attention hy a large canvas, "The Making of the New Forest," full of life and vigour. It is of course easy to understand that the approaching exhibition of the Royal Academy deprives this part of the Kensington galleries of much of the attraction which it would otherwise possess.

The late arrival of the French pictures and the exigencies of space make it impossible to include the foreign pictures within the limit of the present notice.

The following is the return of admissions for the first week, ending April 11. Season tickets, 1,719; payment, 25,279; total, 25,998.

The Canadian Dominion Telegraph Company was organised in August, 1868. At the close of 1869, the company had 147 miles of wire; at the close of 1871, 2,853 miles; at the close of 1873, 4,574 miles of wire. The number of messages in 1873 presented an increase of 88,875 over the number in 1872.

The *Scientific American* gives an account of some wonderful natural deposits of carbonate of soda which have been found in the West, six hundred miles beyond Omaha, and forty miles north of the Union Pacific Railway. Deposits of soda are here found in all stages and conditions. In some cases alkaline lakes are encountered, the water saturated with the carbonate. One especial deposit, of many acres in extent, consists of a crust of carbonate of soda more than 6ft. deep, under which is a strong alkaline liquid.

EXHIBITIONS.

HISTORY OF EXHIBITIONS.

The *Practical Magazine* for March has the following sketch of the rise of exhibitions:—

It is scarcely necessary to enter very largely here upon the history of trade exhibitions and museums; it is enough to state that no European country is without such institutions, and there is no question that the principal upon which they have been established has taken such firm root that they are never likely to fall into disrepute. Paris has its *Conservatoire des Arts et Métiers*, Brussels its *Musée de l'Industrie*, Wurtemberg its *Musterlager* (Depot of Designs), London its South Kensington Museum and allied institutions, Vienna its Museum of Art and Industry, Lyons a similar museum, Baden its National Trade Hall, Berlin its German Trade Museum, Moscow its Museum of Arts and Industry, Bavaria, at Nurnberg, an Art and Trade Museum, and Cologne possesses the Rhine and Westphalian Museum for Art and Industry. Other institutions of an analogous nature flourish at Hanover, Frankfort-on-Maine, Chemnitz, Weimar, Görlitz, and many other places.

While such museums are very useful as recording that which has been accomplished in the industrial arts, of course they cannot serve the purpose of instructing the students of technology in the progress of the various branches of manufacture. Hence it has been found necessary and highly successful to inaugurate periodical trade and industrial exhibitions,—some of a purely local character, and some national or universal in the best sense. France first led the way in this development of commercial and industrial enterprise, in the year 1798, from the 19th of September to the 2nd of October, with only 110 exhibitors. The following list gives the years in which other exhibitions followed in quick succession:—

1801	with	220	exhibitors.	1827	with	1,795	exhibitors.
1802	„	540	„	1834	„	2,447	„
1806	„	1,422	„	1839	„	3,381	„
1819	„	1,622	„	1844	„	3,960	„
1823	„	1,642	„	1849	„	4,494	„

Between the years 1803 and 1866 there have been no less than 53 provincial and special exhibitions in 25 French cities and towns.

In the year 1820, a series of exhibitions were opened in Austria—at Prague, Brunn, Graz, Klagenfurt, Laibach, and other places; but the first national exhibition for the whole empire was held at Vienna in 1835, with 594 exhibitors; again in 1839, with 732 exhibitors; and in 1845, 1,865 exhibitors. Prussia had two national exhibitions at Berlin in 1822, with only 176 exhibitors; and in 1827, with 208 exhibitors; and a National German Exhibition in 1844. Since 1830 provincial exhibitions have frequently taken place at Königsberg, Görlitz, Breslau, Magdeburg, Herschberg, Coblenz, Düsseldorf, Halberstadt, Cologne, Aachen, Liegnitz, Grüneberg, Berlin, Erfurt, Bunzlau, Oels, Warmbrunn, and elsewhere.

National exhibitions in the kingdom of Saxony first commenced in 1824, and were afterwards repeated with increasing success as follows:—1831, with 169 exhibitors; 1834, with 286 exhibitors; 1837, with 364 exhibitors; 1840, with 323 exhibitors; and 1845, with 683 exhibitors. Six national exhibitions were held in the former kingdom of Hanover in the following years:—1835, with 381 exhibitors; 1837, with 385 exhibitors; 1840, with 258 exhibitors; 1844, with 348 exhibitors; 1850, with 255 exhibitors; and 1859, with 296 exhibitors. Electoral Hesse had its first national exhibition in 1817 at Cassel, and several others succeeded it.

The attempts made in 1818 and 1819 in Bavaria, at

Munich, were very discouraging, as were also the exhibitions of 1821, 1822, 1823, and 1827; but the Munich exhibition of 1834 had 779 exhibitors, and 1835 had 941, while the Nürnberg exhibition of 1840 had 1,001 exhibitors. Similar national exhibitions were held in Würtemberg, the Grand Duchy of Baden, the Grand Duchy of Hesse, and the Duchy of Nassau. This last had an extraordinary number of exhibitors for the extent of the territory, the exhibition of 1863 at Wiesbaden numbering no less than 1,317 exhibitors. It will, however, have been seen from these statistics that however varying the success of these exhibitions, the principle had found great favour throughout Germany, and was likely to have greater extension in the future. The first really national exhibition worthy of the name was held at Mainz in September, 1842, with 715 exhibitors—222 of these being natives of the Grand Duchy of Hesse, and the remainder from twenty different German States. This, however, led to another experiment on a much larger scale at Berlin, under the patronage of the Prussian Government, where a German National Exhibition was held in 1844, comprising 3,040 exhibitors—1,932 from Prussia, 859 from the Zollverein States, 174 from other German States not comprehended in the Customs Confederation, and 75 from Austria. The Saxon Government opened a similar exhibition at the Easter fair in Leipzig in 1850, comprising 1,494 exhibitors. In 1854 there was an exhibition with 7,005 exhibitors at Munich, and this, with the exception of the Vienna Exhibition of last year, was the most considerable held in Germany.

Switzerland had exhibitions—in Lausanne, 1839; Berne, 1843, 1846, 1848, 1857, 2,050 exhibitors; St. Gall, 1843; and Zurich, 1847, with 212 exhibitors. The Netherlands had exhibitions at Ghent, 1820; Tournay, 1824; Haarlem, 1825; Brussels, 1830; Arnheim, 1868. Since the establishment of the kingdom of Belgium the exhibitions have been at Brussels, 1835, 1841, 1847, 1848, 1856; at Ghent, 1849. Sweden has frequently tried national exhibitions at Stockholm but with very slight success—1823, 62 exhibitors; 1834, 290 exhibitors; 1840, 200 exhibitors; 1844, 210 exhibitors; but a very successful Scandinavian Exhibition (comprehending Norway, Denmark, and Finland) was held at Stockholm in 1866, comprising 4,175 exhibitors. A Norwegian exhibition was held in 1854 at Christiania. Russia had exhibitions for the whole empire at St. Petersburgh, 1829, 324 exhibitors, 1833, 1839, 1849, 1860, and 1870; at Moscow, 1831 and 1835; and at Warsaw, 1841 and 1845.

Of Italian exhibitions, the most important were those of the Kingdom of Sardinia of 1829, 1832, 1838, 1844, 1850, 1854, and 1858, and those of the Grand Duchy of Tuscany at Florence in 1844, 1850, 1854, and 1861. Of Spanish exhibitions we should name those at Madrid, for the entire kingdom, of 1827, 1828, 1831, 1841, 1845, 1850, and 1854. Two exhibitions took place in Portugal at Lisbon, in 1844 and 1849. Greece, together with her revived Olympic games, had an exhibition at Athens in 1859, with 947 exhibitors. Even the Turkish Government had an exhibition in Constantinople in 1863, comprising the natural and industrial objects of the empire; and a Roumanian exhibition was held at Bucharest in 1868.

Exhibitions have also been held in the United States, at New York, in 1828, 1849, and 1858; at Washington in 1846, at Philadelphia in 1865, besides the International Exhibition at New York of 1853. The Empire of Brazil had an exhibition of raw products at Rio de Janeiro in 1866, comprehending 2,374 exhibitors, and the Australian colony of Victoria had one in 1861, with 183 participators, comprising for the most part natural products and raw materials.

It will have been observed that no mention has hitherto been made of the Great Exhibition of 1851, probably in itself the most unique exhibition in the world. Its history is so well known as to need no record here; but no one who saw it can ever forget the impression made on the mind by the Fairy Palace in Hyde-park. The writer travelled nearly two thousand miles to see it, and only was able to visit it thrice. The number of exhibitors was officially given at 17,062; of those, 7,200 were from the United Kingdom, 1,269 from the British Colonies and possessions, 1,720 from Germany, 748 from Austria, 1,828 from France, 4,270 from other countries. The grand success of this great experiment was to produce numerous imitations all over the world, and we are glad to find that Dr. Karmarsch, in speaking of these imitations, holds the very reasonable view that their frequency has materially interfered with the real interests of industrial science. The Dublin Exhibition (mainly owing to the liberality of Mr. William Dargan, since deceased), opened in 1853, was a failure, and the New York International, of the same year, was a very pinchbeck piece of business, altogether unsatisfactory to all persons who took part in it.

The Paris Exhibition of 1855 was, however, on a grand scale, and although the effects have not been permanent, the sight was most attractive. Here, too, an art exhibition of all nations lent its aid to educate the masses and amuse the general visitors. The number of entries as exhibitors was 21,921, of which France and her colonies contributed 11,050, Germany 2,268, Austria 1,371, and the British Empire 2,849.

The next London exhibition was in the year 1862, on an enormous scale. Perhaps the art galleries erected on this occasion were the most suitable ever erected so large, but they were doomed to fall before an adverse vote of the House of Commons, and finally, after the materials had stood glittering in the sun for years at Muswell-hill, as the Alexandra Palace, amidst financial difficulties innumerable, a plumber's kettle boiled over, and, like other stately edifices, fire swallowed it up.

In 1865, there were three exhibitions of an international character, one at Dublin, one at Oporto, in Portugal (3,911 exhibitors), and one at Stettin, in Germany (1,451 exhibitors). These exhibitions proved by their financial failure the truth that cities remote from the centres of industrial and national activity are by no means fitted for such general gatherings; while, on the other hand, Paris in 1867 gave a brilliant proof of the adaptability of that great continental centre for the purpose. On this occasion no less than 42,217 exhibitors thronged to Paris, and for a time rendered that city a temple of the industrial sciences. Dr. Karmarsch observes (writing before the recent Exhibition at Vienna in 1873) that it is probable future exhibitions will never attain the same success, and, as far as financial matters go, Vienna has justified his prediction. Bringing this section to a close, we have only to observe that in 1869 and 1870 three more International Exhibitions were opened at Amsterdam, Altona, and Cassel; none of these, however, either in importance or popularity, approached the original conception of 1851.

Philadelphia Exhibition, 1876.—With a view of properly exhibiting the geological and metallurgical resources of America at the forthcoming exhibition, an association has been organised, embracing among others the names of Professor Leslie, Professor Genth, Professor Raymond, Professor Wyman, Professor T. Story Hunt, and George H. Cook, to whom is to be intrusted by the Board of Centennial Commissioners the duty of collecting whatever will best answer the purposes in question. It is also stated that each Executive Department of the Government which presents articles illustrative of the functions and administrative faculties of such department is to have a representative, the whole of them to constitute a Board, which will be charged with the preparation and safe keeping of such articles, so as to secure complete and harmonious disposition and and arrangement. Rear-Admiral Jenkins, it is understood, will be appointed on this Board as the representative of the Navy Department.

THE POSTAL CONGRESS AT BERNE.

Of eighteen powers invited at the instance of Germany to take part in the Congress which has for its object the establishment of a general postal union, all but France have now accepted the invitation. The principal dispositions of the programme to be discussed at the Congress in September of the present year are as follows:—It is proposed that each Government shall retain for itself not only all the sums which it shall receive for stamps on prepaid letters, but also all that it receives for unpaid letters, so that there shall be no international post-office accounts, an arrangement suggested more than twenty years ago by the advocates of postal reform. A second principle proposed to be established is, that all transit duty shall be abolished, that, for instance, letters going from France to Russia shall pay nothing to Germany, and those sent from Germany to Spain nothing to France.

Another proposition, which would be particularly acceptable to Great Britain, is that the weight of fifteen grammes, or half an ounce, shall be the universal unit of weight for a single letter.

According to the sketch plan drawn up for the use of the Congress, each Government would itself fix the postage which it would make on letters to each foreign country, but with two reservations; first, that the charge shall be uniform to all foreign countries; secondly, that the charge shall not exceed forty centimes or fourpence, except in the case of sea transport of more than 300 miles, when a surcharge of twenty centimes or twopence may be added.

But the projectors of the plan hope that the various Powers will not fix the postage at the maximum, and Germany proposes to fix her charge for foreign letters at twopence instead of fourpence.

The provisions apply not only to letters, but also to postal cards, journals, printed matter, and written documents and MSS.; the maximum charge for these is proposed to be ten centimes, or one penny. Between any two countries belonging to the proposed postal union such charge to be doubled when the conveyance of the mails by water exceeds 300 miles.

With respect to registered letters, it is proposed that they shall be surcharged to an extent not to exceed the ordinary home postage of the country of their origin. It is also proposed that, in case of the loss of any such registered letter, the sender shall receive an indemnity, as is the case in France at present. The cases of letters insured on declaration of the amount of their contents, in use in France, and that of post-office orders, are to be discussed, but no proposals are put forward under that head.

Finally, it is not proposed that the union should attempt to settle the whole question of foreign postage at once, but that the arrangement should be subject to revision by the union at least once in three years, so a at last to arrive at a logical and economical conclusion.

From the summary of the report for 1873 on mines under lease from the Crown in Nova Scotia, it appears that the 28 collieries at work yielded 1,051,467 tons, of the value of £540,000; the 33 gold mines yielded 11,852½ oz. of gold, of the value of £44,000; and the three iron mines yielded 3,485 tons of ore, of the value of £2,100; in addition to these, other minerals of the value of £31,000, were obtained.

The *American Manufacturer* has the following:—Great Britain has now 36,000,000 spindles in her mills; the United States, 8,000,000; France, 5,700,000; the German Zollverein, 4,300,000, of which Alsace possesses 1,700,000; Russia, 2,000,600; Switzerland, 1,800,000; Austria, 1,400,000; Spain, 1,400,000; Belgium, 600,000; Italy, 500,000, and over 2,000,000 for other countries.

A journal of the Jura announces that a rich deposit of minerals has been discovered at Renaison. It includes silver, copper, lead, antimony, sulphur, and iron, in the form of sulphuret.

CORRESPONDENCE.

ECONOMICAL USE OF FUEL.

Sir,—In the number of your *Journal* for February 13, Mr. W. B. Murdoch states that fire-brick linings are used by every maker of stoves in America. They are used by some of our best manufactures of stoves and hot-air furnaces, but certainly not by the great majority. A few years ago they were very rarely used, but they are coming to be adopted more widely, and I hope that at no distant day your correspondent's statement may be literally true.—I am, &c.,

W. J. Rolfe.

Cambridge, Mass, U.S., March 20th, 1874.

MANUFACTURE OF COCOA.

Sir,—Perhaps your correspondent, Mr. H. W. Reveley, can explain more clearly what he means by saying "Cocoa, considered in the light of a substitute for a warm drink, is utterly useless in every point of view."

Cocoa has as large a proportion of alkaloid principle as tea or coffee, and therefore (when genuine) is quite as refreshing.

It is used as a "warm drink" to a very large and increasing extent, and it is more useful to the system than either tea or coffee.

The description given to the mode of preparation in Spain and Italy, in "private houses," is a rough-and-ready process, which is very far from perfection.'

Everyone who takes any interest in the manufacture of cocoa knows that the first desideratum is to grind the cocoa as fine as cream in consistency, but the plan he speaks of can never accomplish it.

It is evident that your correspondent knows nothing of the complicated and beautiful machinery that is necessary for the manufacture of really fine chocolate.

The plan of having a large pot of chocolate which is never cleaned out "from year's end to year's end," will, we are sure, never commend itself to the more cleanly tastes of English consumers; and when it is known that the manufacturer of best chocolate always keeps a large stock in bulk for several months to mellow, the reason given by your correspondent for the practice is rendered unnecessary.—We are, &c.

Cadbury, Brothers.

Sir,—The lecture lately delivered "On the Manufacture of Cocoa" gave the hearers a good idea of the various ways in which the cocoa seeds are treated to fit them for food. At the same time, some of the views enunciated, both in the lecture itself and in the discussion that followed, were not brought forward in that temperate manner the subject demanded. The supporter of any one process hardly carried his hearers with him when he ridiculed the processes adopted by others.

It appears to me that the main point was hardly touched. Various critics—disinterested and otherwise—have been giving their opinions on the subject, and the result is anything but comforting to those who would be guided by scientific dicta. If "doctors disagree," why not those who manufacture cocoa, or those who drink cocoa? What may suit most may not suit all. What may be too rich a food for one man may suit the multitude, and so on.

Surely then the public, they who drink cocoa, are those who shall decide in what form their cocoa shall be presented to them; and it becomes interesting to know how the public show its preference.

It has been stated on oath that 19-20ths of the cocoa consumed in this country is in a "soluble" form.

There are the other preparations, the de-oiled (with the cocoa-butter removed) and chocolate, but the use of them has not become general, although highly recommended.

A firm doing as extensive a business as any, a quarter of the whole trade, and employing all three modes of preparation, gives as the result of its experience, that the consumption of cocoa would not be what it now is were it not presented in a form readily miscible. Barely 1 per cent. is taken by the public consumer in the other forms.

In the last number of the *Journal* a correspondent writes—"Cocoa, considered in the light of a substitute for a warm drink (sic), is utterly useless in every point of view, and 'patent soluble cocoa' is nonsense." What of those who consume this particular two million pounds in the "soluble" form,—do they consider it nonsense? The lecturer informed his hearers that the average consumption per head of cocoa was under $\frac{1}{4}$ lb. per annum, so the practical opinion of eight million consumers may perhaps be held to balance the *ipse dixit* of your correspondent. I am, &c., H. E.

Hampstead, April 14, 1874.

GENERAL NOTES.

Eucalyptus Globulus.—The Salonica and Adrianople railways in some places pass through marshy and feverish districts, which render the stations in those parts very unhealthy. The company have had their attention directed to the practicability of improving the sanitary condition of these stations by surrounding them with plantations of trees, and especially of the *Eucalyptus globulus*, which has come into much notice of late, and which is said to absorb large quantities of moisture, and to purify the air by camphorous exhalations.

Post-office in Germany—The following are some interesting statistics as to the working of the German postal service in 1872. To a population of 31,341,036, there were 53,720 post-office, 898 of which they also used as telegraph stations; there were 27,578 letter boxes; 2,202 shops for the sale of post-cards and stamps; while the number of persons employed in the service is close upon 50,000. The total number of letters conveyed during the year was 422,589,498, and only 162,90 were definitely returned to the unclaimed letter office. Of newspapers there were 226,868,255, and more than 47,000,000 articles were registered for transmission, representing a value of £617,409,494 sterling, and a weight of 134,000 tons. The value of the 11,351.866 post-office orders issued during the year was £21,517,587 sterling, while 4,521,168 packages were sent through the post only to be delivered on payment of the appended invoice (*contra remboursement* as it is termed in France. 475,333.918 postage stamps were sold during the year, and the surplus of the revenue over expenditure amounted to £629,237, or £150,683 more than during the previous year.

Cinchona in India.—Dr. King, superintendent of the Botanical Gardens, reports to the Government of Bengal, that in the Government cinchona plantations at Rungbee, there were, on 1st October last, 2,505,259 plants in permanent plantation, 5,016 stock plants for propagation, 274,000 seedlings or rooted cuttings in nursery beds for permanent plantation, 220,000 rooted plants in cutting beds, making a grand total of 3,004,257 plants, cuttings, and seedlings. Of these, 235,000 are *C. saccirubra*, 125,000 *C. officinalis*, and varieties, 4,695,000 *C. calisaya*; and the remainder is made up of *C. micrantha*, *C. pahuliana*, and *C. pitayensis*. The extension of the cinchona cultivation in Darjeeling continues. Every year additional land is brought under cinchona culture, and it is calculated that 2,000 acres more will be cleared and planted within the next four years. With regard to Ipecacuanha, upwards of 20,000 plants are now in hand, all of which promise well. Another interesting fact relating to the introduction of useful plants into India, is that of the success in the Terai of the Cacao (*Theobroma cacao* L.). The plants that were planted out about a year ago, were sent from Kew at the suggestion of Dr. Hooker, and they are now in a most healthy and satisfactory condition.

Exports to Australasia.—Our exports to the Australian group of colonies appear to be increasing. Thus, our exports to Western Australia in 1873 were valued at £170,193, against £153,457 in 1872; those to South Australia, at £2,022,270, against £1,413.542 in 1872; those to Victoria, at £6,651,002, against £5,941,379 in 1872; those to New South Wales, at £4,340.912, against £3,569.559 in 1872; those to Queensland, at £815.979, against £575.388 in 1872; those to Tasmania, at £271,924, against £188.205 in 1872; and those to New Zealand, at £4.366,196, against £2,300,143 in 1872

The Ribbon Manufacture in Russia.—The ribbon industry of Russia employs forty-three factories, with 1,000 workmen, and an annual production of half a million roubles value. The silk branch is at a disadvantage, from the tardiness of the manufacturers in accommodating themselves to the changes of fashion. The factories for galloon are 23 in number, and there are upwards of 60 gold-thread factories, employing about 2,000 workmen. The annual produce may be estimated at $2\frac{1}{2}$ million of dollars. Embroidery in a national style is carried out on a large scale. The Russian women show great skill in these productions, many of the embroideries intended for ecclesiastical purposes exhibiting representations of painting. The immigration of Persian artists has led to the embroidering of tablecloths, ladies' jackets, &c., in their national style.

Mode of ascertaining the various kinds of Materials in Mixed Fabrics.—A German industrial journal gives, after M. Vupp, the following treatment for fabrics containing silk and wool, with vegetable fibres. All vegetable fibres resist caustic alkaline solutions even when boiling, and are dissolved by sulphuric, nitric, hydrochloric acids, even when diluted, with heat. Vegetable fibres, when burnt, do not give forth any characteristic odour. Wool, insoluble in the above acids, is readily attacked by caustic alkalis, especially when hot; the sulphur which it contains combines with the alkali, and the solution becomes black when acetate of lead is added to it. In burning, wool produces the same smell as horn. Silk is dissolved, both in the acids and the caustic alkalis, and produces an odour similar to that of wool, but it contains no sulphur, and, consequently, its solution in alkalis is not blackened by acetate of lead. In order to distinguish these materials in a tissue, it is treated first with concentrated hydrochloric acid, cold; the residue is then washed in a filter, and if necessary bleached by means of water containing chlorine, and then washed again in pure water and boiled with caustic soda, which dissolves the wool, leaving the vegetable fibre intact. The wool is distinguished from silk by adding acetate of lead to the liquid, as already mentioned.

The French Temperance Society offers for the year 1875 three prizes for competition, of £40, £20, and £40 respectively. 1st. For determining by the aid of repeated chemical analyses, on a large number of samples obtained at hazard from retail shops in Paris and the Departments, the analyses and differences which exist between spirits of wine and the various alcoholics sold as drinks, a prize of £40. 2nd. To ascertain, if it be possible, by analysis of their chemical or physical properties of natural wines and brandies arising from the fermentation of the juice of the grape and other saccharines, from those of artificially prepared and fortified beverages, a prize of £20. 3rd. To determine by chemical observations and experiments, the differences which result on the system from the use of pure natural wines and alcohols, and of others manufactured and artificially fortified and compounded with spirits, a prize of £40. The treatises to be written either in French or Latin, and bearing a motto or device, accompanied with the name of the writer, in a sealed envelope, addressed to Dr. Lunier, general secretary, Rue de l'Universite 6, Paris, before the 1st Dec., 1874.

NOTICES.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque, Post-office order, or Cheque Bank cheque, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

The following arrangements for Wednesday evenings have been made:—

April 22.—"On Progress recently made in Ornamental Processes connected with Metallic and other Industries." By W. C. Aitken, Esq. On this evening Lieut.-Col. A. Strange, F.R.S., will preside.

April 29.—"On some Recent Inventions and Applications of Lambeth Stoneware, Terra Cotta, and other Pottery for Internal and External Decorations." By John Sparkes, Esq., Head Master of the Lambeth School of Art, and of the Art Department of Dulwich College.

May 6.—"On Timber Houses." By Frank E. Thicke, Esq.

May 13.—"On the Importance of a Special Organisation for the Diffusion of Sanitary Knowledge." By Major-General Synge.

The discussion on Mr. G. C. T. Bartley's paper, "On Thrift as the Outdoor Relief Test," will be resumed on Friday morning, the 24th April, at 12 o'clock. The Right Hon. the Earl of Shaftesbury, K.G., will preside.

Indian Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

April 17.—"On the Indian Famine, with Especial Reference to the Means which should be Adopted for Preventing or Alleviating Famine." By General Sir Arthur Cotton, K.C.S.I. On this evening Sir Charles Trevelyan, Bart., K.C.B., will preside.

May 1.—"On the Ruins of Cambodia, and the Antiquities of Indo-China." By H. G. Kennedy, Esq.

African Section.

These meetings are arranged for Tuesday evenings, at 8 o'clock, and the following arrangements have been made:—

April 28.—"On the History, Progress, and Prospects of South Africa." By Col. J. C. Gawler.

Chemical Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

April 24.—"On Pyrites, as a source of Sulphur, Copper, and Iron." By Dr. C. R. A. Wright, F.C.S. On this evening Dr. Frankland, F.R.S., will preside.

May 8.—"On Sugar Refining, with special reference to Finzel's Sugar Crystals." By Dr. Griffin.

May 22.—"On the Manufacture of Chlorine." By W. Weldon, Esq., F.C.S.

Cantor Lectures.

The third course will be by Professor Barff, M.A., "On Carbon and Certain Compounds of Carbon treated principally in reference to Heating and Illuminating Purposes."

The object of these lectures is to explain the scientific principles involved in all heating and illuminating processes, and to apply those principles to practical purposes. The absorbent properties of carbon will be briefly noticed.

Lecture II.—April 20.

Compounds of carbon and oxygen, carbonic acid, carbonic oxide.

Lecture III.—April 27.

Gaseous compounds of carbon and hydrogen, marsh gas, and olefiant gas.

Lecture IV.—May 4.

Liquid compounds containing carbon and hydrogen, and fuel.

Lecture V.—May 11.

Coal gas, its composition and purification, and its illuminating properties.

Lecture VI.—May 18.

Heat of combustion; how heat is communicated, and how quantity of heat is determined.

Lecture VII.—May 25.

Consideration of furnaces, stoves, lamps, &c., in which the principles stated in the former lectures will be applied.

All the above Meetings and Lectures are open to Members, each of whom has the privilege of introducing two friends.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Mon. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Professor Barff, M.A., "On Carbon and Certain Compounds of Carbon treated principally in reference to Heating and Illuminating Purposes." (Lecture II.)
British Architects, 9, Conduit-street, W., 8 p.m.
Medical, 11, Chandos-street, W., 8 p.m.
Asiatic, 22, Albemarle-street, W., 3 p.m.
Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m. Mr. E. W. Gosse, "On the Ethical Condition of the Early Scandinavian People."
London Institution, Finsbury-circus, E.C., 4 p.m. Prof. Bentley, "Elementary Botany."
Social Science Association, 1 Adam-street, Adelphi, W.C., 8 p.m. Mr. William Vallance, "On Outdoor Relief."

Tues. ...Royal Institution, Albemarle-street, W., 3 p.m. Professor Rutherford, "On the Nervous System."
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Renewed Discussion "On the Fixed Signals of Railways."
Statistical, 12, St. James's-square, S.W., 7¾ p.m. Prof. Leoni Levi, "On the Reconstruction of the Income and Property Tax."
Pathological, 53, Berners-street, Oxford-street, W., 8 p.m.
Zoological, 11, Hanover-square, W., 4 p.m.
Anthropological Society, 37, Arundel-street, W.C., 8 p.m.

Wed....SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. W. C. Aitken, "On Progress recently made in Ornamental Processes connected with Metallic and other Industries."
London Institution, Finsbury-circus, E.C., 7 p.m.
Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m.
Archæological Association, 32, Sackville-street, W., 8 p.m.

Thur....Royal, Burlington House, W., 8½ p.m.
Antiquaries, Somerset House, W.C., 2 p.m. Annual Meeting.
Society for the Encouragement of Fine Arts, 9, Conduit-street, W. 8. a.m. Mr. Daniel Grant, "On Characteristics in Art."
Royal Institution, Albemarle-street, W., 3 p.m. Mr. W. Noel Hartley, "On the Atmosphere."
Royal Society Club, Willis's Rooms, St. James's, S.W. 6 p.m.

Fri.......SOCIETY OF ARTS, John-street, Adelphi, W.C., 12 (noon). Adjourned Discussion on Mr. G. C. T. Bartley's paper, "On Thrift as the Outdoor Relief Test."
8 p.m. (Chemical Section.) Dr. C. R. A. Wright, "On Pyrites as a source of Sulphur, Copper, and Iron."
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Mr. C. W. Merrifield, "On Sea Waves."
New Shakspere Society, University College, W.C., 8 p.m. Rev. F. G. Fleay, "On the Authorship of the 'Taming of the Shrew,' with remarks on 'Titus Andronicus.'"
Quekett Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.

Sat......Royal Institution, Albemarle-street, W., 3 p.m.
Royal Botanic, Inner Circle, Regent's-park, N.W. 3¾ p.m.

[The Editor will be glad to receive notices of papers for insertion in the above list.]

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,118. Vol. XXII.

FRIDAY, APRIL 24, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

FUNERAL OF DR. LIVINGSTONE.

Dr. Livingstone's funeral on Saturday last was attended by Major-General F. Eardley-Wilmot, R.A., F.R.S., (Chairman of the Council) and Lord Alfred Churchill, representing the Council, and by Vice-Admiral Erasmus Ommanney, C.B., F.R.S. (Chairman of the African Committee), representing the African Section.

ECONOMICAL USE OF FUEL.

A meeting of this Committee was held on Saturday, April 18th, at the Testing Houses, Western Annexe (not avenue), International Exhibition, South Kensington. Present—Major-General F. Eardley-Wilmot, R.A., F.R.S. (in the chair), Mr. F. A. Abel, F.R.S., Dr. Mann, Rev. A. Rigg, with Mr. Le Neve Foster, Secretary, and Mr. S. W. Davies, in charge of the testing.

MUSEUMS AND PUBLIC GALLERIES.

A meeting of the Executive Committee was held on Thursday, April 16th. Present—Mr. Carleton Tufnell (in the chair), Mr. F. A. Abel, F.R.S., Mr. Henry Cole, C.B., Lord Ronald Gower, Mr. J. Hinde Palmer, Q.C., Mr. U. J. Kay-Shuttleworth, M.P., Mr. Thomas Webster, Q.C., F.R.S., with Mr. Le Neve Foster.

INTERNATIONAL EXHIBITION OF 1874.

The Council have resolved to offer the Society's Gold and Silver Medals in connection with the International Exhibition of 1874.

A gold and a silver medal is offered in each class, and these medals will be given for any object exhibited which, in the opinion of the Council, shows paramount or very great excellence, whether in respect of the final result, the machinery, method of production, or novelty.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

A meeting of this Section was held on Friday, the 17th instant, Sir Charles Trevelyan, Bart., K.C.B., in the chair.

The Chairman said he thought it unnecessary to make any introductory remarks on a subject the appalling importance of which was now so fully appreciated and recognised; and he thought Sir Arthur Cotton's name needed no introduction. He would only say that Sir Arthur Cotton's whole life and great abilities had been devoted to the benefit of India, and to the prosecution of measures which gave the best, if not the only, hope and means for the prevention of such calamities as Bengal was now suffering from, and there could hardly be a higher authority on the subject.

The paper read was:—

THE INDIAN FAMINE; WITH SPECIAL REFERENCE TO THE MEANS WHICH SHOULD BE ADOPTED FOR THE ALLEVIATION OR PREVENTION OF FUTURE FAMINES.

By Lieut.-General Sir Arthur Cotton, R.E., K.C.S.I.

This subject plainly divides itself into two parts, viz., the dealing with actual famine, and the prevention of such a calamity.

The first part does not so much fall within my proper line, and I shall therefore not attempt fully to discuss it; indeed, it is now too late to attempt much discussion with respect to the present famine; there is now an overwhelming demand for action.

It seems, strange to say, too certain that after all the great space so freely given to discussion in all the leading newspapers in England, and all the meetings for discussion on that terrible subject in this or other associations, the four months of warning that we had were almost all lost, as in former famines.

Instead of covering the threatened tracts with depots of grain, European and native agents, projects of public works, shelter for working parties, stores of tools, &c., at our leisure, so as to have everything ready when the pressure came, and before the people were exhausted, and fodder for cattle withered, so that there might be no danger of life, no confusion, no waste of labour, &c., it is too evident from the letters from the spot, that in the worst parts famine had actually begun before anything was done; and most terrible scenes have already been reported at the very commencement of failure of food.

There is something very incomprehensible in this. Is it from fear of wasting money, in case the emergency should turn out less severe than was expected. If so, how could it be concluded that it was better to risk life than to risk money? But with respect to a very large population, the failure of food was a perfect certainty months ago, so that there was no risk of loss in making preparation among them.

As a specimen of the strange delay to provide in time, it was urged at the first that a large flotilla of small steamers should be at once purchased ready-made, and sent out to convey food to every

point that could be reached by water. Instead of this, not a month ago, ten such steamers were ordered to be built. But what false economy it is not to keep a large flotilla in the hands of Government for this or any other kind of contingency. There are now stated to be 700,000 people employed on relief works, a very large proportion of which labour will certainly be wasted, because not employed on previously selected and prepared projects.

It is certain that a large number of those who have to be fed could be conveyed to the line of some great important project, if shelter, tools, food, and superintendence had been prepared beforehand.

Thus the continuation of the Sone Canal to Calcutta might have been constructed, and if 300 miles would cost, at £3,000 a mile, £900,000, about 200,000 people could have completed it in about six months, and instead of the money being lost it would certainly have been one of the most productive works ever executed, and have saved in the cost of transit a far greater amount per annum than the interest of the whole sum that the famine will cost. The saving on a single million tons carried on such a work, even as compared with the cost of river carriage, near ½d. a ton a mile, would be £2,000 a mile per annum; and on that line, connected with the Sone Works and ultimately with the Ganges and Sirhind Canals, the traffic would certainly be two or three million tons. It seems of no use now to dwell upon this unhappy loss of the ample time so providentially given to prepare, though it may yet be of use to teach us a lesson for a future famine. But, on the other hand, it is most cheering to see that now at length this calamity is grappled with in a way, both in respect of liberality and energy, that there was never any approach to in former cases. And I must especially refer to what I consider perhaps the most important thing that could have been done in the case, and that is the Viceroy giving up his retirement to a cool climate and showing his sympathy with the people by remaining at Calcutta during the hot season. I think we cannot over-estimate the importance of this in all sorts of ways, but especially in assuring the natives of the consideration of their rulers.

Another point seems to me especially worthy of note in this matter, and that is the strong light in which it places the immense benefits derived from a sprinkling of non-official Europeans over the country. We had a strong proof of this in the mutiny, and nothing can be more striking than the accounts we now have of the blessing to the people that such residents are, both men and women. The weight of influence that one gentleman can exert by setting an example to and organising multitudes of natives is incalculable, and I suppose there is not a calamity to which India could be exposed that would not be essentially softened by non-official European residents. We have this great advantage at this time in the districts most affected, and the accounts of the effects of their aid given in the papers are most striking.

With respect to the future of the present calamity, I have not sufficient data to enable me to form any complete opinion, but I fear, in spite of all the great exertions now making, there will yet be great loss of life, a large portion of which might certainly have been prevented if those exertions had been made four months ago. But if, as seems now certain, even a much larger number of men and women will have to be employed—indeed, it seems not improbable that two millions or more may have to be fed, who could be set to work—it is yet a great question how to employ them.

There is no want of projected works, and works under construction, over all that part of the country on which any number could be employed. Of course great numbers of the sufferers cannot be removed from near their villages, and must be employed on works in the neighbourhood, however comparatively unremunerative they may be. But a great number can be conveyed to distant works and employed, as I have stated, to the greatest advantage, if such numbers have to be fed, and if the scarcity continues, as is now feared, for several months more. Nothing can be more certain than that there are works of irrigation and navigation that might be constructed, which would be so enormously remunerative that this temporary calamity could be turned into a permanent blessing.

There is another point bearing on the present famine which it is not too late to advert to more particularly, that is the providing of steamers for the canals and rivers. I have heard of fifteen small steamers being contracted for from England, four more being built in Calcutta.

These of course will be of some use before the end of the famine, and they form only a very small part of what might be used with great advantage if they could be ready in time. I apprehend that the Government would be justified in putting a vast number of these in hand yet, as not one of them could be wasted. There are at this moment probably 3,000 miles of large canals in use and under construction, and for these for various purposes a very large fleet of Government boats will certainly be required, so that we should be quite safe in providing five times the number already ordered, though some of them might be too late for the present famine.

One of the mistakes made in the papers on this subject is the omission of all reference to the effects and benefits of the relief works. They all imply that if ten millions are spent, ten millions will be lost; nothing could be more false. No doubt a great deal of it will be comparatively unproductive, in consequence of the want of systematic preparation beforehand, but almost all the work will be useful, and, as I have before said, works of the utmost importance and value may yet be executed. Even a small part of the expenditure, if bestowed upon important lines of navigation or irrigation, would produce a return which would be very great interest on the whole expenditure.

This is the great point that I think should now be kept in view. And it is imperative; if we are to have two or three millions of people upon our hands, what are we to do with them? This must be looked in the face. We cannot judge rightly of this matter without keeping before us the reports that are now daily reaching us. I will only make one short extract, as the paper would be essentially defective without such an account, though it is only one of many and far from the worst.

"I had seen nothing of the kind before, and it came upon me with vivid force that here was the furious hunger of famine, recklessly battling against all restraints. I thought the people would have killed each other in their wild eagerness to force their way to the front; women were screaming, children were crying, and now and then there was a surge of the crowd that threatened wholly to sweep away the food and its distributor, &c."

All this solely from having utterly thrown away the ample time given for preparation,

Now think that in this place ought to have been seen a small part of this mass, well fed, and perfectly quiet, receiving money from many native agents, all thoroughly organised under the superintendence of a European; and the greater part of this terrible crowd most profitably employed on some work of immense importance, in high health and spirits, and learning many useful lessons as natives always do when working under European superintendence. I have had abundant proof that a population which has passed through this training of public works are essentially improved in many ways, and the permanent effect is most salutary.

They are actually now preparing to send multitudes to Burma, &c. How wonderful it is that they are not deporting them 100 or 200 miles to where their labour is most urgently required, in Bengal itself. There are the very best works they could possibly be employed upon, urgently demanding execution, and the authorities are looking to foreign lands for employment for them.

There remain three millions to be spent on the Sone Canals, which would give employment to a million of people for five months, and every rupee spent on them would yield 50 or 100 per cent.

And at this very time authorities are protesting against the main lines of canal being carried on. Who can account for these incredible things? Think of the line of canal from Calcutta to the Gorai, and so to the main Ganges and the Burhampoota, 100 miles, to save 300 miles of Soonderbund navigation, and accommodate a traffic of four or five million tons a year, saving six rupees a ton, or 2½ millions a year, £25,000 a mile. This work left undone, and the Government sending men to Burma to find employment! In 1858, I was ordered to report upon a plan for opening this water communication with the main Ganges, so important did the matter appear 16 years ago, and nothing has been done to this day. At this moment three or four million tons are travelling this 400 miles of dangerous river navigation, at the rate of 12 miles a day, and losing 2 per cent. of boats by the way. In the 16 years, since 1858, probably 25 or 30 millions have been lost on this one line of navigation for want of a canal that would have cost about a quarter million.

And then we wonder that India is poor, and cannot pay sufficient taxes to support her Government. I am certain that if these plans for utilising water had been carried out when they were urged instead of railways, 20 years ago, the saving to India would have been several times the amount of her present debt.

And now here are millions of people wanting food and employment, and the only thing we can think of is to send 1 per cent. of them to Burma. I am informed that the Government are paying ½r. a ton a mile for carriage in Tirhoot, more than 100 times what it would cost to carry it by water. And in that very tract they have just now decided upon irrigation works, on the express condition that the canals shall not be made navigable. Could any thing possibly have occurred showing more clearly the immense importance of these non-official discussions, when official prejudices show themselves so inveterate that the famine itself, and millions now actually being spent in transit, cannot overcome them. They are also there making a railway at a cost of £7,000 a mile, while a canal could be cut, to carry at one-tenth of the cost by rail, for £2,000 per mile, the country being especially easy for canals.

I am informed also that the Governor of Bengal is urging that the Western main Sone Canal should be stopped four miles short of where it would have a connection with the Ganges, so that it may have no effective terminus.

It is too evident from these things that nothing but the energetic interposition of this Society will secure a thorough investigation into these matters, and that the more palpable it becomes that land carriage cannot contend with water, the more strenuous are the efforts making to prevent the canals which are being cut from becoming effective navigations.

I have late accounts also from Orissa. They state that 600 villages have now taken leases for water, though only to a very small extent. But this is quite sufficient to show that with proper management the difficulties about the people not using the water can be got over.

There also the main canal to connect Calcutta with Cuttack is ordered to be stopped short of an effective temporary terminus at Tide-water, near Balasore, instead of being pushed on with all possible vigour to Calcutta. The price of rice in Orissa in December was £4 a ton, and in Nuddeea, near Calcutta, it was £9, a difference of £5 for a distance of 250 miles, over which it could be carried by canal for 1 r. Thus the price of rice where they wanted to buy was double the price it might have been bought at, or half what they might have got for it where they wanted to sell. Think of food being sold in a district at the famine price of 1d. a pound, when it was selling within 250 miles at less than one halfpenny, for want of one link of canal of about 80 miles.

With a system of canals, the cost of carriage from one end of India to the other would be under a pound per ton, making a most serious difference in the cost.

I proceed to the second part of the subject—the prevention of famine.

On that point one thing is quite certain, that wherever water for irrigation is provided, famine is effectually met, and wherever effective water transit is, grain can be conveyed in any quantities that can possibly be required, and at such an insignificant cost of carriage that if it had to be brought from the furthest point in India, the expense of transit would be of no consequence.

I cannot see what necessity there is for looking further for other remedies when we know that these are perfectly effective, and at the same time will answer all other purposes.

Nothing can be more certain than that the extensively-irrigated districts are perfectly safe from famine; that is, supposing, of course, the seasons continue as they have hitherto been.

But I must first try to meet two false notions which are frequently brought forward.

One is that famine is caused by failure of water. It is not. There is plenty of water in India, both from the local rains and from the large rivers. It is not that God has not favoured India with ample supplies of water; it is from want of regulation of it that the crops fail. In the year preceding the famine in Orissa. there was a local fall of 60 inches of rain, besides rivers flowing through the district that would have secured a crop on every acre perhaps fifty times over. If every acre were cultivated, a fall of rain of 36 inches would secure a crop of rice, provided it were suitably distributed. There was very little less than this in Behar this year, I am informed.

What is wanted is works to regulate the supply. If naturally 30 inches of rain fall in June and July, and there is then an interval sufficiently long to allow of the crops withering, a second fall of 30 inches in the latter part of the monsoon is quite in vain, and famine is inevitable, while a very few inches in the interval would have secured an abundant harvest. But the rivers afford an overwhelming supply of water, quite independent of the local rains. A single day's supply of the six great rivers of India would give a crop of rice on four million acres, providing food for ten millions of people.

And this brings me to another false notion which is very common—that irrigation merely supplies moisture, and consequently if the rain could be depended upon irrigation would be useless. The mistake here lies in the idea that river-water and rain-water are the same, but they are not. The former is full of nourishment for plants both in suspension and solution, far beyond what the latter contains. Thus the old river-irrigated districts have gone on producing undiminished crops for hundreds of years without manure; and hence every acre ought to be irrigated from the rivers, even if it was secured in a supply of local rain; the increased value of crop from river water would be a return of 50 or 100 per cent. on the cost of the works. And so with the supply of water for canals. All the water they require is a drop in the ocean compared with the quantity in the country; and the cost of supplying it for canals, by whatever way, is quite a trifle.

A late governor wrote a pamphlet on transit in India, commencing with this assertion, that water was so scarce and expensive that it could not be used for carriage; and every word in the paper rested on this foundation, which is as directly false as it is possible to be.

The foundation of all our proceedings in the matter is that water is so abundant and so cheap that it ought to be applied to every purpose possible—production, transit, and power. On the Godavery, we distribute 8,000 million cubic yards per annum, for 8 per cent. on £500,000, that is £40,000, or 20,000 cubic yards per rupee; and where the works have cost 3½ times as much as in Orissa, the cost is 1 rupee for 6,000 cubic yards. These rates include all the distribution and drainage works and others.

Now, to supply the evaporation of a canal fifty yards broad would require 180,000 cubic yards per mile, costing from ten to thirty rupees per annum, and the cost of lockage water would be equally insignificant.

But before I go further, I beg to be allowed to state my advantages for giving opinions upon these points. First, I have had forty years' actual experience in projecting and executing such works; and secondly, having now been out of office for ten years, and so freed from the continual pressure of detail work, I have had leisure to digest the materials I had accumulated, and I must state that during this latter time some of my former conclusions have been greatly strengthened, and some have been modified.

As to the general conclusion that water is the great treasure of India, that is, that the difference between its cost and its value is greater than that of anything else that India contains, this conclusion has been only confirmed in every possible way by all my investigations. Thus 20,000 cubic yards, costing from 1 to 3½ rs. for irrigation in interest and management, will produce an increased value of crop of about 60 rs. or from 17 to 60 times its cost, if it were all used, and even allowing for great waste from 10 to 35 times its cost, and this besides its use for transit in the same canals.

On the other hand I have modified my opinions on the use of water for transit in this respect, that I have come to the conclusion that it is of greater value than I formerly thought it, and that in the present state of things in India, it is perhaps of greater importance than for irrigation, so that I feel persuaded that the first thing now to be done is to complete a net-work of steamboat canals for India. Of course this need not interfere with the prosecution of irrigation, and indeed much of it would necessarily be done in connection with irrigation; but that if it were necessary to do one of them only, I think I should cut the canals for transit first.

With respect to famine, it is quite evident that if all India could be laid under contribution to supply food and fodder to a tract suffering from that, it could certainly be met, and would be, almost entirely in the ordinary course of trade, if only the sufferers were supplied with money.

If food could be brought 2,000 miles, that is from the very extremity of India, for 1-20d. per ton per mile, or for 4 rs. per ton, only increasing the cost from suppose 2-3d. a lb., where it was abundant by 1-22d. per lb., or from 18 seers per rupee to 19 seers in the famine tract, there could be no difficulty in supplying food in respect of cost, and such canals could convey any possible quantity without any difficulty. The boats now in use in India would convey five times as much by canal as they do now by river, as instead of averaging about 12 miles a day, they would, on a canal, move night and day, and average about sixty miles a day, even if worked by men. Thus, there could be no want of means of conveyance. But while transit canals would in this way so far meet the demands of a famine, though they would still leave so much to be done in the way of distribution, &c., they would produce nothing less than a revolution in the prosperity of India if this main net-work was completed.

But the general ideas on this subject of transit are so utterly erroneous that I must first try to correct them. How common the idea is that the railways have accomplished the task of effectively conveying the traffic of India, and that that ques-

tion is finally settled. Now let us compare this fancy, that the conveyance of 130,000 tons (the average carried by rail) on the main lines of India, at a charge of $1\frac{1}{2}$d. a mile, is all that is required, with the actual state of things on one line of which I have the statistics.

This is the line from Calcutta to Goalundo, the confluence of the Ganges and Burhampoota, 130 miles direct. The modes of conveyance are by the rail 160 miles, and by rivers 470 miles, by native boats and steamers, and the quantity and cost is as follows:—

		£
By rail, 160 miles, 220,000 tons at 9 rs. ..		198,000
By boat .. 1,700,000 tons at 6 rs. ..		1,000,000
Steamer .. 30,000 tons at 9 rs. ..		27,000
	1,950,000	1,325,000
Insurance 2 per cent. on 100 rs. per ton, for 1,700,000 tons		340,000
Interest for 6 weeks, $\frac{1}{2}$ per cent. on 100 rs.		70,000
Total cost of traffic		1,735,000

Thus is shown—

First.—That only 1-9th goes by the rail, though the navigation is very bad, the loss of boats enormous, the distance three times as great by water as by land, and the average time six weeks by water, against one day by land.

Second.—That no less than $1\frac{3}{4}$ millions are paid on this short line of 130 miles, or £13,000 a mile, the interest at 8 per cent. of £160,000 a mile, so that it would be worth while to spend £100,000 a mile on a work that would reduce the cost from 9 rs., the railway rate, to 3 rs.

Third.—The total quantity carried the whole way is 2 million tons; with these drawbacks of high charge, great risk, and great loss of time.

Fourth.—But further, a great part of this line (100 miles direct) is used for the Upper Ganges traffic during seven or eight months in the year, and I believe more than a million tons pass that way, so that 3 million tons at least are carried in this direction, and probably if a perfectly effective canal were cut, the whole of the Upper Ganges traffic would go this way, making 4 million tons of present traffic. Now the total receipts for goods on the railways is £4,300,000, on 5,500 miles £800 per mile, which at $1\frac{1}{2}$d. a ton, gives 130,000 tons as the average amount carried by them. The above 3 million tons is certainly that of the greatest traffic in India, but on the other hand it is only the present traffic.

If on that line there were a canal carrying at 1-20d. a ton a mile, or $\frac{1}{4}$ rs. for the whole distance, 1-24th of the present lowest charge without any risk or loss of time, or less than 1-30th of the present total cost, we may be sure that there would be a great increase of traffic, and probably 5 million tons would be carried by it instead of 220,000 by rail, or more than 20 times as much, the total cost being at $\frac{1}{4}$ rs., £125,000 for 5 million tons, instead of $1\frac{3}{4}$ millions for 2 million tons.

Fifth.—Including the Upper Ganges traffic the cost of transit on this line cannot be less than $2\frac{1}{2}$ millions, so that if the same were carried by canal at $\frac{1}{4}$ rs. for the whole distance, the 3 million tons would cost only £75,000, a saving of £2,400,000 a year on present traffic, besides the profit on the new traffic.

But if India is paying $2\frac{1}{2}$ millions on that 130 miles, what is she paying on suppose 6,500 miles of main line (besides all the secondary lines), and what is she losing by the stopping of perhaps three or four times as much from the prohibitory cost of transit at present.

After this investigation, what are we to think of men resting satisfied, as if the great question of Indian transit had been settled, when we have 5,500 miles of railway carrying 130,000 tons at $1\frac{1}{2}$d. per ton.

Nothing can be more certain than that if water-carriage was provided on these main lines, an average of at least 1 million tons would be carried, more likely 2 millions. And nothing is more certain than that they could be carried night and day, even by men, at 60 miles a day, at a cost of 1-20d. per mile, and without any risk worth mentioning.

Now, to connect this with the famine. If these works, placing a famine tract in effective communication with all India would counteract that calamity, and if the same works are absolutely essential to the well-being of India in all other respects, surely they are the very first works to be put in hand.

The question thus remains, what would they cost? But for this we have abundant data in the thousands of miles already cut.

In the plains they have cost from £1,000 for the Ganges and the Ellore canals, to £4,000 for the Sone main canal, the first from 60 to 15 yards broad, the second 25 yards, and the third 60 yards at the head.

In the upper undulating country the Toombuddra canal has cost about £7,000 a mile, from 60 to perhaps 15 yards broad, and with great lockage, about 500 feet in 190 miles.

Now, the main network of these lines would be from Bombay up the valley of the Indus, down that of the Ganges to Calcutta, round the coast of the Peninsula by Cape Comorin to Carwar on the West Coast, with three cross lines, viz., from Madras south-west to Ponany, and north-east to Carwar, and from Coringa to Surat. These lines, with the Burhampoota, a fair navigation which no doubt might be improved, would form a complete system connecting all India, and conveying its goods to the nearest points to the Red Sea.

There would be about 6,500 miles of canal, which would average about £3,000 a mile, a total of 20 millions. But of this about 2,000 miles are provided for in the irrigation works now under construction, leaving about 4,500 miles, to cost $13\frac{1}{2}$ millions, to be constructed.

To give some idea of the value of this system in money, to convey a million tons by it at $\frac{1}{20}$d. per mile, would cost £1,300,000, besides 8 per cent. on 15 millions, or £1,200,000, together $2\frac{1}{2}$ millions, while to convey the same quantity by river at $1\frac{1}{2}$d. would cost 13 millions, and by rail at $1\frac{1}{2}$d., 40 millions. But who can estimate the effect that such a system would produce on every interest of India, setting every province free to produce principally whatever it was peculiarly fitted for, while it was provided with other things from those tracts where they could be most cheaply produced. I have not here complicated this

subject with irrigation, though of course most of the lines would be used for that, and the interest abundantly paid by it, leaving the navigation free.

Upon the whole, therefore, I am quite satisfied that the first thing to be done for India, in respect of both the famine and its general interests, is to give it such a system of cheap transit, and at the same time to carry out the various projects of irrigation already planned and others, which would indeed be necessarily connected with it. I need hardly state that all the lines I have mentioned are perfectly practicable. But while on this subject I should point out that the main line of all, those of the Gangetic plains, want only a little to complete them, in addition to the irrigation lines now under construction. Thus, a line of 100 miles from Calcutta to the Gorai, and so to the main Ganges, an aqueduct across the Jumna at Allahabad to connect the Sone Canal with the Lower Ganges project, and another over the same river near Delhi, to connect the Sirhind Canal with the Ganges Canal, would give a tolerably direct line from Calcutta to Loodianah, quite effective throughout the year, and at the same time afford a tolerably direct line to the Burhampoota. But it would have the disadvantage of river navigation by the Gorai and Ganges to the lower end of the Sone Canal at Monghyr. To complete the line, the latter ought to be continued from Monghyr to Calcutta; most of this line is provided for by the Rajmahal project. Thus, for about half a million, the line might be effectively opened from Calcutta to Loodianah, 1,200 miles, and for a million more the canal from Calcutta to Monghyr be opened, independent of irrigation; and I should recommend this being done at once, as it would take a much less time than the irrigation works. The effect of this one line of 1,200 miles, through such a vast population, about 120 millions, would be prodigious. I have no doubt two million tons a year would be carried along it on an average.

I may reply here to the objections commonly made to water communications.

First.—The speed is so low. Any speed can be applied, as on land. A boat is now building, guaranteed to run at 20 miles in open water.* But 19-20ths of the traffic does not require speed at all. Worked by men night and day, a speed of 60 miles a day would be obtained, which would meet the demands of by far the greater part of the traffic. We have seen that 8-9ths of the traffic to Goalundo averaged 12 miles a day; and for that which requires higher speed steam will supply it, as on land.

Second.—The locks cause such detention. The answer is that the large locks now constructing are made to fill in one or two minutes, and with proper arrangements for opening and shutting the gates in a few seconds, the whole time lost at a lock need not exceed two or three minutes. Further, on most of these lines very few locks will occur.

Third.—The banks will be injured by the waves. The reply is that on these broad canals the effect of any wave is not great, and the banks can be easily protected.

Fourth.—I have before shown how easily water can be supplied. But I may here refer to a plan for making a canal in the plains on any level that may be cheapest in construction, without reference to the level at which water is found on the spot. It is to supply it by steam power. For instance, from Calcutta to Goalundo, to cut a canal down to the level of low-water would be a very long and expensive work; but to cut one on a level that would give the least work is a very simple operation. A channel 50 yards broad and 1½ yards deep, with embankments to retain water 2 yards deep above the surface, would be very inexpensive. The raising of the water to supply evaporation and lockage by steam power is quite trifling. For instance, to raise 180,000 cubic yards per mile to supply the evaporation, if raised 20 feet, would cost only £15 per annum, the interest at 5 per cent. of £300. And so with the lockage water. I calculate that for a traffic of 5 million tons it would cost only at the rate of £30 a mile, the interest of £600 a mile, or together equivalent to a capital of £900 a mile, while it would save probably £5,000 a mile in construction. The total charge on this line on 5 million tons, for raising the water, would be only £45 per mile, or 1-440th a penny per ton.

And on this plan the canal of 130 miles could easily be cut in a few months, and probably would not cost £3,000 a mile, or £400,000 in all, which would be saved on 4,000,000 tons per annum in six weeks; the present cost being, as before given, £3,500,000, and that at $\frac{1}{10}$d. per ton, or half rupee for the 130 miles, £200,000, a saving of £3,300,000 a year.

It seems essential, in arguing for water transit as a remedy for famine, that these objections continually put forward should be removed; they are in the great majority of cases not in the least the conclusion of real thought and judgment of the matter, but solely those of violent bias in favour of railways, searching about in all directions for something to say against any other means of transit.

Nobody can deny these things :—

First.—That water carriage, even with human labour, is cheaper than land, even with the help of steam.

Second.—That nobody can discover a reason why steam is to be applied to land carriage, and everything else in the world except inland navigation.

Third.—That the most perfect steamboat canals can be cut in India for a fifth or a tenth of what single railways have cost in India.

Fourth.—That boats can be propelled by steam at ample speed for all purposes.

Fifth.—That for $\frac{19}{20}$ of both goods and passenger traffic high speed is not wanted at all in India.

Sixth.—That wherever there is even wretched water carriage almost all the traffic goes on just the same as before the railway.

Seventh.—That it is impossible a country without good water carriage can contend with one that has it.

Eighth.—That the railways have laid the terrible burden upon India of £1,750,000 a year to make up the interest to the shareholders, besides £2,000,000 more the interest of their debt of £30,000,000, and of the cost of the land, &c., which is not included in the Blue Book accounts. What would be the state of Indian finance now if we could recover this £30,000,000, and be freed from £3,750,000 a year that we are paying for this mistake?

* I ran the half mile in her in 1 minute 17 seconds at still tides—23½ miles per hour.

The East Indian Railway to Loodiana has cost, including land and debt, £40,000,000, and it carries an average of 200,000 tons a-year at a charge stated to be $1\frac{1}{8}$d. The debt on this line was stated in the Blue Book to be £7,500,000 at the end of 1869; it must be now about £10,000,000.

A steamboat canal of the most perfect kind could have been made at that time at certainly £2,500 a mile, or for £3,000,000 in all—a saving of £37,000,000 on this one line. But this is a small matter compared with the loss of traffic, for a canal would certainly have produced a traffic of 2,000,000 tons instead of 200,000, and it would have carried that tenfold quantity for the same money. It could even have been worked at the same speed for those things that required it. Who can estimate the loss to the country on this one line, by this mistake of attempting to carry by land instead of by water.

It is of the utmost possible importance to the future management of India that this terrible mistake should be thoroughly considered, that we may understand what can now be done to counteract it in a measure, and to enable India to bear this great burthen which the railways have laid upon it.

I am fully persuaded that nothing can do this but cheap production and cheap transit by means of water. If any man has any other plan to propose let him propose it. It is certainly very humiliating to have to acknowledge to ourselves that we have made a grievous mistake, but it can answer no possible purpose to ignore it, and keep the country deprived of effective transit, or transit which will enable it to contend with the rest of the world.

The President of the United States, in his last message, made this matter of water transit a leading point, and they are now preparing to enlarge, extend, and complete all the great water lines of the States, so fully do they acknowledge at length what everybody indeed knew thirty years ago, that railways cannot carry cheaply, and that no country can fully develope without water carriage. And if from fear of acknowledging our mistake we persist in paralysing India by keeping it without effective transit, it will be left still more completely behind in the race with America, and we shall do it such an injustice as cannot be estimated. Besides this, millions are still being expended on these works, not one of the new railways much more than paying their expenses. In the last Blue Book seventy miles of railway are stated to have yielded a profit of £5,400, or £80 a mile on a capital not stated, but certainly not less than £7,000 a mile, showing a loss of £20,000 a year, besides the interest of their debt, and all this solely for the purpose of enriching the country, leaving taxes laid upon districts hundreds of miles distant to pay the interest of these lines, and the work persisted in, in spite of every new work, without exception, entailing a new burthen on the revenue; and then every official paper, with very few exceptions, saying it is impossible to give the country irrigation and navigation, which pay enormous interest, on account of the state of the finances.

I may now notice some of the misapprehensions which lie at the root of these runious proceedings. In speaking lately to a gentleman in office, he said "Everybody approves of irrigation, but it is a question of money." Both these common assertions were directly opposed to the truth. Every high official in India is opposed to irrigation, and still more to navigation. There are about ten irrigation works that had been actually begun, or for which plans and estimates have been fully prepared, which have been stopped by the authorities. The late Viceroy stopped the Dumooda Canal and other works, stating the heavy responsibility that rested on him, that he should not run the smallest risk of leaving an additional burden on India; at the same time he was pressing on the Chanda railway at an estimated cost of £6,000 a mile, the head of the department acknowledging that it would not pay its interest, while on that very line the river Wurdah could be rendered navigable for £2,000 a mile, and carry at 1-10th of the cost by rail. And this without the usual excuse that we must have high speed, for it was only to carry cotton and coal.

The other idea that it is only a question of money is equally false. It is no question of money; the profits on irrigation and navigation are as well known and as certain as anything can possibly be. There is certainly one work which is unfinished, which has yet made no returns, but the other seven new works are making the most prodigious returns, several of them certainly the most productive engineering works in the world, not only in their total results, but direct into the Treasury also.

And the Orissa works are yet unproductive, not from any failure in the project in itself, for it has cost 35 rs. an acre, and the carefully estimated effects where the water has been tried are 15 rs. in grain only, 40 per cent. besides transit, drainage, fodder, and other things.

But what must be the mismanagement when the people will not use the water with a payment of 1 r. at first and $2\frac{1}{2}$ rs. ultimately, while the value of it is 15 rs. in produce above the other land, even when the latter has a crop. They say, "What's the use of our having the water when half the profits go to the zemindar and half to the money-lender." How can anything do any good if the cultivator is not secured in his rights by the authorities?

But are we to base our proceedings upon this temporary failure of one, or upon the prodigious success of the other seven?

Further, the main canal to connect this tract with the great market of Calcutta has been stopped, and the district cut off from this main outlet for its produce. What can stand against such things as these? What would have been said if the East Indian Railway had been stopped at 100 miles from Calcutta? Even by sea the traffic to Orissa, not only in goods, but in passengers also, is very great. What would it be if the charge for both were greatly reduced, and all the risks and disagreeableness of sea transit had disappeared?

If there were not the most unaccountable prejudice against these essential works, the very life of India in every respect, returning upon the whole 15 or 20 per cent. (including Orissa) direct to the Treasury, how can we account for their being kept out of public view as far as possible by withholding a Blue Book, while the railways that have entailed such a heavy burthen permanently on the country, that have at this moment a hopeless debt of 30

millions on them, increasing at the rate of 4 millions a year, and have totally failed to carry the great traffic of the country, have a separate department in the India House and a Blue Book?

Take a single fact about irrigation. The works have cost from £1 to £3 10s. per acre; the value of a crop of rice in a famine at $1\frac{1}{2}$d. a lb., with a produce of 1,200 lbs., is £7 10s., grain only; a single crop more than double the whole cost of the most expensive of all these works, besides cheap transit, &c. The Sone works have this year irrigated 130,000 acres, and the crop is valued at £450,000, £3 10s. per acre, while the works have cost about £500,000, which includes all the heavy works, commanding a much larger area.

Further, it must be remembered that the present works include all the mistakes of our apprenticeship, which will, of course, not be repeated in general. The Ganges Canal, for instance, cost much more than double what it would have done with our present experience, and yet it is returning good interest, and its total profits are enormous. It has cost about £2 10s. per acre, and the estimated value of the increase of crop is £1 10s., or 60 per cent., besides cheap transit, &c.

On all the great projects now in hand or estimated, a vast amount of talent and experience has been brought to bear, beyond those of which the works in operation had the benefit, and even these latter works are every day being corrected and improved, under the influence of this experience. The present head of the Irrigation Department, Colonel Rundall, has had under his review more than a dozen of these great projects, and each has the benefit of his accumulated experience. We cannot be mistaken in calculating upon all future works being much more economically and effectually planned and executed than those which are now producing such unprecedented results. Thus, I have every reason to believe that the Sone works are far more effectually planned and executed than any previous works.

The famine is already producing good effects in this respect. Several works that had been stopped have been resumed. The Governor of Bengal had stopped the western main canal from the Sone, but the Viceroy ordered it to be resumed, notwithstanding the continued protest of the Governor. It is evident that nothing less than this overwhelming calamity was sufficient to overpower in any degree the strange determination to suppress these essential works. Not that there is not a great deal doing in a desultory way for irrigation and transit, but all under some external pressure. There has been no distinct acknowledgment of the vast effects of these works, nor anything approaching to the formation of a separate department in the Indian-office, or a well-digested general plan for a system of such works embracing all India. In consequence of this, all the great projects are isolated, and thus are not one-tenth of the use for transit that they ought to be for want of a few links to connect them; and even in some of the works defects are left uncorrected. Thus, the Ganges Canal, though provided with locks for irrigation, was left for 25 years so defective as to be of very little use. One of these defects was that the bridges were so low that well-loaded boats could not pass under them. This has now been corrected; but it was one of many. In this way one of the finest highways in the world was hardly of any use till lately. It was also stopped at Cawnpoor, 120 miles short of the north-western capital, which alone reduced its value to one-tenth of what it ought to be. The Lower Ganges Canal is now planned to continue the Ganges Canal towards Allahabad, but I understand the late Viceroy, in spite of protest, ordered it to be stopped 50 miles short of Allahabad. Whether this extraordinary order has now been set aside I have not heard. With this continuation, nothing is wanted but an aqueduct across the Jumna to connect this whole system of canals with those of the Sone.

In dealing with the famine it is essential that all these things should be brought into full light. Water is the only remedy for them, and until this infatuation about it is swept away, India cannot escape from these most awful calamities, nor can she prosper as she might, till this, her greatest treasure, is in some good degree extensively and effectively turned to account, till a general system of irrigation and navigation is carried out.

The simplest way of showing the wants of the country in the way of transit is by stating the difference in the prices of food in different localities, of which I have already given an instance. The greatest difference I have found stated is between Ahmednuggur, in Bombay, £11 a ton, and Ferozpore, in the Punjaub, £3; a difference of £8 for a distance of about one thousand miles, while it would be transported that distance by canal for about four rupees, if there were one direct, and for less than £1 with a great circuit. Between Tirhoot, north of the Ganges, £10 10s., and Pooree, in Orissa, £4, a difference of £6 10s. for a distance of 700 miles, which would cost by canal about three rupees; and between Coringa on the East Coast, £6 10s., and Surat, on the West, 800 miles, £11, a difference of £4 10s., where by the Godavery and canal the cost of carriage would be about £1. It is thus that the country is paralysed, one district growing at a great cost what is not suited to it, or suffering from famine, while another is suffering from ruinously low prices for want of a market. Most of Orissa, Berar, Raipoor, Cuddapah, and the Punjaub are suffering from low prices, while a large tract is under famine.

The main network of 4,500 miles (besides 2,000 miles now in use or under construction) would be cut for about 13,500,000, a tenth of what the railways have cost, carrying ten or fifteen times as much, and at a tenth or twentieth of the cost by the latter, and really and perfectly meeting all the wants of the country.

I give another illustration of the state of this question of transit in the case of the Central Provinces. The total external trade for 1872-3 is stated to be 250,000 tons—value, £6,900,000 exports and imports; and the population is about 10,000,000, which gives $\frac{1}{40}$ ton and £$\frac{7}{10}$ per head; this implies a state of absolute paralysis. How could it be otherwise? The province is entirely cut off from all traffic worth mentioning, both with other parts of India and with the rest of the world, by many hundred miles of land carriage.

The Commissioner, in reporting upon this, says, "There seems little hope of material increase. In the development of agriculture, and by the provision of means of cheap and rapid transport alone

is there hope of much progress." The word "rapid" is of course introduced here to support the railways. Nobody can imagine that rapidity of transport has anything to do with the matter. Whether agricultural produce or 99 per cent. of the passengers travel at 5 miles an hour or 30 does not signify a straw. The sole thing required is cheapness. He goes on to say, "And to this end it has been proposed to construct a line of railway to Chatisghur. I have already alluded to this railway project as one of the most urgent needs of the province, and as the statistics of the existing traffic on this line prove that a light railway can be worked on it with profit, I earnestly trust that sanction may be accorded to it."

Now railways have been tried to Nagpoor, and what has been the result. The following is the statement of the accounts of the Peninsular Railway:—

	£
Cost of 1,280 miles	23,500,000
,, land &c., $\frac{1}{12}$	2,000,000
	25,500,000
Debt about	8,500,000
Total cost	34,000,000
Interest of do. at 5 per cent.	1,700,000
Net receipts in 1872	610,000
Charge upon taxes	1,090,000
Cost per mile	20,000
Add for debt	6,000
Total cost per mile	26,000

And the debt is increasing at more than a million a year. If one-fourth of this were charged upon the Central Province revenues, or £270,000, as it ought to be, it would swallow up the small balance to the credit of the province and leave it without one rupee to send to the general treasury for its share in the expenses of the Government.

	£
Thus, Revenue of Central Provinces	1,130,000
Expenditure	860,000
	270,000
Share of railway loss	270,000
Balance	000,000

And the remedy is to spend more on railways in a part of the country with the thinnest and poorest population!

The two Government railways lately constructed in the next province, Berar, are only a little more than paying their working expenses. Now what effect has this Peninsular Railway had upon these provinces after five or six years? The trade is still next to nothing. The charge by rail is from £5 to £8 a ton to Bombay, from double to quadruple the cost of freight to Europe. Who can imagine that this would have any significant effect upon the province?

Now to open this line effectively to the coast, the Godavery navigation was undertaken. It was carried 220 miles to the second barrier, at a cost of £2,000 a mile, 1-10th of that of the railway, and the whole line could be completed to Nagpoor and to where the railway crosses the Wurdah at that rate. But the river is not navigable two or three months in the year. For £3,000 a mile a perfectly good navigation throughout the year could be completed, carrying at certainly $\frac{1}{2}$d. a ton a mile, probably $\frac{1}{3}$d., or for a charge of from $7\frac{1}{2}$ rs. to 9 rs. to the port of Cocanada.

At this charge the province would be effectively opened to the whole world, and the traffic on it would be enormous, especially in coal to the Coast, and in salt from it, which two things alone would certainly be soon 100,000 tons.

When the works at the Second Barrier on the Godavery were half finished, an order was sent from the Secretary of State to stop them instantly, when they would have given 150 miles of additional navigation, and opened up the populous country. Thus this line of really cheap transit, costing only £2,000 a mile, was stopped, and the part already opened rendered of little use, while railways, which have been proved after several years use both to lay an intolerable burthen on the country, and entirely to fail in respect of the trade of the district, are still pushed on at £7,000 a mile, and the only cry of the local authority is for more expenditure in this way.

Nothing could show more clearly both the utter failure of railways to meet the demands of the country as actually proved, and of the wonderful infatuation of those in authority about them.

I ought not to conclude this paper without speaking of water power. On all our great irrigation works, wherever there is a lock there is a great water power perfectly ready for use. I suppose there is at this moment 100,000 horse-power of water available in the different works; and it is in the best possible situation on the lines of transit and scattered over the most populous tracts. The advantages that India has thus for manufactures certainly surpass those of any other country in the world. The water power is not hid away in inaccessible and non-populous places, as is frequently the case, but exists where labour is at hand and where the produce of enormous tracts can be brought to the door of the mills, and the goods carried away to the markets and ports at a nominal cost of carriage.

I am glad to see this is beginning to be investigated. A gentleman who has fought his own way as a coffee planter lately called upon me to talk over this matter of manufactures with me, and I believe he has taken it earnestly in hand.

With abundance of cheap labour, cheap production, cheap power, and cheap transit, what country could contend with India?

DISCUSSION.

General Sir George Balfour, M.P., after expressing the great pleasure which he felt in seeing Sir Arthur Cotton coming forward again to do, as he always had done, his utmost for the benefits of India and her inhabitants, said that probably if these schemes were carried out, they must end in changing the whole features of the country, and not only improve the country but benefit the people, than which a nobler effect could not be desired. Possibly it would have been better if England had not had the responsibility of India cast upon her, but as this had occurred, it was quite time to see whether we were doing our full duty to that vast country.

It was evident that if good communication were established throughout the country, produce would soon follow, and the water necessary to raise that produce would be applied to the soil. It was well known that irrigation increased the produce at least four-fold, and not only so, but it increased the certainty of the crops. In Madras, where Sir Arthur Cotton's services had been so long applied, immense changes had taken place, for whereas when he began his labours the revenue was fallling off, and a deal of land was utilised, a great improvement had since taken place. Nearly the whole district was irrigated, and but little was heard of the famines which formerly visited it. If the same system were further extended, the calamity which was now spreading so much distress in Bengal could not have arisen.

Dr. Burn said he had been very much pleased with the paper of Sir Arthur Cotton, who deserved the highest credit for having the courage to bring forward his opinions as he had done. It was very difficult to bring anything to the notice of the East Indian Government, as might be seen by the opposition Sir Arthur Cotton had encountered in advocating irrigation works. No doubt irrigation must be the great means for preventing famines in India, but it was not, in his opinion, the only measure. He had spent a great many years in India, and had devoted a deal of time to studying their methods of cultivation, and he must say there were no better agriculturists in the world, for in many cases their system was almost equal to that of the Lothians in Scotland, which was acknowledged to be the best in Great Britain. Not only was irrigation required to produce the crops, but care must be taken of the produce of the land; and with regard to that point they could not improve upon the old village system as carried out by the ancient rulers of the country, who had skill, ability, and knowledge of agriculture which they were not frequently credited with. They understood thoroughly the wisdom of putting by sufficient produce to protect themselves from the effects of famine, always keeping from 12 to 18 months store to fall back upon. Not only so, but every village was provided with a tank containing sufficient water for every man and animal in the community, and no one formerly was allowed to join the village until he had dug a sufficient amount of soil out of the tank to allow of as many extra cubic feet of water being contained in it as would be required by himself and family. The fodder of the cattle was also provided for in a similar manner, so that provision being made for grain, water, and fodder, the village was safe from many such calamities as were occurring. There was no doubt then that famines had been lately increasing in India in consequence of the destruction of this village system which had been going on for the last twenty years. It would be a great advantage if the present haughty tone of the Civil Service could be in some degree removed, and that those gentlemen, who were no doubt men of the greatest ability, would devote a little more attention to the system of native agriculture. They were now measuring out the country, making a sort of Doomsday book, which might be an admirable production no doubt, but it would never be the means of providing food for the people, or for raising the country from the wretchedness and misery which now existed. In order to do this the officials ought to understand the village system, the conditions of agriculture, the rotation of crops, and the scientific cultivation of the soil, and for want of this knowledge the revenue of the country was falling off year by year. This need not happen, for there was no more productive country in the world if it were properly managed. The cultivation of cotton was carried to the highest perfection, and also indigo and opium, though some of these articles could not be produced by the natives alone, without the scientific superintendence of Europeans. India also might grow enough wheat to supply the whole wants of England without having recourse to America or other countries. More than 20 years ago he grew a large crop of wheat in India, at Broachin, Guzerat, which fetched the highest price of the day in the Liverpool market. Unfortunately it had not been followed up, because the merchants did not understand how to guard against that destructive insect, the weevil, which damaged the cargo to a great extent on the voyage. He devoted some attention to the subject, investigating the habits of these insects, and made public the results, but they were not attended to. It would be in every way beneficial to India to engage in the cultivation of wheat, because the natives would then be supplied with a more nourishing food than at present, besides which it could be exported to pay a very large profit. Having lived so long in India, he could not but feel the deepest sympathy for the poor natives who were now suffering so much, especially when he considered how easily those sufferings might have been averted by the means which he pointed out, viz., the establishment of village stores and better means of communication. Some time ago, Colonel Sykes devoted himself for some time to a study of the meteorology of India, and showed most conclusively that when the rains failed, which they did periodically, famines inevitably followed, and therefore it was of the greatest importance that measures should be taken to prevent such disasters.

Mr. Coomarasawmy Modeliar (Member of the Legislative Council of Ceylon) said that a perusal of the ancient history of India would show that the ancient rulers of India paid much more attention to this subject than the present rulers. In fact, the principal aim and object of every ruler and king in former times was the promotion of agriculture; and one of the principal means for effecting this object was the construction of tanks and wells where water could be stored. If the present rulers would only follow them to that extent alone they would be going in the right direction. Not only did the old sovereigns of India, but the people at large considered agriculture to be the most important function of man; and there was no profession so esteemed or honoured as that of an agriculturist. Even now, in Southern India or Ceylon, no one was more respected than a man called Villahla, which simply meant a man who lived by the cultivation of the soil. That showed the feelings of the race, and what importance should be attached by those connected with India in the development and utilisation of that element. Now, in promoting agriculture, the old rulers thought it necessary to consider two things, viz., the water which came from the clouds, and that which was provided by the rivers. Sir Arthur Cotton had mainly devoted his attention to the river supply, but the rain-fall should not be forgotten. An ancient poet of India said, "Unless the drops of water fall from heaven, you would not find even a blade of grass on earth." Now, there was one point which was not often alluded to, which he believed greatly affected the rain-fall, and that was the denudation of the country of its ancient forests. Why was it at present that there were such immense tracts of India in an arid desert condition, dried and burnt up almost like the African Sahara, as he had himself seen in travelling over it, from Calcutta to Delhi, and in other directions. It could not be supposed that this was always the condition of that glorious India which was described in the ancient poems as so fertile and rich; and he believed one cause of this barrenness was that the forests which once existed had been destroyed. This was a subject which deserved the attention of those connected with India, because all scientific men were now of opinion that forests had a great deal to do with the amount of rain-fall. With regard to irrigation works, to which so much importance was attached, it was not enough to construct them, but means must also be provided for preserving them, for sometimes when they had been liberally executed they were allowed to fall into disrepair. One cause of this had been already mentioned, viz., the extinction of the old village system, the destruction of which had led to the decay of agriculture,

and the commencement of famines and distress. It would be therefore worth attention in connection with future famines to consider what could be done to revive this system on which the prosperity of the country so much depended. He had had an opportunity of studying this question in a part of the country where measures had been introduced for the purpose of restoring it, and one of the most prominent subjects kept in view was the maintenance and preservation of irrigation works, for if only a small defeet were allowed to pass unnoticed, it soon spread, and might end in complete destruction of the work. Now the revival of the village system would enable the tanks and works to be preserved at very little expense. With regard to the question of railways, he could not go the whole length of saying they were not useful in India, but without going into the vexed question, he would conclude by expressing his most heartfelt thanks to Sir Arthur Cotton for the interest he had taken in India, and also to the Chairman, whose services to the country would never be forgotten.

Col. Smith, R.E., desired to express his general concurrence in the views of Sir Arthur Cotton, having studied the subject for a long time but he thought there was one point which might be a little further explained, viz., that canals were better suited to India than railways, because of the circumstances of the country. He hoped the present paper, and the efforts previously made by Sir Arthur, would lead to the appointment of a commission to inquire into this important subject, and that it would be decided one way or the other. No doubt railways could carry with great expedition, and in a country like Great Britain were the best means of communication; but in a poor country like India he believed canals were preferable. To show the importance of communication, he might mention that he had lately been reading an account of the famine in Guntoor in 1832, which had taken off two-thirds of the population, when the price of food only 150 miles off was one-half what it was in the famine districts.

Mr. Labapathy Tyah (Madras) said there could be no two opinions as to the necessity for canals and irrigation works in India, but he would make only one addition to the excellent paper which had been read, viz., that any canals which should be made hereafter should not be made by privato companies, but under the superintendence of Government or officials appointed by them. He said this because under the present system such enormous charges were made for the use of the water as tended to greatly restrict its use. In some parts of the south which he was acquainted with, 24s. per acre per annum was charged for the use of it, and many villages which would have taken it at a lower price had not done so for that reason. Many heads of villages had told him that if half the sum were charged, they would have applied for the irrigation of several thousand of acres. Therefore, if instead of these companies getting 40, 60, or 70 per cent. profit on these works, they were constructed by Government, and only a moderate return looked for, they would be far more useful to the country.

Mr. Ward had been sorry to hear railways so completely condemned, because in some parts he believed they would be of great advantage, particularly to Darjeeling, about which he wished Dr. Campbell had been present to state his opinion. However, good sometimes came out of evil, and it would be very satisfactory if that were the case with the present famine. To show how this might arise, he might mention that he had information from the managers of a tea plantation that last year rice was too cheap, so that people would only work four days a week, but they were now in hopes that the dearness of rice would make the people work every day.

Sir Alexander Arbuthnot thought, if any advantage could result from this great evil which was now pressing upon the population of Bengal, it was that the important questions to which Sir Arthur Cotton had drawn attention would have a chance of receiving that consideration which they deserved. He would not go into the question of the revival of the villago system, but it was the opinion of many persons that as civilisation advanced the old features of the ancient system must gradually disappear, and that it was very difficult to revive them. But there was another matter somewhat akin to the important question, and one in which the Chairman had taken great interest, namely, that of the decentralisation of administration in India. He believed a great deal might be done by a more complete adaptation of the policy which was inaugurated by the late Governor-General in the matter. With regard to the maintenance and prosecution of irrigation works, and the future carrying out of communication, he believed they must look to a thorough and effective adoption of that policy, and that the various provinces be allowed to exercise greater discretion than they had hitherto done in these matters; at the same time a greater responsibility should be imposed upon them than it had hitherto been possible to enforce. As to the merits of railways compared to canals, both in India and England, very diverse opinions prevailed; but it was now very generally admitted—probably in a great measure owing to the persistent exertions of Sir Arthur Cotton—that a serious mistake had been made. at all events in the quality and character of the railways which had been constructed, for even those who admitted that on political grounds it was of great importance that some of the more expensive railways should have been constructed, also admitted that if they had to be done over again, a much cheaper description of line would have sufficed. The great value of Sir Arthur Cotton's views had long been admitted in Madras, and under the Government of Lord Napier a great deal had been done towards carrying them out; but the great evil in India was that what one man did another undid, and there was that continual spirit of reaction which constantly delayed the progress of useful measures. In the province of Madras, there were a great many projects of various kinds for the benefit of the country which were only stopped for the want of funds; and there was one in particular, the Periah project, which would have irrigated and rendered fruitful a large extent of barren country, which when he left India, about 17 months ago, was perfectly matured, but whether anything had been done to carry it out he was unable to say. He hoped that now these projects would attract the attention they deserved, and that some good, in the future at all events, might arise out of the present sad calamity.

Mr. William Austin, C.E., as an engineer who for 37 years had been connected both with railway and canal works, desired to express his thorough concurrence in the views of Sir Arthur Cotton as to the desirability of constructing canals in India. Railways might be better fitted for the conveyance of passengers who wished to travel quickly, but canals were preferable for goods traffic; and, if necessary, a light tramway might be constructed on each bank of the canal, on which a small engine might run to draw the canal boats, or steam tugs might be employed. He also attached great importance to providing means for storing rain water.

Sir Arthur Cotton, in replying to the observations that had been made, said he had not gone into the question of tanks and the storage of water, because it was impossible to refer to every branch of the subject in one paper, not because he did not think the storing of water one of the most important works in India. In fact nothing had given him a higher idea of the powers of former rulers than the magnificent works of that sort which they had executed, and which undoubtedly were the only things which preserved the Carnatic to this day from continual returns of famine. Another important point with respect to native works was the un-

doubted fact that the success of river irrigation works in Madras was really owing to their having imitated the native works, and learnt from them how to construct the aqueduct leading the water from the river. The Periah project which had been alluded to was an admirable instance of what he had endeavoured to enforce, for when he visited that part of the country in 1822, fifty-two years ago, that project was then thoroughly matured, but it had been hanging fire until this day, and at the present moment was exactly in the same position it was in then—everybody approved of it as a highly useful work, but it was never carried out. This showed the necessity for some new machinery for dealing with these questions in India. During the Russian war, two different merchants in London had showed him their books containing the account of importation of wheat from the North-West Provinces of India, which fetched the highest price of any then in the English market, having been landed in beautiful condition, quite free from weevil; and it showed a good profit even after having borne the enormous cost of transport for one thousand miles before it reached the port of embarkation, and the high price of freight at the time round the Cape. Nothing prevented the importation of that wheat in any quantity, rather than corn from Chicago and other countries, but the enormous cost of transit from the North-West Provinces to the seaport. He could only say, in conclusion, that it was impossible in one paper to go into one-tenth of the mere points of detail he should have desired to do.

The Chairman, in proposing a cordial vote of thanks to Sir Arthur Cotton, said the only serious criticism he had to make on his excellent paper was upon the first part, in which the present Government was somewhat blamed. It seemed to him that that part of the paper was founded on an extremely exaggerated view of the power of governmental action. What were the facts? There were tens of thousands of small peasant proprietors scattered over a great region far in the interior away from water carriage, or any means of communication, each raising on his own allotment what was required for the food of his family, and from the surplus purchasing the other necessaries of life. All at once this great calamity fell upon them, and the crop to a great extent failed. This multitude had then no food, or money to buy it, and their case was at once at its worst, because, as has been said, they had been accustomed to rely upon food of the lowest description. The entire social system by which food had been provided and distributed had collapsed, and it was quite impossible that any administrative machinery could be improvised by the Government to supply its place. The *Times* Commissioner had stated that he had seen a string of carts ten or twelve miles long going to the relief works, but the first shower of rain which fell put an immediate stop to the whole of the machinery, because the time was at hand for cultivating the ground for a new harvest, and if it were not prepared the famine would be indefinitely prolonged, and the whole population would melt away. The carts therefore would be each required in their respective villages; besides that, the foot and mouth disease had already appeared amongst the cattle, and panic amongst the carters. This showed the total inadequacy of any efforts which a Government could put forth to supply the place of the ordinary social industry, to provide a machinery for feeding a great population. Then it was said Government ought to have sent away the able-bodied population to certain great works, but all these able bodied population were fathers of families, and what was to become of the wives and children. It was difficult enough to provide relief works in the villages actually inhabited, but it would be still more impossible to feed multitudes of people at a distance, and experience had shown in the Irish famine, that when a real famine had set in and the strength and spirit of the people had begun to fail, relief works comparatively ceased to be of advantage. In Ireland, so called able-bodied men actually starved on the relief works, because they came to them in such an exhausted state. Again, when large numbers of people were gathered together under such circumstances in an emaciated and dispirited state, disease and mortality were sure to set in. As to making preparation beforehand, it was bad enough for the entire social system to be violently disturbed when the famine was in progress; but what would it have been if the Government, months before, had made arrangements all over the country on the hypothesis that it was to bear the whole burden. The whole private trade of the country would have collapsed, the whole population would have thrown themselves upon the Government for support, there would have been a general panic, and the people would have ceased to exert themselves. The Government did what was in its power, making as little show as possible, by collecting large stores of grain which could be distributed when the exigency really arose, and matured measures of relief which Sir Arthur Cotton admitted were now working effectively. With the main point of the paper he cordially agreed, being satisfied that with a thorough system of irrigation famines would be impossible. This might be illustrated by Sir Arthur's own works—the great aqueduct on the Godavery and on the Krishna. It was truly magnificent to see those two great rivers stopped in their course, and the water lifted up so as to be available for irrigating the deltas of the respective rivers, and also for navigation. In fact, he himself went direct from the steamer right into the mouth of the high level canal and up the Godavery without any transshipment. If all India were treated in the same way famine would be impossible. The gentleman from Ceylon had referred with great justice to the ancient village system of India, which contained the germs of a local administration, and arrangements for storing water and preserving the lives of the people. The whole south of India was covered with these tanks, but how they came to fall into decay had not been explained. It really was the effect of the intestine wars and anarchy from which England had delivered the country. With regard to the comparative merits of canals and railways, he had already said that canal navigation was very valuable, but he did not think it necessary to condemn railways altogether; no doubt both were useful in their way. It was an undoubted fact that railways had been generally admitted to be an improvement on canals. He was just old enough to remember the later period of the canal fever in England, but when railways began to be constructed canals gave way; two or three remarkable instances of which he could mention. Each had its own advantages, canals for heavy goods, and railways for passengers. He remembered an expensive system of native carts being organised by the merchants in Calcutta for the conveyance of valuable piece goods, though the navigation of the Ganges was fully open, and, therefore, it could not be supposed that if a railway were available it would not be made use of. In conclusion, he said that though some persons might differ from Sir Arthur Cotton on some points, all would agree that his past services to that country had been such that he would be always regarded as one of the greatest benefactors of India.

NINETEENTH ORDINARY MEETING.

Wednesday, April 22nd, 1874; Lieut.-Col. A. Strange, F.R.S., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Astbury, W. S. W., 48, King-street, Manchester.
Carulla, Facundo J. R., F.C.S., 28, Broomfield-crescent, Sheffield.

Chrispin, William, 39, King-street, Huddersfield.
Cullin, Edward, Lahore, Punjab, India.
Currey, Elliott S., 21, Duke-street, Westminster, S.W.
Durham, Henry, City of London School, Milk-street, E.C.
Field, Frederick, F.R.S., Hither-green-lodge, Lewisham, S.E.
Glass, William, F.C.S., 10, Ashmead-road, St. John's, S.E.
Hampson, Robert, 205, St. John's-street-road, E.C.
Hucks, William, Gilbey's Distillery, Camden-town, N.W.
Janvrin, A., 61, Pall-mall, S.W.
Nicholson, John, Carlton-house, Richmond-road, Putney, S.W.
Wilson, William V., 7, Cottage-grove, Bow, E.

The following candidates were balloted for and duly elected members of the Society:—

Barnes, William Charles, Oak-hall, Buckhurst-hill, Essex.
Epps, Hahnemann, 1, South-hill-park, Hampstead, N.W.
Finlay, Kirkman J., Abergwynant, Dolgelley, North Wales.
Gill, C. Haughton, 59, King Henry's-road, N.W.
Hack, Daniel, Sunnyside, 151, Upper Lewes-road, Brighton.
Hinks, Joseph, The Patent Duplex Lamp Works Birmingham.
Lawes, Robert Murray, 9, Clarges-street, W.
Manning, F. A., 18, Billiter-street, E.C.
Mitchell, William Augustus, F.R.G.S., Marlborough-villa, Lea-bridge-road, Leyton, Essex.
Morrison, John, Viaduct Chemical Works, Widnes, near Warrington.
Morson, Thomas, 124, Southampton-row, Bloomsbury, W.C.
Muspratt, James Liebig, Widnes, near Warrington.
Roche, John, 31, South-terrace, Cork.
Searle, Samuel, North View, Central-hill, Upper Norwood, Surrey.
Varley, John, C.E., Swadford-street, Skipton.

The Paper read was:—

ON PROGRESS MADE IN ORNAMENTAL PROCESSES CONNECTED WITH METALLIC AND OTHER INDUSTRIES.

By W. C. Aitken.

It may be remarked as regards the last exhibition, viz., that at Vienna, that the experience gained by previous international exhibitions, accessible to all nations who choose to refer to the reports concerning those already held, appears to have been set at naught. The arrangement of exhibits adopted in the English Exhibition of 1851, and also that of France in 1855, was proved to be unsatisfactory and defective, but was again repeated in the Exhibition (English) of 1862; *i.e.*, in all these, the arrangement adopted was geographical. The most satisfactorily arranged yet held was the French International of 1867, in which the exhibits were arranged in classes, on a series of concentric tables or stalls, its success being marred only by the principle adopted not being worked out completely. A visitor to that display must have been convinced (if he had visited previous exhibitions) with how much ease he was enabled to examine similar kinds of goods or articles of various countries and make comparisons. The worst possible kind of arrangement is the geographical; it is calculated, in order to give prominence to the industry of the country in which the exhibition is held, unnecessarily to increase the number of examples, without reference to use instructively, comparatively, or as regards quality. The gigantic scale of the Paris Exhibition of 1867 elicited the recommendation which follows from the executive commissioners of the various countries exhibiting, viz., "The usefulness of international exhibitions does not depend upon their size, but on their selectness and quality; therefore the tendency to increase the size of each succeeding exhibition should be discouraged." Despite this warning, and in face of it, Austria ignored the results of the experience gained altogether. Thus, the exhibition building in London in 1851 covered 800,000 square feet; that in 1862, 978,288 feet; at Paris, in 1867, 1,581,725 feet; the aggregate exhibiting space of the Vienna Exhibition exceeded 5,000,000 feet. It was $3\frac{1}{6}$ times larger than the Paris Exhibition of 1867. The surrounding park was more extensive than that in the Champ de Mars at Paris. The vastness of the Vienna Exhibition, and the difficulties arising from the mere physical exertion, apart from the mental labour undergone in its examination, may thus be imagined by those who did not visit it. The Americans, warned by the difficulties attendant on the examination of exhibits in the geographical arrangement, as at Vienna, &c., have very wisely adopted arrangement in classes (as at Paris in 1867) for their projected international exhibition to be held in 1876.

It is impossible to imagine any greater contradiction or inconsistency than an exhibition of objects of industry to gain publicity, and to defeat that intention by the miserable system of "concessionaireing." International exhibitions, when held, should be totally independent of the paltry pittances realised by the sale of concessions. For example, in future international exhibitions it is to be hoped that at least the right to sketch will be conceded; the power to restrain being the right of the exhibitor only or his accredited agent. At Vienna the farce of juries was again re-enacted. Every one at all conversant with the past of exhibitions is acquainted with the facts. Firstly, there is a difficulty in getting jurors competent for the work; secondly, jury work is never well done; thirdly, when done, the public pays little attention to the judgment of jurors—it has a mind of its own; fourthly, in their awards juries make blunders, as on a recent occasion manufacturers whose works involved the highest principles of art in their production, and engineers whose machines demonstrate in construction the triumphs of genius and scientific skill, received diplomas of honour (the highest possible recognition), but so did a firm engaged in the manufacture of—hats! I regard, and always have regarded, the Exhibition of 1851 as the initial letter of progress in England—for the first time showing to the world England's industrial power and greatness, and letting her know in turn what the industries of Continental nations were doing, and what they could do, unveiling the secret that other than merely natural ability was at work against us, viz., that "they were industrially educating their artisans." Mr. Cole has said the Exhibition of 1851 has been a fruitful parent. None of its successors equalled it either in brilliancy or financial success. 6,039,135 visited it; it left a balance of £213,305 15s. 8d. That of 1862, open seventeen days longer, was visited by

6,117,450, or 87,000 additional visitors, but it only "nearly paid its way." The first of the "little goes" or "small internationals," illustrating at the rate of five departments of industry each year (commenced in 1871); the visitors during the entire period it remained open did not reach in number an average day's attendance at the Exhibition of 1851.

The nearly 7,000 English exhibitors in the Exhibition of 1851, at Paris in 1867 were represented by 3,609; at Vienna they amounted to 770 only. The opinion expressed "that the world is getting tired of great exhibitions" is confirmed by the opinions expressed by manufacturers, who now almost unanimously vote exhibitions a "bore." They very well know the exhibition of ordinary trade examples fails to attract attention, that the production of special examples does not pay—are a hindrance to the ordinary routine of business. A reputation gained in an exhibition must be maintained, especially in certain classes of trade. Manufacturers make for exhibitions, while they protest against them. In the country the yearly limited international exhibitions attract no attention whatever, and are viewed with indifference. It requires extreme efforts to get representation. In 1872, the jewellery trade of Birmingham was moved to exhibit with great difficulty. The feature of that year's exhibition appears to have been the most perfect collection of peasant jewellery from all countries ever shown. These were not contributed direct by manufacturers, but by the South Kensington Museum.

The intention of rendering the exhibition of the present year more useful by converting it into a school for giving technical instruction, is to be commended, but its use for so good a purpose will be limited to the inhabitants of London; it will be impossible for artisans from the country to take advantage of these teachings. The demand for general technical instruction must be met by some more widely extended and generally accessible means. If numbers of visitors are to be taken as an evidence of success, it may be predicted that the international exhibitions now being held in London never will be a success; the representation of only five branches of industry annually limits the interest. The Commissioners of the Exhibition of 1851 should select some town or centre where the most prominent feature of the year's industry to be represented is most extensively cultivated, and hold their exhibition there; the end sought would be more successfully realised. Thus an international exhibition of china would be most usefully held in the Potteries. In the projected programme for 1875, will be found brass and copper manufactures; in that of 1876, works in precious metals and their imitations; in 1879, iron and general hardware—these industries harmonise. The great centre for metal working which distinctly embraces all these is Birmingham. The Commissioners should hold their exhibition there; if general technical instruction is important, special is more so, and it would most usefully be dispensed in connection with such an exhibition, viz., where the greatest number of artisans interested in the production of specialities named is employed. Other exhibitions, as of textiles, &c., should be held in centres of their special industries. I simply indicate what, after mature consideration, I believe will be the greatest good to the greatest number, and will make the best use of exhibitions.

I do not think rewards will stimulate to exhibition; if they do, the rewards received at Vienna must. Of 770 English exhibitors, 670 were recognised. Of 30 exhibitors from Birmingham, 28 were rewarded. The highest possible recognition was gained by Elkington and Company—seven medals for "progress," twelve for "merit," and "good taste" and other qualities, eight honourable mentions. Many causes operated against English manufactures being fully represented at Vienna, either adequately, or even approximately. I failed to discover the official promoters of international exhibitions in this country were really in earnest in reference to it. In the district to which I belong, the few who contributed did so voluntarily; no effort was made as on previous occasions to secure representation, distance may have operated against sending, and a growing feeling against exhibitions did its share, while a not political but industrial Conservative idea of teaching other nations and suffering thereby operated in no small degree. That idea will be dispelled by comparing the present state of English industries, with what these were previous to the Exhibition of 1851. If the increase of imports and exports of raw material raised and converted, vastly augmented national industries, increased power for propelling machinery, old manufactories increased in size, the erection of new, the means by which the products of these manufactories are conveyed to foreign countries means anything, and if the extension of the means of travelling within our own country means anything it means increased prosperity. In 1851 the year in which the first international exhibition was held, the imports were £95,252,084; exports, £71,367,885. Twenty years thereafter, in 1871, the imports were £331,015,480; exports, £223,066,162.

Coal Raised.

	Tons.	Value—£.
1860	80,042,698	29,010,674
1871	117,439,251	30,121,347

Iron Raised.

	Tons.	Value—£.
1860	3,826,752	9,566,880
1871	6,733,179	16,700,500

The imports in cotton and wool were:—

Cotton.

	Imports—lbs.	Exports—lbs.
1850	1,034,342,176	149,609,600
1871	1,778,139,776	368,234,160

As regards steam-power, it was, in 1850, equal to 71,005 horses; persons employed, 330,942. It was, in 1870, equal to 300,480 horses; persons employed, 450,837. The number of factories and spindles working therein were increased from, in

	Factories.	Spindles.	Workpeople.
1850	1,932	29,977,017	249,627
1870	2,483	38,218,758	441,276

The wool imported and exported in

	Imported—lbs.	Exported—lbs.
1858	126,738,723	26,701,542
1871	323,036,299	135,189,794

The steam power employed in wool factories in

1850 was equal to 13,455 horses; workpeople employed, 74,443; in 1870 was equal to 52,164 horses; workpeople employed, 125,130.

The steamboats engaged in foreign trade in

	Number.	Tonnage.	Sailors.
1858	428	257,861	17,821
1871	1,066	936,914	40,023

Steam and sailing vessels in

	Number.	Tonnage.	Sailors.
1858	20,071	4,325,242	177,832
1871	22,207	5,633,561	199,732

Finally, as regards the three great great industries of cotton, wool, and iron, the exports in

	£
1869 of cotton amounted to....	67,159,064
1871 ,, ,,	72,821,411

In wool exported—

	£
1869, woollen fabrics, yarn, &c.	22,625,190
1871 ,, ,,	33,283,112

In iron and steel, pig and puddled, bar, angle, bolt, rod, and rails, wire, and turned plates, hoops, and sheets, including unwrought steel, in

	£
1869 Value exported	22,343,080
1871 ,,	26,124,134

If the extension of railways indicate the prosperity of a people, then there is a vast increase in mileage, and returns—

	Miles open.	Passengers travelling.	Traffic—£
1862	11,551	180,485,727	29,128,558
1871	15,756	375,220,754	48,892,780

The progress of a nation is not to be tested by the production of works for the few gifted with wealth, but in the abundance of those produced for the use and comfort of the many; the true wealth of a nation is not best represented by its mines of precious metals, or its works in these. It is in the abundance of its mines of useful metals, as iron, and the coal with which its ores are smelted, and in the energy and ability of its people to convert these into the thousand forms given to it, that the true wealth of a nation consists.

The production of iron in England in 1871 amounted to 6,733,213 tons; the united production of North America, Germany, France, Belgium, Austria, Russia, Norway, Sweden, Italy, Spain, Switzerland, South America, Asia, Africa, and Japan, the aggregate of the production of iron in all parts of the world, except England, only amounted to 7,107,324 tons. England therefore produces nearly as much iron as all the other countries in the world. Since 1860 she has nearly doubled her production; in that year it only amounted to 3,826,752 tons; in 1871, it was increased to 6,733,213 tons. It must not be forgotten that the means which have conduced to the development of the manufacture of iron in other countries are all our own. Dudley was the first who applied mineral fuel to the smelting of iron; Cort introduced the puddling furnace and the rolling-mill; the genius of Watt placed in the hands of the manufacturers of iron the irresistible and unlimited power of steam to propel and give motion to their rolling-mills, to produce which the comparatively feeble and not always available force of water is totally unequal; Neilson economised the consumption of fuel by the application of the hot blast; Nasmyth rendered practically useful the steam hammer; Armstrong built up wrought iron and steel, and produced ordnance, the penetrating power of which necessitated an increased thickness of armour plating; Sanderson suggested the possibility of rolling armour plates, such as are now produced by John Brown and Co., and Cammell and Co., of Sheffield; the universal rolling mill was the creation of Arrowsmith. At the root of the cheap conversion of iron into steel lies the discovery of an honoured member of this Society, Bessemer, whose process is to be found applied all over the Continent, wherever iron is made. The ease and economy with which iron will in the future be converted into steel, will owe its existence to Bessemer's discovery as the initial letter. Industry in iron has recently received a check, a shaft guided by a feather from the wing of a collateral industry has inflicted on it a serious injury. To this is due the origin of the paragraphs going the round of the public prints. The *Scotsman*, about five weeks ago, had the following:—

"Belgium, France, and Germany are gradually ousting English iron from all the large foreign markets. Belgium bars, of a quality which could not be produced in this country under £12 10s. to £13, were offered at £10 10s. delivered at Birmingham."

On the 10th of the present month it was stated in a Birmingham newspaper—

"If the reduction of wages which the masters are seeking to enforce should be accepted by the men, the price of coal may perhaps be reduced to a sufficient extent to enable ironmasters to compete with foreign producers, but of this we regret to say there is little present prospect, neither masters nor men being willing to make any concession."

A national industry is checked by the war between capital and labour, having its origin, at present, in the coal districts. No fact is more certain than that the wages of miners bears no relation whatever to the advances made in the price of coal, which has checked our manufacture of iron, and laid it open to the introduction of foreign iron, the cheap production of which is aided by the economical living of foreign artisans, who are also better educated, industrially; and in whose countries a better feeling exists between master and workmen, and strikes are almost unknown; Governments aid their manufacturers by the publication of reports, written by their most able men, setting forth the improvements made in other countries calculated to advance their iron industry. The progress, even the very introduction of the manufacture of iron into France and Belgium, is due to Englishmen. The largest iron works in France, "the Creusot," owe their existence to John Wilkinson, of Brosley, who, in 1782, made the first iron bellows, and built a canal boat of iron, (the parent of iron-ships, steamers, and iron-clads). The industry in iron of Belgium is due to another Englishman, John Cockerell, who, in 1817, commenced works at Seraing, near Liege. On the industry in iron of every country England is inscribed. The superiority, where exceptionally recognisable in foreign iron or steel, is entirely due to English inventive skill, and no doubt aided by foreign scientific education on the part of workmen. England must industrially educate her artisans employed in the iron trade; want of intelligence will not be compensated for even by cheaper coal.

The significance of the rumour in 1867, about foreign engineers carrying away orders for locomotives, should not be disregarded. Ten locomotive engines were ordered from an English firm at £2,450 each, ten more from Esscher, Weiss, and Co., of Zurich, at an advance of £100 or £2,550 each. The latter firm, on the completion of the contract, represented a loss had been sustained, and requested to be allowed to make ten more at an advance of £250, or £2,800 each. The secret of the whole affair is thus explained. When the order was given, English engineering firms were full of work and could not promise early delivery. The Zurich firm executed the ten engines. Two-thirds of the material came from England. In 1865, when fifteen locomotives were ordered from the Creusot, it was not known forty others were ordered from English manufacturers. An offer being made to the same establishment to produce twenty-five more at the same cost, the director, M. Schneider, declined to undertake the execution of the order.

The most wonderful work in the Vienna Exhibition was the internal cupola, twice the diameter of that Michael Angelo "hung in the air"—in height and diameter two St. Peters could have been stowed within it. "Hanging in the air" is simply a figure of speech, for much solid masonry helps to support the dome of St. Peter's; that at Vienna was only supported by slender rods of iron, bedded at their base in concrete. These rods descended down hollow pilasters of brick, which took no part in sustaining the cupola. This wondrous dome, "to which Diana's temple was a cell," the mightiest, the most overpowering in conveying the effect of vastness and immensity ever constructed "since the world began," owed its existence to the constructive skill of an English engineer—John Scott Russell.

The largest mass of iron exhibited was the work of an English firm—Johnson, Cammels, and Co., of Sheffield; in the rough it weighed 33 tons, was 20ft. in length, 6ft. 10in. in width, and 10in. thick, bent to a radius of 13ft. 6in.; it was not produced by a Prussian, though to be used for a Prussian ironclad.

The above as to progress of English mechanical genius, invention and skill; then, as to her art industry. It is scarce 37 years since any effort was made to improve the character of our industries into which art enters by instituting schools of design. The work of changing the character of a nation is not the work of one generation, but of many; we must learn to labour and to wait. Fifty years ago such a noble monument as that which commemorates the virtues of Albert the Good—The Albert Memorial—could not have been executed by Englishmen. I am very doubtful whether it is the best way to encourage English talent in metal working by proclaiming, "In respect to certain works of art, especially in working metals, the work done was nothing like the work done three centuries ago. The conditions under which works of an ornamental character in metal are now executed are entirely different." With all the disadvantages under which we labour, there are firms in England who could rival the iron work of Matsys; a well cover like that at Antwerp could be produced if paid for, or iron work such as in St. George's Chapel, Windsor, is not beyond the skill and cunning of living Englishmen. Pay the price, and the work can and will be done. A good deal of old iron work owes its beauty and coherence to rust; besides there is no reason for supposing it was executed by contract, estimates advertised for, or the lowest tender accepted. A good deal has been said about "doing work for the work's sake;" the principle is a good one, but no really good work is now done without pay. You may catch some rising man to do one work for fame, that done, it is not likely he will continue to work for the same paymaster. Those who are not intimately connected with manufactures pronounce verdicts manufacturers alone know; the money expended by them is rarely repaid by the sale of works of excellence in metal, some examples of which are equal in merit to those produced 300 years ago. It may be anticipated other branches of industry labour under similar difficulties. At Vienna we have been told "we were utterly beaten in art as applied to certain manufactures; in silversmiths' wares and enamels we were lamentably behind." Respecting silversmiths' wares, in which character it may be presumed would be included *repoussé* working, I failed to observe any examples superior or even equal to those of Elkington's in the Vienna Exhibition. The truth, however, should be told that there were only two English exhibitors of silversmiths' wares in the Exhibition. Against these were arrayed the manufacturers of silversmiths' wares from every country, especially those of Austria, Germany, Russia, Sweden, and France. I here, in illustration, place for your inspection an example of the beauty and delicacy of their work on a salver executed in *repoussé*, in silver and iron damascened in gold.

Permit me now to direct attention to a few ornamental processes which it appears to me advisable to cultivate in connection with English industries. There is the process of enamelling. Enamel is simply glass, composed of lead and sand. When transparent, oxide of tin renders the transparent glass opaque; mixed with oxide of gold it changes the clear or opaque glass into a purple; red is produced by the addition of sulphate of iron, oxide of copper produces green, violet is produced by manganese, blue by oxide of cobalt.

The enamel is poured from the crucible in which it is melted into flat cakes; these cakes are broken up, and reduced to a fine granular condition, in a mortar, or to an impalpable powder, by grinding with a muller on a slab; it is applied on metal which will stand a red heat without changing its form or fusing; gold, silver, copper, brass, or iron can be enamelled. There is no true enamel which has not been fused at a red heat. The modes of application vary; applied on a flat plate or plaque, it is worked with a brush. Of this class are the Limoges enamels. Other methods of application consist in incising or cutting small troughs in the surface of the metallic object intended to be enamelled. In these the enamel is placed or applied; this method of application is called the "Champlevé." It may here be remarked that in what may be called commercial as opposed to fine art enamels, the "champlevé," or grooving, or cost of cutting the troughs, is obviated by using a pattern in which the troughs have been cut,

copies being multiplied by the ordinary process of casting. Another method of reproducing is by means of electro-deposition; this method is that adopted by Messrs. Elkington, who succeeded in getting the enamel to adhere to the deposited foundation; the French enamellers were unsuccessful in doing so.

The next variety of enamels is the partitioned or "Cloisonné;" in this variety the cells are not cut out, but are formed by bending a flat narrow strip of ribbon or metal in such a manner as to form the retaining walls of the cells, cut in horizontal section a honey-comb, or examine the cutting-out tools used by a pastry-cook to cut out paste with which to decorate pastry, gives the best idea as to the appearance of an object prepared according to the "Cloisonné" method for the reception of the enamel. In proportion to the simplicity or complexity of the design, so are the number of cells or parts of cells. These, after being prepared, are arranged on the object and soldered to it. The various colours of enamel are then applied in the cells, and fired by subjecting the object to be enamelled to the heat of a muffle. Repeated applications of enamel with repeated firings are required to fill the cells. The superfluous enamel is finally removed by grinding it away with pumice stone, smoothing it with stones of different degrees of fineness. Apart from the labour of forming and placing the minute cells, there are difficulties attending the firing operation. Should one part of the muffle be too hot, and the solder become melted which holds the cells, the more the enamel is in a fluid condition, the colours mingle, and a confluent mixture of colours is the result. The examples which are now submitted for your examination were produced by Messrs. Elkington; they only commenced their experiments three years ago; the results are most satisfactory. Larger and more important examples by them will be exhibited in the coming exhibition of enamels which will shortly be opened at South Kensington. A complete series of examples illustrating the production of "Cloisonné" enamel are exhibited, and an illustrated example of the difficulties attending the process of enamelling.

Your attention will next be directed to the niello process, not much or generally known, only incidentally applied in England, and only to the more elaborate and costly objects used for ecclesiastical purposes. It was extensively taken advantage of by Italian gold and silversmiths. Niello may be called a metallic enamel, composed of silver, copper, lead, and sulphur; in its preparation the most difficult metal to fuse is first melted, the next fusible added, and so on; the melted metals in the crucible are stirred with stick charcoal to ensure homogeneity; the result is a black compound, which, poured from the crucible, is beaten into strips. The design to which it is applied is engraved on the metal object to be decorated, the lines being more pronounced and stronger than on an ordinary copper-plate for printing from. In testing an example of engraving, to which niello was intended to be applied, Finegerra, a goldsmith, of Florence, originated the art of copper-plate printing; he filled the lines of his metal plate with a black fluid, used damp paper to get an impression instead of taking a sulphur cast, and hence arose the art of copper-plate printing. The mode of applying the niello is by heating the vessel or object to be nielloed, and rubbing the niello into the lines; when skilfully applied, the niello adheres firmly; excess of it is removed by files, the surface is then stoned, and it is finally polished. Niello is undoubtedly by far the best means for decorating in a quiet rich manner surfaces exposed to friction or wear, it preserves unbroken the contour of the larger objects where the preservation of pure form is desired; it is tougher than enamel—no small recommendation. The Russians have cultivated the process very successfully; recently the French have adopted it. In the Vienna Exhibition, it was shown very extensively applied to the decoration of trinkets, but the re it was evident engraving, for the reception of the niello was dispensed with, and stamping took its place, the great bulk of objects to which it was applied being stamped.

Damascening, or inlaying one metal in another, is an art which has been practised a very long period, introduced chiefly on armour, and caskets, &c. There are two methods of practising the process. By one method the surface of the metal to be damascened is raised up into a file-like surface: the artist by his skill causes to adhere to the roughened surface threads of gold or silver, which are applied and burnished down. Broad surfaces are produced by working the threads or wires side by side. Heat is applied; the degree necessary requires great judgment. In the other surface to be damascened is incised or cut into, the incision at the bottom being expanded; into this channel gold or silver is introduced and beaten down. An example of an iron plate damascened with gold, illustrated this process.

A considerable misapprehension prevails as to certain works supposed to be inlaid exhibited by French manufacturers. These were incised for the reception of the metal to be inlaid, but the introduction of the metal was effected by depositing, not really inlaying.

Against English progress is arrayed cheap labour, united with higher intelligence. The wages of foreign artisans engaged in the various industries on the Continent are very much lower than those of England engaged in similar industries. High wages such as those paid to English artisans are earned only by the few in each country whose skill and power of manipulation very far exceed those of their fellow workmen, the exception being those of the United States of America, where every article used is more expensive than in England. A family, consisting of five individuals, living in England (clothing not included) cost £1 10s. 6½d.; in New York, £2 6s. 6d. To single men, board and lodging, including clothing, which in New York would amount to £95 9s. 10d., in England comes to £45 17s. 8d. In Germany, a working man earning 9s. 7¼d. per week (£25 per annum), supported his family on £21 and had a balance of £4 10s. over. Another, who earned the exceptionally high wage of 29s. per week, lived, supported his family, and saved in the year £24 15s.

Low wages extend all over Austria, Italy, Switzerland, France, and Belgium.

The English manufacturer is placed at a disadvantage in the element of wages. But the power of endurance, arising from a better physically

constructed body, supported by nourishing diet, enables the English artisan to do more work than the foreign artisan, in a given time, especially where strength and sustained energy are required. The small industries in England are the large on the continent, *i.e.* those into which art enter—where physical endurance is less necessary than taste and neat-handedness. In these, owing to the superior education of the foreign artisan, the English manufacturer, especially of light fancy articles, is placed at a disadvantage. In this direction considerable progress has been made in light ornamental articles; those now produced in England are very much improved, better, lighter, and more elegant in style—as examples of this there are the pen and needle cases of Messrs. Avery and Son, and articles known as *Nouveautés de Paris.*

In Vienna, the wages in the jewellery trade are from 6s. to £2 per week; a few specially good workmen get more. At Stuttgart (Germany) 16s. per week, which fairly represents the wages at Hanau and Pforzheim. In Paris the great majority get 25s., 18 workmen only out of 10,000 in the trade realising £3 15s. per week.

How far the element of the cost of labour interferes with the English glass manufacturer is proved by reference to the low rate of wages paid to engravers in Bohemia. Blowers in that country, also in Austria, receive equally low wages; average engravers (good workmen) get from 8s. to 12s. per week; best, from 14s. to 16s. Their diet is the produce of their little patches of land. Animal food is rarely partaken of. A high-class engraver, who worked for a Prague manufacturer, out of 16s. per week said he had saved money.

In Germany, in the great centres of the glass trade, wages are equally low. In the districts of Saarlouis, Saarbruck, Hirschberg, Bunzlau, and Gorlitz, the wages of blowers are 15s. to 18s., and from 12s. 8d. to 11s. 2d. per week. Grinders who have shops get 9s. 3d., journeymen 7s., apprentices 1s. 3d. per week; exceptionally good workmen earn at some kinds of work up to 6s. per day. In England workmen of equal excellence with those of Bohemia, Austria, and Germany, earn double the money. In Venice, where the skilful manipulation of glass is carried to its fullest extent, average workmen earn 19s. per week, lower classes 13s. 9d. and 7s. 6d., women 3s. 9d., children 2s. 3d. The very highest class of workmen (exceptionally good) get 60s. per week, women 7s. 6d. In France 177 of the second best earned 27s. 6d., ten of the best 55s. per week.

The workmen in ivory and pearl buttons in Austria are included among the turners, their weekly wages average from 8s to 14s.; a few get from 14s. to 20s., fewer still 24s.; women 4s. to 10s. per week. In Saxony (Dresden), 4s. 6d. to 15s.; in Wurtemberg 16s. per week. The hours worked per day 13, two hours allowed for meals; overtime (according to skill) from 1d. to 2½d. per hour.

In Vienna there are 900 workers in bronze; of these, 200 earn per week from 12s. to 14s.; 500, 14s. to 18s.; 100, only 18s. to 22s.; and 100, at piece-work, from 14s. to 20s.; the hours worked are from 6 a.m. to 6 p.m., one hour for dinner. Lamp-makers and plumbers get 10s. per week. Smiths and ironworkers, because the supply is below the demand, are the best paid workmen in Vienna (in the metal trade); good men get 24s., best 36s. per week.

The wages of tin-plate and sheet-copper workers as follows:—Dresden, 6s. to 24s. per week; in Wurtemberg, 9s. 6d.; Denmark, 13s. to 15s. 6d.; Sweden, 11s. 9d.; Netherlands, 8s. 6d. In France the largest number have 20s., the next 25s., highest 30s. per week. In the United States of America medium workmen get 24s. per week.

Of German silversmiths in Vienna there are 300; in all; 200 get 12s. to 14s., and 100, 14s. to 20s. per week; hours worked 12, 1 hour for dinner; extra work is paid for at 3d. to 5d. per hour. Saw grinders (a riskish and dirty trade) get from 14s. to 16s. per week. The hours worked are longer, the wages lower than in England.

For forty years I have been connected with manufactures, thirty of which I have spent in the great head centre of metallic industry—Birmingham. The study of the advancement of manufactures has been that of my life; there has been no scheme, local or national, for their advancement which I have not promoted and actively engaged in. The future progress of manufactures is bound up in extending the means of diffusing education—scientific and industrial. The operation of the Education Act, by diffusing elementary instruction, is laying the best possible foundation for the higher, viz., the scientific, technical, or industrial, which must follow, the teachings of which will be largely assisted by local museums, such as the Council of the Society of Arts are now actively engaged in promoting.

The abuse which has been heaped wholesale on the ornamental manufactures of England can, I think, be traced to the absence of collections of objects calculated to increase by cultivation the æsthetic faculties of the provincial artisan population. The absence of such means of industrial art education has been dearly paid for, and has cost the nation, by retarding the progress of its industries into which art enters, more in the aggregate than the maintenance of a local museum in every town where manufactures are conducted in which taste is required. The history of the advancement of all art industry can be traced to the study of examples.

The wonderful progress made by Wedgwood in the improvement in the external forms of pottery is due to examples previously existing, examined and studied by him, borrowed in some instances, purchased in others. His desire to be the possessor of the Barberini vase, which is not china, but glass, was only satisfied by the Duchess of Portland, who became the purchaser, promising him the loan of it to be copied from. His appreciation of the beauty of the vase was demonstrated by his being the next bidder to the Duchess, who paid for it the then large sum for a work of industrial art, viz., 1,800 guineas.

Boulton, an equally spirited manufacturer (of the Wedgwood period) aimed also at superiority, by the study of examples of excellence in previously executed metal work. When in London, he often went to the British Museum, and frequently came to London for the express purpose of making drawings, and reading about rare works in metal in the Museum. He borrowed articles in metal from the Queen; members of the nobility lent

him examples; what he could not borrow he purchased.

The influence of examples to aid the work of progress in design is borne evidence to by Sir Matthew Digby Wyatt, whose experience as to the value of examples was gained by observations made in foreign travel, and confirmed as secretary to the Exhibition of 1851, and as juror in the Paris Exhibitions of 1855 and 1867. In directing attention to the value of art examples as influencing art industry, he says:—

"Deprive the Parisian workmen of access to the Louvre, the Hotel Cluny, Sèvres, the Gobelins, Versailles, the Luxembourg, Jardin des Plantes, the Ecoles Communales, &c., on his 'Dimanche,' and to expect him still to be an artist, would be madness. Shut up the Bau-schule, museums, Industri Gebaude, and public libraries of the German capitals, and away would go that interest in his craft which every German 'bursch' now takes. If we would elevate the English workman, we must recognise some other stimulant to his energies than beer—we must provide museums for him, where he may see what others have done before him, and better than him, in his own trade."

Mr. Cole, a few months ago, demonstrated the value of example of art industry, his experience gained in art manufactures, and, more important still, in collecting together and directing, until recently, the South Kensington Museum, in advocating the importance of local art museums, said:—

"What did Flaxman do when he applied himself to pottery? He studied Greek pottery. What did Herbert Minton do to get a rank for his manufactures which compete successfully with Sèvres? He collected and studied the masterpieces of Sèvres. Why is Mr. Phillips the jeweller trusted to set jewels with good taste? Because he studies the ancient and mediæval models. What gave Pugin his reputation for Gothic metal work but his study of mediæval models? What has created a trade in majolica in this country but the Soulages collection? What has given the Craces, and Jacksons, and Grahams, and Hollands, &c., their reputation for art furniture but their knowledge of ancient examples?"

The only regret is that the Government has failed, up to the present time, to recognise that, for the provinces as for London, museums would not be equally if not very much more beneficial, unquestionably very much more important. The money spent on the purchase of examples for South Kensington has almost exclusively benefited only metropolitan industry. The names in the paragraph quoted above are, it will be observed, chiefly metropolitan producers. They doubtless benefited by South Kensington examples: that, it may be supposed, is the inference intended to be drawn. Hardmans, those which enabled Pugin through them to realise the production of metal work according to true principles. Some of their work I am able to show you in the illustrations of iron work and enamelled work on the table. Wealthy manufacturers will always purchase examples for themselves; but there is a class of manufacturers, these very numerous, in the provinces, whose means are limited; they cannot afford to purchase examples. They employ thousands of artisans who require their taste improved by examples. Incidental loan collections for a brief period may stimulate attendance to an already established museum—the presence of a loan collection for a brief period may temporarily operate in exciting the attention of the inhabitants of the town to which it is sent—but museums with a large propor ion of permanent examples to operate on particular branches of industry in centres of special manufacturing districts can alone provide for the wants, and supply that which will operate permanently and beneficially. A Birmingham manufacturer, in his report on the Vienna Exhibition, deploring the want of suggestive examples to aid his industry, says:—

"The immense collection of objects of art at South Kensington, bought with the nation's money, should be our source of strength, if judiciously applied; but of what use is South Kensington Museum to art workmen here (in Birmingham) or in remote and distant parts of the country?"

The progress of museums dependent entirely on local support for extension (as those of Birmingham—its Art Gallery and Aston-hall) must necessarily be slow, unless aid is given by Government in the way of examples, or in some other way, as the grant in aid for the completion of the Museum at Bethnal-green, or as that to the British Museum of £25,000 for the purchase of antique jewellery, respecting which so little is really known; its value infinitely greater from an industrial than from an antiquarian point of view. A London jeweller, writing in *The Jeweller and Metal Worker*, (a cheap and excellent little paper, which deals with the subjects of the trades named) on the subject of a jewellers' museum for Clerkenwell says, "In the British Museum it is said there is ancient jewellery, but who would think of going to see it there?" Personally I have made inquiries of many Birmingham jewellers whether they had seen it; they had not; the majority of them were not even aware of its existence. A visitor to the museum would fail to discover it, and so far as any notice of it is to be found in the guides, the examination of their contents reveals nothing of either its existence there or its whereabouts. Probably being made aware of it, two London jewellers visited, saw, examined, and copied one example, a gold necklet; the copy made by Sig. Guilliano, of Frith-street, I am now, by the kindness of the artist, able to exhibit to you. It is exquisite, a very perfect copy, and proves that skill in in metal working is not quite extinct; it illustrates the value of objects of art industry for purposes of study and examination. It is to be regretted such examples of working in precious metals should be hidden where they are. A portion of the collection ought to be sent to Birmingham for the inspection of its jewellers, In Birmingham, an art gallery is open every day in the week, which in the evenings is lighted with gas, somewhat of a contrast to the "three days open" of the British Museum, where all the examples of antique jewellery are now buried, £25,000 of national money reserved for the study of antiquarians. The fact is, however, the British Museum never charged itself with the responsibility undertaken by South Kensington, viz., the improvement of manufactures; the latter, as conducted in the past, and up to the present time, "is chargeable to an extent with monopolising art treasures, which, though paid for by the nation as a whole, can only be consulted by those resident in London. This charge is not removed by the fact that there is a small travelling museum which goes from place to place. The museum has been furnished for the good of the nation, and not for the advantage of any special district."

It would be interesting to know the value of the stock of examples from which the travelling museum or loan collection has hitherto been selected, as compared with the permanent examples in the museum which cannot be removed—sent out "rather because they were not wanted at South Kensington than that they would be useful where they were sent." "If manufacturers need the development and encouragement of a higher taste in the provinces, the seat of such manufactures, so ought the education, the examples, and embellishments to be afforded; and in proportion to our numbers and taxation, we have a right to our share of public instruction and ornamental display"—this proposition was enunciated in 1855, when the now vast museum at South Kensington was represented by a limited number of examples exhibited in a few rooms in Marlborough-house. If the proposition when it was uttered was correct in principle—and it cannot be denied that it was—if examples do operate in improving the results of industry into which art enters, and if these manufactures are conducted in towns and localities at a distance or distances varying from one to two hundred miles from a museum ostensibly founded to improve them, even with the facility of railway travelling to aid communication, during the years the said museum has been in existence, and if the advance made in the improvement of these industries has not been great, on whom is this chargeable, with the knowledge that Frenchmen are more apt in industrial art than Englishmen? Knowing that for a century the Frenchman has had museums in Paris and in every large town free to him, and to museums tracing that aptitude, the effort should have been made by those who undertook to improve manufactures, to see that museums filled with examples fitted to stimulate and improve the various centres of manufacturing industry were provided, where workmen could see what others had done before them, and were doing better than them in their own trade, rather than a great central museum at a distance from any one manufacturing centre. Objects of art-manufacture, to be useful, must be placed where manufacturers, designers, and workmen in the industries it is intended to benefit can have easy access to, see, and study them, without the trouble, inconvenience, and expense of visiting London.

The loss of time in procuring, the difficulty which now exists in procuring, the competition for examples in the market, and the consequent increase in their value, point to South Kensington Museum as the "national treasury" from whence they may be procured for present purposes. A considerable portion of the jewellery and metal work sold in London is made in Birmingham and Sheffield; the former town and Stourbridge supply a very great portion of the finished, and many articles in glass sent up in an unfinished condition, afterwards to be cut, or engraved and sold in London. Carpets, rugs, curtains, lace, and other fabrics of an ornamental character are woven in the looms of Kidderminster, Halifax, Leeds, Axminster, Nottingham, Norwich, Manchester, &c., &c. The Potteries, Worcester, &c., furnish all the ceramic wares for use or ornament sold in the metropolis.

It will thus be readily understood that London is not the centre of any one of our great industries, therefore South Kensington does little more than cultivate the taste of the inhabitants of London, aid those who "make" (not manufacture) and helps to instruct students attending its art schools. Examples selected from South Kensington sent to benefit the industries of the towns named would certainly not affect in any appreciable degree the growth of the public taste of the one and a half million of visitors to South Kensington, those who go specially for purposes of instruction would still have above their fair share of examples to study from.

It is a matter for doubt whether the purposes of the grants in aid voted for the purchase of examples were quite understood by the members of the House of Commons who voted them.

The previous remarks have dealt exclusively with museums, their contents illustrating what may be defined as art industry. There is yet another class of museums equally important to the industrial progress of England. Nearly one hundred years ago, Dr. Barnes, a member of the Royal Society of Manchester, clearly saw the importance of industrial scientific instruction even then, and lamented that so few dyers were chemists, and so few chemists dyers, deploring the deficiency of taste, clearly indicated the means by which these several wants were to be supplied. He writes:—

"Our manufacturers must now (1782) have not merely that strength of fabric and that durability of texture in which once consisted their highest praise; they must have elegance of design, novelty of pattern, and beauty of finishing."

To supply technical wants he suggested a public repository for the cultivation of chemical and mechanic knowledge:—

"A museum to consist of all machines in the various arts which seem to bear the most distant relation to our own manufactures. All the processes in those of silk, wool, linen, or cotton should there be illustrated. There should also be provided an assortment of the ingredients used in dyeing and printing; and for the purpose of experiments a superintendent would be necessary to arrange and apply the collection to its proper use. He should be a man well versed in chemical and mechanical knowledge, should deliver lectures, and give advice and assistance to those who wish to obtain a better knowledge of the arts."

The above clearly indicates the wants of a town engaged in the production of textile fabrics, "the all machines" suggests to us the starved, neglected-looking museum belonging to her Majesty's Commissioners of Patents at South Kensington, at present dying for support, with a yearly increasing income, up to the 31st December, 1872, with a plethoric surplus of only £1,012,920 7s. 5d. Four objects for the utilisation of that surplus are named in the interesting paper, "On Museums for Technical Instruction in the Industrial Arts, &c.," by Thomas Webster, Esq., read before this Society on the 14th January last. To destroy patent right, as advocated by interested inventors, would be suicidal to the progress of invention, and remove much of the stimulus to invention. The realisation of the "poor man's tale of a patent," *i.e.*, the reduction of the cost of a patent to "half-a-crown," is scarce to be anticipated or desired on national economical principles. The amendment of the patent-law, largely promoted in 1850 and 1851 by the Society of Arts, has borne

invaluable fruit. The admirable publications issued by the Commissioners of Patents, the specifications, abridgments, indexes and other works, which are freely given to public institutions all over the country where they can possibly be useful, set forth the whole history of inventions which have made England so great, a greatness, however, to be preserved only as regards invention, by the education of those powers of mind in which invention has its origin. All true inventions are in accordance with science; inventions have been made by men entirely ignorant of science, but these have been successful only so far as they have been in accordance with the principles of science. Hence a wise appropriation of the surplus to the purposes of scientific technical instruction, to aid it, the advantage of a "General Museum of Mechanical Inventions," to illustrate and explain the commencement, progress, and present position of the most important branches of mechanical invention, to show the chief steps by which the most remarkable machines have reached their present degree of excellence; to convey interesting and useful information, and to stimulate invention. In the unhappy "museum of mechanical inventions," such as now exists side by side with the more attractive South Kensington of Industrial Art, showing an unattractive exterior and by no means light interior, visitors to the museum of the Commissioners of Patents are repelled by the mass of valuable objects crowded together for want of space. The untold value of the collection, unattractive and limited as it appears, cannot, in an instructive point of view, be estimated. Is it not generally known that in the collection are to be found machines and models which were the foundation of the textile manufactures of England. The first perfect steam-engine made by James Watt, after his connection with Matthew Boulton at the Soho, the source of much, if not all, our national prosperity; the parent marine steam engine used by Patrick Millar, in his experiments on the application of steam to the propulsion of vessels, which helped to solve the difficulty, and resulted in the now universal application of steam to navigation; Bentham's ingenious machines for working wood; Bramah's wonderful inventions; and the original reaping machine invented by Bell, may be pointed out as objects of interest to be found in the Patent Museum. The rescuing from oblivion and destruction of not a few, the collecting together of the models and machines, &c., are due to Mr. Woodcroft. The necessity for a National Museum of Inventions is proved in the evidence given before the Royal Commission on Scientific Instruction and the Advancement of Science. In it Colonel Strange says:—

"There is no doubt that some years ago there was no nation that could compete at all with England in such matters (*i.e.*, machines and tools); but we have taught the rest of the world, and the pupil has now become somewhat in advance in many directions of his master. Also the spread of scientific education on the Continent has tended to the application of more sound principles of construction in such things than with us."

The fourth report of the Commission already named, just issued, in reference to the use of the surplus (alluded to), says:—

"We consider this fund, which is derived in great part from the application of scientific principles to various uses in the arts and industries of the country would be very properly spent in bettering some of the conditions on which invention and discovery depend. It is recommended that a collection of physical and mechanical instruments be added to the collection already existing at the Patent Museum; also that the Scientific and Educational Department of the South Kensington Museum should be united to the above."

Such a museum, by the distribution of examples or duplicates, would render material assistance to local museums, in reference to which the report of the Royal Commission alluded to appears to be decided as to their value. It says:—

"In many towns of considerable importance there are no museums, or only such as are worthless for purposes of instruction; some of these towns are well fitted for becoming centres of scientific instruction to groups of population. A town containing (as in the coalfields) 30,000 or 40,000 inhabitants, is not unfrequently the centre of a group of smaller owns, connected by railways; within this area the population is often as numerous as 100,000 or 150,000. If a science school provided with a museum existed in such a centre, it would exercise a most important influence on the scientific education of the district. The museum would also be eminently attractive and humanising as a place of popular resort."

In conclusion, I must apologise for the length to which I have allowed my paper to run.

DISCUSSION.

The Chairman said that the able lecturer had apologised for the length of his paper, but he thought no apology was necessary. It was true that it had extended to a greater length than usual, but the lecturer had connected together under one head a vast variety of subjects, which had a real connection, and which perhaps would be better understood by being treated in one paper than if they had been made into six or eight, for there was certainly material enough for six or eight. Though long, the paper was wonderfully condensed. The length of the paper left very little time indeed for discussion, and he thought they could hardly discuss a paper of that length and with so many subjects in the short space of time at their disposal. He should, therefore, after making a few brief remarks on the paper, ask them to give their thanks to the lecturer. The principal remark he would make was that England presents, at the present time, a spectacle which had never been presented by any nation since the world began. It presents a spectacle of a nation having attained to the highest degree of manufacturing power No nation in history has ever attained to the height of manufacturing power now reached by England. This fact was sometimes overlooked in discussing questions of this kind. He merely raised the question, without presuming to express an opinion upon it, whether it was not possible that this high development of manufacturing power has something to do with the alleged degradation in art power? He was himself inclined to think that they were two antagonistic things—manufacture and art. The tendency of manufacture was, in his opinion, certainly to limit and restrict art. He thought the application of manufacturing processes to art productions was not favourable to high art. He would instance such matters as drawing and photography. Nobody would deny that there was more interest to be found in fine drawings by the old masters, and even by many of the so-called modern masters, than in the finest photographs that could be produced, because the photograh did not contain the impress of the human mind, and that he thought was essential to the highest production of art. The same thing might be said of metal work of every description; indeed, Mr. Aitken had alluded to one ingenious mode of inlaying adopted by the French, the electro-typing process, which he understood him

to say did not produce as fine an effect as the same work done by hand.

Mr. Aitken said the French had really taken what was an English invention and applied it to this mode of filling up the lines which were to be inlaid.

The Chairman remarked, however, that it was a process without the intervention of the human hand. And to that he was rather inclined to fear might be attributed the fact that manufacturing power and artistic power appeared to him antagonistic to some extent, and that a nation which had developed to the highest possible extent its manufacturing power would possibly not develope the other to the highest extent. He thought that might be the secret of the alleged degradation of art in the present day. With respect to some remarks as to South Kensington, he agreed with the lecturer that the diffusion of such museums was highly desirable, but he thought that if the attempt to form such museums had first been made in the way suggested by the lecturer, that is to say, to provide first local museums, the attempt would probably not have succeeded. It was a much wiser thing to found a museum in London first, but he thought that they should not rest satisfied with that, but that such museums should be spread all over the country. With these few remarks he would now ask them to give their best thanks to the lecturer, as he was quite sure they would readily do.

Mr. Aitken, in reply, said he should like to explain that what he thought was, if they were going to improve manufactures, and if museums were a benefit to special industries, it would be necessary that they should be put into districts where these special industries might be developed, rather than creating one central museum, which caused artisans who were to be benefited to go to London to see them. He concluded by expressing his obligations to the audience for the vote of thanks, and in addition for the patience with which they had listened to this paper.

JUVENILE LECTURES.

The following is the text of the two lectures delivered by Mr. Frank Buckland, M.A., her Majesty's Inspector of Salmon Fisheries, to a juvenile audience, in continuation of the series commenced during the Christmas holidays. They form the third and fourth of the series. The third was delivered on January 16th, at the Museum of Economic Fish Culture, South Kensington. The fourth at the Brighton Aquarium, on April 10th.

Lecture III.

Mr. Buckland began by explaining his preparations, showing the growth and development of the salmon, from the egg upwards. He had already alluded to the fact that a salmon carried nearly 1,000 eggs to each pound of her weight. Immediately on emerging from the egg, the young fry began to swim about and breathe, but did not eat, being provided with an umbilical sac or vesicle, containing a secretion of albuminous matter, which comprised their food for the first six weeks or so of their existence. From the "fry" stage the young fish developed in about two years into the "smolt" stage, when it descended into the sea; and when it had increased in size, it was ready as a "grilse" to make its first deposit of spawn, and ascended the rivers for the purpose of continuing its race. After spawning it was in a diseased state, technically known as a "kelt." In this condition the male fish developed a cartilaginous hook on the lower jaw; this protuberance disappeared after its visit to the sea again. The dangers of mill-wheels were explained, and examples of the injuries inflicted thereby were shown, the mill-wheel frequently crushing and seriously injuring or killing the fish. One of the greatest dangers to the spawning fish was the poacher's gaff or spear, specimens of which were shown. A poacher who speared a fish on the spawning bed, did not take one life, but the lives of thousands of fish at one blow. Trout were next passed under review, and their importance as an article of diet commented upon. Among other fresh water fish, pike or jack, eels, barbel, tench, and carp were exhibited; and some preparations explained. Of carp, Mr. Buckland had some new varieties in his aquaria; one, the *speigel* or "looking-glass" carp, was very curious, having rows of glistening scales, like burnished gold, along each side. He also had some novel kinds of tench—the *goldschlei*, or golden tench of Prussia; these were a fine fish, weighing up to 6 or 8 lbs., which were worthy of careful cultivation in this country. Much good might be done by introducing foreign varieties of fish into this country, and we might reciprocate the benefit by sending a stock of our indigenous fish to other lands. In America, for example, there were neither carp nor soles. This had been done in the transport of salmon and trout to New Zealand and Tasmania, and in the introduction—besides the carp and tench above referred to—of the *Salmo Fontinalis* or brook trout from America. Eels were very valuable fish, and ought to be protected. He was glad that the destruction of young eels was prohibited by the Salmon Fishery Act, 1873. Eels were a very nutritious food, and if they were carefully cultivated, might become a still more important article of diet, especially for the poorer classes, and they ought to be much cheaper. Of sea fish, the mackerel, herring, and cod, were probably the most important of British fish. They were migratory in their habits, and only visited our shores occasionally, for the purpose of spawning. For the flat fish, which lay near the bottom of the sea, a special net was required, called a "trawl net," which was sunk to the bottom of the sea, attached to ropes. Tons of young and immature fish were captured in the spring months, and, being unable to escape, were crushed by the weight of the incoming fish. This destruction of young fry was a very important point to consider. The curious forms and varieties of instruments showed the variety of habits of the different fish, all of which had to be studied by the fishermen before they could pursue their calling with success. Many of these nets were very costly, and necessitated a large outlay. Not only nets, but boats and gear had to be supplied, and an enormous sum was represented by the stock-in-trade and appliances of the hardy race who supplied our markets with fish. From fish proper, the lecturer turned to the edible shell fish and cretacean—oysters, mussels, whelks, lobsters, crabs, &c. The oyster had been for ages celebrated for its good qualities as an article of food, and English oysters, above all others, are the best. Unfortunately, by some means or another, the beds had been less productive, and every means was being resorted to to increase the supply. In France, the artificial cultivation of oysters was a large industry. It took three to five years for an oyster to attain an edible size. At birth, the young "spat" was no larger than very fine sand, though the fish was fully formed, and its structure might be examined by means of the microscope. Turning to other forms of fish life of less commercial value, Mr. Buckland pointed out casts of the porpoise, the skin of which was said to make very good leather, and whose blubber or fat yielded a considerable quantity of oil; the tunny, a gigantic species of mackerel; the angler fish, or fishing frog (*Lophius piscatorius*), with its curious contrivance like a fishing rod on the top of its head, from which its name is derived; the torpedo, with its wonderful electric battery; the various kinds of sharks, from the "foxtailed shark" to the dog-fish; the lumpsucker, with its curious sucking apparatus, and the variegated hues which it assumes at different periods of its existence; the sun-fish, a creature apparently all head with no tail,

whose delight was to bask in the sun, and which was eagerly sought after on account of the quantity of oil which its liver yielded; the eagle-ray, with its large fins, or flappers, from which its name is derived. The powers of the saw-fish and the sword-fish were exemplified by means of examples of damage actually inflicted by them on ships' plates or other substances; and the action of the curious marine insect, the *teredo navalis*, which bores its way through wood, and thus often endangers the safety of ships, was plainly shown by specimens of wood sent by Sir Bartle Frere from India, with the track of the insect plainly marked in them. Among the principal points to be considered in connection with fresh water fisheries particularly were weirs and pollutions. Fish could not ascend the rivers if they were blocked by natural or artificial obstructions, and it was necessary to enable many kinds of migratory fish, such as the *salmonidæ*, to surmount these obstacles. Special contrivances, called "fish passes" had been raised with this object, and models of these different appliances were exhibited. Pollutions were even more serious. Fish were often killed by thousands by means of pollutions from various sources, and it was his object to show to factory proprietors and others that it was to their interest to keep their refuse out of the rivers.

Lecture IV.

Mr. Buckland said the Brighton Aquarium was in fact a "Marine Zoological Gardens." It was one of the greatest practical educational institutions of the country. In the first place, by means of the Aquarium, they should study the habits of deep sea fish; next, they should use the institution as a means of training their observation; and, thirdly, they should, by it, learn to know that everything is admirably and beautifully made and exactly adapted to the circumstances of life under which it lives. As Inspector of Salmon Fisheries, he (Mr. Buckland) had the honour of presiding over 38 natural aquaria—that being the number of districts over which he had jurisdiction in regard to salmon fishing. Each river was, in fact, an aquarium, and each provided the means of obtaining knowledge concerning the habits of fish. At the same time, they could not tell—except at the Brighton Aquarium—what were the habits of those creatures when they were at home in the sea. If, however, they now used their powers of observation, they would see that there was a law of economy in the ocean, as upon land. Having endorsed the opinion of his father (late Dean of Westminster) that everything in Nature was made good and perfect for a reason, Mr. Buckland went on to speak of different kinds of fish, explaining many of their peculiarities of form, their habits, and their uses. Producing the body of a dead porpoise, he described it as a mammal in every respect but its ear, which was that of a fish; and he also remarked upon the great peculiarity of its being an air-breathing animal living in the water. Speaking of seals—which he described as very intelligent creatures—he referred to their wholesale slaughter in the northern seas, and asked the audience to back him up in endeavours to obtain an Act of Parliament to prevent vessels going out to kill the young seals. The nose of the seal was a very beautiful adaptation of Nature, and the peculiarity was to be found nowhere else except in the camel; in the one case it was used for excluding the water and in the other for keeping out the desert sand. When seals were killed they often sank to the bottom; and they were then found by means of a very simple contrivance which enabled the hunters to look into the water. This consisted of a hollow tube, with a piece of glass in its centre, which being placed on the water, enabled the observer to see to the bottom of the sea or river. Passing on to speak of the turtle, he pointed out that these creatures had a very small brain, but that their teeth were admirably adapted for the mastication of the hard vegetable food upon which they lived. He also expressed his belief that, if nothing were done to prevent the wanton destruction of turtles, there would, in a few years, be no turtle soup. He next alluded in detail to the habits of the shark, the dog-fish, the sword-fish, the saw-fish, the different species of skate or ray, &c. Speaking of the sole and the turbot, he said that the fry of these fish were destroyed in large numbers by shrimpers, and he thought that an Act of Parliament should be passed to say that during the months of April and May, to the 15th of June, nets should be used with a mesh of sufficient size to let through the young fish. Pilchards were favourably spoken of as an article of food, though they seldom or never found their way into the London markets. If the habits of fish were studied, there was no reason why they should not be understood, and this would undoubtedly lead to a vast increase in the supply of fish, and would necessarily tend greatly to cheapen these products as articles of food. This, as he had said, was one of the great objects of the Aquarium. The herring, the sprat, the cod, the lobster, the crab, and the oyster were all remarked upon in turn, Mr. Buckland asserting that they should all be available for consumption at much less than the current prices, and prophesying that the Aquarium would be the means of greatly cheapening them. His argument generally went to this—that, the habits and requirements of fish being made known by observation in that building, scientific men and the public would be able to apply that knowledge in various ways which would tend to the culture and development of fish in such a manner as to prevent their wholesale consumption or destruction when young. The question of oyster culture was becoming of great importance, as their supply was gradually becoming less and less. Experiments had, however, convinced him that if, between May and July, the temperature of the ocean could be kept at between 60 and 70 degrees, oysters would be cheap, as the young fry would then be able to get safely over the infancy. On the subject of salmon, Mr. Buckland spoke of the steps taken by himself and colleague, Mr. Walpole, to cultivate the breeding of that fish, and held out the hope that, before long, it would be had for sixpence per pound. Brook trout were also referred to, and the opportunity taken to condemn the pollution of rivers by manufacturers and others. While speaking of the octopus, Mr. Buckland exhibited a sketch of an immense cuttle-fish, recently taken in Newfoundland, the dimensions of which had been furnished him through Lord Kimberley, the late Colonial Secretary. It had two arms, each twenty feet long, and eight shorter ones, each eight feet long. The uses of these arms were obvious, viz., to catch the prey of the animal, but the uses of the creature itself were not so apparent. No doubt it had its *raison d'être*, which the aquarium might be the means of discovering. Mr. Buckland concluded by praising the arrangements at the aquarium, and the manner in which the tanks and fish were kept by Mr. Lee and the officers of the building. He felt sure that if the specimens were always kept in such good condition his hopes on the usefulness of the institution would be perfectly realised.

The French Assembly have voted a pension of 12,000 francs to M. Pasteur for his eminent services to science, more particularly for his researches into the causes of the diseases of the vine and of silkworms.

The highways of England and North Wales, according to a parliamentary paper, are 59,348½ miles in length, and the expenditure upon them during the past year was £824,740 3s. 11d., or nearly £14 per mile.

The coal-beds of the Faroe Islands have been examined by Professor Johnstrup. The area of the main mass, in Sudero, is about five English square miles. The Professor's opinion is that the Faroe coal is Miocene. In illuminating power it averages nine-elevenths of that of good English coal.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

The *Examiner*, in an article on the Exhibition, has the following :—

The novelty has worn off, and International Exhibitions cease to interest the general public in the same lively way they did. We must not forget, however, the immense benefit we have derived from them, or derive from them, or lapse into the vulgar error of thinking that things become useless the moment they become familiar. Stay-at-home Englishmen possessed of the ordinary perceptions of their race were startled in 1851, when for the first time they beheld the gulf which separated them from their Continental brethren in some of the useful and in all the decorative arts. They saw many ways of effecting the amenities of life never dreamed of in the practical philosophy which they so freely vaunted; and when at last satisfied that grandeur our of doors and sweetness within were perfectly compatible with utility and comfort, they bestirred themselves like men. Our streets widened, edifices with design in them arose on either side, and the eye began to have a foretaste of the stately glories of the architecture of cities. The genius of design once stimulated, we set our wits to work upon paper-hangings, pottery, furniture, and all manner of familiar things; and having tried our best to make our surroundings pleasant to contemplate as well as comfortable to use, we discovered, after a decade had passed away and another Great Exhibition was opened, that the gulf which separated us from our neighbours in matters æsthetic had palpably diminished to a gap; and were we to repeat on the same grand scale next year such an exhibition as either of the first two, we should discover that the gap had shrunk to a mere fissure, traceable only here and there. * * * Decorative manufactures, in the wide sense, have sprung into being since 1851, so far at least as this country is concerned, and have occupied successfully the attention of some of our best men. When we examine furniture for example, shown by English firms, and designed by native artists, we shall find that we have still much to learn. All or nearly all our best things in the decorative way are still in product of foreign genius which our popular, or perhaps, rather, fashionable manufacturers have sense and discrimination enough to retain in their service. Still our advance in taste is decided and plainly visible. It took us two or three generations before we acquired, as Englishmen, the silk-weaving art of our Huguenot immigrants; and although in the process of learning the subtle feeling for colour vanished, still the texture of the fabric itself became the best in the world. The Englishman in workmanship—and that, after all, must take precedence of design and colour—is still *facile princeps*, and we would fain hope that with so many examples of what is chaste and lovely, and soothingly suggestive, continually before his eyes, he will by-and-by see that the gods themselves designed the beautiful to be wedded to the useful, and that in ignoring such union he but reflects impiously upon them.

The following is the returns of admissions for the second week, ending April 18. Season tickets, 1,185; payment, 11,471; total, 12,656.

The Postal Department of the Swiss Confederation is authorised to enter into an agreement with M. E. Meyer, of Paris, the inventor, for the introduction of a telegraphic apparatus by which several currents can be sent in opposite directions through the same wire at the same time.

EXHIBITIONS.

Exhibition of Applied Art in Paris.—The Union Centrale des Beaux-Arts appliqués à l'Industrie announces that its fourth public exhibition will open in the Palais de l'Industrie on August 10. The coming exhibition is on the same plan as those of former years, and is divided under the three following heads:—(1) the Modern Exhibition, consisting of works of art prepared for industrial reproduction, and modern products of the artistic industries; (2) the Retrospective Exhibition, a series of objects of decorative art of past times grouped in such a manner as to form a complete history; (3) Exhibition of the Works of the Schools of Design of Paris and the Departments. M. Ernest Chesneau, of the Louvre, has been appointed Director or Agent-General of the Society.

COMMISSION ON SCIENTIFIC INSTRUCTION.

(Fourth Report.)

The fourth Report of the Royal Commission on Scientific Instruction and the Advancement of Science deals with Scientific Museums and Collections. As the proper system of management for our national museums and galleries forms a subject which has long been under the consideration of the Society, and one which is now in the hands of one of the largest and most important of the existing committees of the Society, no apology need be offered for entering with some minuteness of detail into the substance of this report.

The following are the institutions specially dealt with:—(1) The British Museum; (2) The Museum of the Royal College of Surgeons of England; (3) The National Botanical Collections and Gardens; (4) The Museum of Practical Geology; (5) The South Kensington Museum at Bethnal-green. The report also devotes a section to (6) other scientific collections, and concludes with some remarks on (7) public lectures in connection with museums.

Each of these receives consideration in a separate part of the report.

(I.) The British Museum.

First of all a summary of the constitution of the Museum is given, as far as regards the portion shortly to be moved to South Kensington, viz., the Natural History Collections, including the Mineralogical Collection. It is governed by a Board of Trustees, 50 in number: 25 are *ex-officio*, 1 is nominated by the Crown, 9 are representatives of the families of benefactors, and 15 are elected by those otherwise appointed. Among the *ex-officio* trustees are the Archbishop of Canterbury, the Lord Chancellor, and the Speaker of the House of Commons, who are named principal trustees, and with whom rests the appointment to all offices in the museum, except the office of Principal Librarian, to which the Crown appoints. The remaining official trustees are certain chief officers of State, with the Presidents of the Royal Society, the Society of Antiquaries, the College of Physicians, and the Royal Academy. The General Body annually appoint fifteen of their number, who, with the three principal trustees, form a Standing Committee for carrying on the ordinary government of the museum. The Standing Committee appoint, from among themselves or from the general body, sub-committees for special superintendence of the several branches of the establishment, one being for natural history. The sub-committees report their opinions and recommendations to the Standing Committee.

The Natural History Collections form four departments:—Zoology, Botany, Geology, and Mineralogy. Each is under the charge of a keeper or head, under

whom are assistants and subordinate officers. The whole are placed under a Superintendent, who at present is Professor Owen. His duties are to exercise a general superintendence over the four departments and their officers, to prepare and transmit certain reports to the Principal Librarian and the Standing Committee, to edit catalogues, &c., and to watch and increase the collections.

All funds applied to the maintenance of the museum, whether derived from property belonging to the institution, or voted by Parliament, are entirely under the management of the trustees.

On the value of the existing system, very various opinions were laid before the Commissioners. Some witnesses considered that it worked well, and deprecated any fundamental change; they proposed to strengthen the hands of the Standing Committee, and that the Board of Trustees should merely make an annual inspection of the museum. They also thought a larger proportion of scientific men might be introduced as trustees.

In opposition to such opinions as these, other witnesses condemned the entire system, and advocated the creation of a responsible minister. In default of such an authority, the responsible control of the museum might be vested in the Lord President of the Council.

The creation of a Board of Visitors was also suggested, such board to include some members of scientific attainments, and conversant with natural history.

The resolution arrived at by the Commissioners is sufficiently definite. They consider that:—

"The objections to the present system of government of the British Museum by a Board of Trustees, as at present constituted, so far as relates to the Natural History Collections, are well founded; and they have been unable to discover that the system is attended by any compensating advantages."

They are in consequence prepared to recommend considerable changes in the present system, and they are of opinion that the removal of the collections to South Kensington offers a favourable opportunity for such changes. They propose:—

"That a Director of the National Collections of the Natural History Department should be appointed by the Crown, and should have the entire administration of the establishment, under the control of a Minister of State, to whom he should be immediately responsible; that the keepers of collections should be responsible to the Director; that the appointments of keepers and other scientific officers should be made by the Minister after communication with the Director and with the Board of Visitors; and that the Director should prepare the estimates to be submitted, after consultation with the Board of Visitors, for the approval of the Minister.

"That the present Superintendent be the first Director.

"That a Board of Visitors be constituted. That this Board be nominated in part by the Crown, in part by the Royal and certain other scientific societies of the Metropolis, and, in the first instance, in part also by the Board of Trustees; that the members be appointed for a limited period, but be re-eligible; that the Board of Visitors should make annual reports to the Minister, to be laid before Parliament, on the condition, management, and requirements of the museum; and that they should be empowered to give advice on any points affecting its administration to the Minister."

Although the Commission consider it no part of their duty to attempt to define the boundary between the scientific and the art collections of the museum, they "conclude that the collections to be left in Bloomsbury will have reference, in the main, rather to literature and art than to science, and that the collections at South Kensington will be exclusively scientific." They think, however, that the Banksian Library ought to follow the Botanical Collections to South Kensington. They urge that every facility should be given both for study, and for public visiting, and mention with approval a suggestion put forward as practicable "by some of the witnesses conversant with the management of museums;" this consists in making the glazed cases to open at the back, so as to be accessible from the working rooms, whilst they are effectually and permanently closed towards the public galleries. They also approve the idea that a selection of typical specimens should be made for the use of general visitors, which might adequately represent the several departments; and that the rest should be reserved, and accessible under appropriate arrangements, for the purposes of special scientific investigation.

(II.) Museum of the Royal College of Surgeons.

This is founded on the Hunterian Collection, which was purchased by Government, and placed in the keeping of the College of Surgeons, subject to periodical inspection by a Board of Trustees. Though the State purchased the collection, and spent on it and on buildings the sum of £57,500, the college now spends £2,500 a year on its maintenance and extension. It contains a great osteological collection, and an extensive series of preparations of the internal organs, &c., of animals. It is "now, probably, the most complete and best arranged museum of the kind in existence." It is easily accessible to students, and lectures, to which admission can be readily obtained, are delivered in connection with it. Although it is, in many respects, supplementary to the British Museum collections, the Commissioners by no means advise its removal.

They recommend:—

"That, should the fund at the disposal of the college, owing to changes in medical legislation, or from any other cause, prove inadequate for the efficient maintenence and continued extension of the museum, it should receive support from the State, as an institution intimately connected with the progress of biological science in this country. At the same time, there seems to be no sufficient reason why it should, in such a case, pass from the custody and management of the college, under which it has so long and so greatly prospered."

(III.) The National Botanical Collections and Gardens.

Two institutions for the promotion of botanical science are at present supported by the State in or near the metropolis. Of these, one is lodged in the British Museum, under the charge of the Keeper of Botany; the other at the Royal Gardens, Kew, under the Director of the Gardens.

From the date of its foundation, in the year 1755, the British Museum has contained a collection of dried plants, the most valuable part of which, at that time, was the Sloanian Herbarium; but botany is said to have been almost entirely neglected in the British Museum, from the death of Dr. Solander, in 1782, until the year 1827. In the latter year the Botanical Collection was made into an independant department, of which Mr. Brown was appointed keeper; and the Banksian Herbarium was provided with accommodation in the Museum.

The collection, as it now exists, consists of—

1. The herbarium, comprising, (*a.*) The general herbarium. (*b.*) The British herbarium. (*c.*) Various separate herbaria of historical interest.

2. The structural series, comprising, (*a.*) The fruit collection. (*b.*) The collection of gums, resins, and other natural products. (*c.*) The general collection, consisting of the larger specimens chiefly exhibited to the public; and (*d.*) The microscopical preparations, illustrating the minute structure of recent and fossil plants.

The general collection of fossil plants is under the charge of the Keeper of Geology.

At present the full staff of the Botanical Department is a keeper and two assistants, and its cost, during the financial year 1870-71, was £1,767.

The Royal Gardens at Kew were the private property of the Crown until the year 1840, in which year a report upon the condition of the gardens, drawn up by Dr. Lindley, by order of a committee appointed by the Treasury, was published as a Parliamentary paper in 1840.

According to this report, the garden (including the Arboretum) occupied 15 acres, and the collection of herbaceous plants was stated to be then "inconsiderable." The reporter recommended that the Royal Gardens at Kew should become public property, and be converted into a National Botanical Garden, and brought into close official relations with the botanical gardens of the

colonies; that considerable additions be made to the gardens and houses; that everything should be systematically arranged and named; that there should be nurseries for the propogation of plants for Government exportation or for public purposes; that gratuitous lectures should be given upon botany in a popular form; and that the most beautiful specimens of the vegitable kingdom should be carefully preserved for exhibition. He further urged the necessity of providing an extensive herbarium and a considerable library.

Most of Dr. Lindley's recommendations were carried into effect by Sir William Hooker, who was appointed Director of the Gardens in 1840, when the gardens became public property.

Sir William Hooker brought a large private herbarium and library to Kew, and these were increased, at his own expense, until his death in 1865. After his death, the herbarium and library were purchased by the Government at a valuation, and have been added to the public herbarium at Kew, which was founded in 1854, when Mr. Bentham presented his large private collection of plants and botanical library to the nation.

For 40 years the herbarium has received almost all collections made by Government expeditions; and it has been the chief recipient of contributions from both British and foreign travellers, as well as from continental museums. At present the gardens occupy 300 acres, and are estimated to contain 20,000 species of plants. In addition, there is the work of the Economic Museums.

There is no competition between the Kew and South Kensington Museums; for the Museum at South Kensington consists chiefly of manufactured articles arranged according to their uses. The collection of numerous vegetable products in the Food Museum at South Kensington is totally different in object from the Kew Economic Museum, and cannot be said to be intended for the promotion of botanical science.

Besides the director, who has charge of the whole establishment at Kew, the staff consists of a keeper of the herbaria and library, two assistants, a clerk, a curator of the museums, and two attendants, whose pay altogether amounts to £1,792 a year.

Three methods were proposed for dealing with the Botanical Collection. The Keeper of Botany in the British Museum, and the Director of Kew Gardens, thought that it would be better to keep the two collections, but each considered that if one only were to be preserved, it should be the one under his own charge. Professor Owen, however, thought the the herbarium at Kew should be altogether transferred to the British Museum; and that it should be the duty of the Director of the Royal Gardens to occupy himself exclusively with Physiological and Horticultural Botany.

This last proposal is not opposed by the Commissioners, they looking at the fact that the two collections actually exist, considering that each institution has followed a separate line of investigation, for the botanical department of the British Museum, under its present keeper, has inclined in the direction of botanical palæontology—"a direction rendered particularly convenient and appropriate by the existence of a large and valuable collection of fossil plants in the museum;" while, under the late and present directors of the Royal Gardens, the herbarium at Kew has tended towards the cultivation of systematic botany.

The following are the conclusions of the Commissioners with regard to the Botanical Collections and Gardens:—

1. That the collections at the British Museum be maintained and arranged with special reference to the geographical distribution of plants and to palæontology; and that the collections at Kew be maintained and arranged with special reference to systematic botany.

2. That all collections of recent plants made by Government expeditions be, in the first instance, sent to Kew, to be there worked out and distributed, a set being reserved for the British Museum; and that all collections of fossil plants made by Government expeditions be sent to the British Museum.

3. That opportunities for the pursuit of investigations in physiological botany should be afforded in the Royal Gardens at Kew.

(*To be continued.*)

THE SPORADES.

The sponge fishery is the principal branch of industry of the Islands of the Sporades. The yearly average crop of sponges may be estimated at £120,000, of which about £50,000 are sent to England. France used formerly to absorb a good portion of the yield, but since the last war, Austria, Germany, Italy, and especially Great Britain, have been the principal customers. Native speculators generally take themselves their sponges to England for sale, and invest the proceeds in articles of British manufacture, which they bring back. It is, however, to be anticipated that the depreciation in the value of sponges, owing to the large stock existing in Europe in consequence of more abundant crops since the introduction of the diving apparatuses, together with the increasing taxes imposed upon these fisheries, will gradually restrict this industry, and drive the divers to seek a more remunerative and less dangerous work. Many accidents have to be deplored every season, owing to the divers exceeding the prescribed depth, in order to secure a more abundant haul. The apparatuses are exclusively imported from Great Britain and France. In 1870, those of English manufacture were unjustly taxed, for permission to fish for sponges, in excess of what was charged on French apparatuses. This privilege would have been the cause of entirely thwarting English importation. The case was submitted to her Majesty's embassy at Constantinople, and redress was obtained. Though there is no difference in the construction between English and French machines with regard to the depth they can attain, or the length of time a diver can remain under water—the two principal conditions requisite for success in the sponge fisheries—still English produce generally proves stronger, and the gears are of superior quality, as the islanders have not failed to perceive. The air-tubes, however, have hitherto laboured under the disadvantages of being heavier than the French, and thus impeding the free movements of the diver, the tubes being caught on rocks, in consequence of which their use was not in favour. Samples of French floating-tubes were however sent to England, and the result has already been a great improvement in the manufacture of the English article, which, it is to be hoped, will finally supersede its competitor.

All sponges now sent to England contain a large admixture of sand. English merchants, being accustomed to buy this article with as much sand as may be introduced into the sponge, will not pay a proportionably higher price for those which may contain less. The same system was formerly used also in France, and in some other markets of Europe, but experience has shown them that it was preferable to purchase the sponges just as they are fished; and in order to ensure this, agents are sent to Rhodes, which is the centre of this commerce, to purchase them from the divers or owners of diving apparatus. They thus obtain the sponge at first hand, and can rely on their not being weighted with sand. Valonea, which was formerly sent to Smyrna, is now exported direct to Great Britain, and is considered to be of very good quality. During the last two years ancient Persian pottery, generally known under the name of Lindos plates, have been exported to Great Britain. Storax oil is also largely shipped to India.

The value of the tea imported in the first three months of this year was £2,261,643, as compared with £2,654,676 in the corresponding period of 1873, and £4,011,173 in the corresponding period of 1872.

PATENT MUSEUM.

In the House of Commons on Friday last, the 17th inst.,

Major Beaumont asked the Secretary to the Treasury whether the Government had had its attention drawn to the fact that more than £80,000 a year is derived from surplus patent fees, while the Patent Museum afforded totally inadequate accommodation to the unrivalled collection of machinery and models now exhibited there; and whether he could hold out any hopes that suitable premises would be provided.

Mr. W. H. Smith said the Government was aware of the facts mentioned by the hon. and gallant gentleman, that more than £80,000 a-year is derived from surplus patent fees, and that the accommodation was not altogether satisfactory in the Patent Museum. The subject was under the consideration of her Majesty's Government.

OBITUARY.

Owen Jones.—The death of Mr. Owen Jones took place on Sunday last. Born in 1809, he was 65 years old at the time of his death, and almost the whole of his life was devoted to art, especially to decorative art. His principal writings were his great work on the Alhambra (the result of a three years' residence on the spot), published at a vast expense many years ago, and his Grammar of Ornament, showing in a series of elaborate illustrations the progress of art in all countries from the earliest ages, and its origin in the study of Nature, and in the imitation of Nature's processes of form and colour. It was in connection with the 1851 Exhibition that Mr. Jones became most extensively known among his countrymen. He was one of the Royal Commissioners of the Exhibition, but he was also the sole designer of the decorations of the palace. When the building was moved to Sydenham Mr. Jones designed the Alhambra Court, a great portion of which has been unfortunately destroyed by fire. At the last International Exhibition in Paris he received the gold medal for his contributions to the department of decorative art. He was also the gold medallist of the Royal Institute of British Architects. In 1847 he became a member of this Society, of which he was a most active and energetic member, both in connection with the Great Exhibition and in other matters. On April 28, 1852, he delivered the ninth of the second series of lectures on the results of the Exhibition of 1851, the title of the lecture being, "An attempt to define the principles which should regulate the employment of colour in the Decorative Arts."

Dr. Livingstone.—It may be worth putting on record that the great African traveller was elected an honorary member of the Society on his last visit to England. In 1856 also he took part in the discussion on Prof. Owen's paper on "The Ivory and Teeth of Commerce."

GENERAL NOTES.

Italian Telegraphs.—Sicily has more telegraph offices than any other Italian province, and sent the greatest number of telegrams last year, viz., 502,440—that is, one for every five persons. The Abruzzi, Basilicata, and Umbria stand lowest on the list. Naples, in 1872, sent 252,955 telegrams. As showing the relations which exist between Italy and other countries, it is stated that 35 per cent. of the telegrams were dispatched to France, 22 per cent. to Austria, and 8 per cent. to 9 per cent. to Germany, England, and Switzerland.

Coral Fisheries.—In one of the French official reports on the Vienna Exhibition, some details are given respecting the coral fisheries of Algeria. It appears that the reefs extend in a continuous line from Bona, to a point beyond La Calle, and at intervals in other places notably at Mers-el-Kebir, near Oran. Since the sixteenth century various efforts have been made by the Government to promote this industry, and one effect was the creation of a thriving trade at Marseilles in the making up of the coral for ornaments, but during the wars of the Empire, England assumed the fishery rights and handed them over to Sicily and Greece. The coral manfacturing industry thus passed over to Italy, and has since remained centred in Naples. The fishery is carried on under the surveillance of a French vessel. Foreign vessels pay £30 for the right of fishing, vessels of French make and ownership half that sum, while owners resident in Algeria, and owning vessels manned by native crews, pay nothing. Each reef is divided into ten parts, only one of which is allowed to be explored during the current year, so as to admit of the development of the product. During last season the coral fishery occupied 311 vessels, manned by 3,150 sailors, nearly all of whom were Neapolitans, from Torre del Greco. Only twenty craft came from Genoa. The annual value of the fishery is about 3,000,000 francs, or about £118,000.

New Fuel.—In *Des Mondes* is an account of a new fuel invented by M. Pagliani, and composed as follows:—

Conde Petroleum	25 kil.
Or Distilled Petroleum	20 "
Resin	30 "
Coal dust..	40 "
Charcoal dust	30 "
Sawdust	6 "
Sulphate of Calcium	10 "
	136 kil.

The resin is dissolved in the petroleum heated to 70° C., and the other matters mixed in.

NOTICES.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque, Post-office order, or Cheque Bank cheque, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

Extracts from the Reports of Captain Nares, H.M.S. *Challenger*, with abstract of Soundings and Diagrams of Ocean Temperature in North and South Atlantic Oceans. 1873. Presented by the Lords Commissioners of the Admiralty.

Reports of the Inspectors of Factories for the half-year ending 31st October, 1873. Presented by Alexander Redgrave.

A Series of Pamphlets on Phonography. Presented by Sir Walter C. Trevelyan, Bart.

A Statement of Services Performed by John Anderson, Superintendent of Machinery to the War Department, from 1842 to the present time. Presented by John Anderson, LL.D.

The Gas Managers' Handbook, by Thomas Newbigging.

Wool and its Uses; a Handbook for Contractors, Builders, &c., by P. B. Eassie. Presented by Eassie and Co., Limited.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

The following arrangements for Wednesday evenings have been made:—

April 29.—"On some Recent Inventions and Applications of Lambeth Stoneware, Terra Cotta, and other Pottery for Internal and External Decorations." By John Sparkes, Esq., Head Master of the Lambeth School of Art and of the Art Department of Dulwich College.

May 6.—"On Timber Houses." By Frank E. Thicke, Esq.

May 13.—"On the Importance of a Special Organisation for the Diffusion of Sanitary Knowledge." By Major-General Synge.

The discussion on Mr. G. C. T. Bartley's paper, "On Thrift as the Outdoor Relief Test," will be resumed on Friday morning, the 24th April, at 12 o'clock. The Right Hon. the Earl of Shaftesbury, K.G., will preside.

Indian Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

May 1.—"On the Ruins of Cambodia, and the Antiquities of Indo-China." By H. G. Kennedy, Esq.

African Section.

These meetings are arranged for Tuesday evenings, at 8 o'clock, and the following arrangements have been made:—

April 28.—"On the History, Progress, and Prospects of South Africa." By Col. J. C. Gawler.

Chemical Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

April 24.—"On Pyrites as a source of Sulphur, Copper, and Iron." By Dr. C. R. A. Wright, F.C.S. On this evening Dr. Frankland, F.R.S., will preside.

May 8.—"On Sugar Refining, with special reference to Finzel's Sugar Crystals." By Dr. Griffin. On this evening Dr. Letheby, M.B., M.A., &c., will preside.

May 22.—"On the Manufacture of Chlorine." By W. Weldon, Esq., F.C.S.

Cantor Lectures.

The third course will be by Professor Barff, M.A., "On Carbon and Certain Compounds of Carbon treated principally in reference to Heating and Illuminating Purposes."

The object of these lectures is to explain the scientific principles involved in all heating and illuminating processes, and to apply those principles to practical purposes. The absorbent properties of carbon will be briefly noticed.

Lecture III.—April 27.

Gaseous compounds of carbon and hydrogen, marsh gas, and olefiant gas.

Lecture IV.—May 4.

Liquid compounds containing carbon and hydrogen, and fuel.

Lecture V.—May 11.

Coal gas, its composition and purification, and its illuminating properties.

Lecture VI.—May 18.

Heat of combustion; how heat is communicated, and how quantity of heat is determined.

Lecture VII.—May 25.

Consideration of furnaces, stoves, lamps, &c., in which the principles stated in the former lectures will be applied.

All the above Meetings and Lectures are open to Members, each of whom has the privilege of introducing two friends.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Mon. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Professor Barff, M.A., "On Carbon and Certain Compounds of Carbon treated principally in reference to Heating and Illuminating Purposes." (Lecture III.)
Royal Geographical, 1, Savile-row, W., 8½ p.m. Right Hon. Sir H. Bartle Frere, K.C.B., in the chair, "Extracts from the recently received Letters of Dr. Livingstone."
Medical, 11, Chandos-street, W., 8 p.m.
London Institution, Finsbury-circus, E.C., 4 p.m. Prof. Bentley, "Elementary Botany" (Lecture V.)
Social Science Association, 1 Adam-street, Adelphi, W.C., 8 p.m. Mr. Rowland Hamilton, "On Compulsion and other means of carrying Primary Education to all Classes."
Institution of Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. C. Bidwell, "On Coprolites."

Tues. ... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (African Section.) Col. Gawler, "On the History, Progress, and Prospects of South Africa."
Royal Institution, Albemarle-street, W., 3 p.m. Professor Rutherford, "On the Nervous System."
Medical and Chirurgical, 53, Berners-street, Oxford-street, 8½ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. 1. Continued Discussion "On the Fixed Signals of Railways;" and, time permitting, 2. Mr. Joseph M'C. Meadows, "On Peat Fuel Machinery."
Anthropological Institute, 4, St. Martin's-place, W.C., Mr. H. H. Howorth, "Strictures on Darwinism.—Part 3—On Gradual Variation."

Wed.... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. John Sparkes, "On some Recent Inventions and Applications of Lambeth Stoneware, Terra Cotta, and other Pottery for Internal and External Decorations."
London Institution, Finsbury-circus, E.C., 12. Annual Meeting.
Meteorological, 25, Great George-street, S.W., 7 p.m.
Geological, Somerset House, W.C., 8 p.m.
Philosophical Club, Willis's Rooms, St. James's, S.W. 6 p.m. Annual Meeting.
Royal Society of Literature, 4, St. Martin's-place, W.C., 4½ p.m. Annual Meeting.
Zoological, 11, Hanover-square, W., 1 p.m. Annual Meeting.

Thur.... Royal, Burlington House, W., 8½ p.m.
Antiquaries, Somerset House, W.C., 8½ p.m.
Society for the Encouragement of Fine Arts, 9, Conduit-street, W. 11 a.m. Morning Meeting at Grosvenor-house, Upper Grosvenor-street. No Evening Meeting.
Royal Institution, Albemarle-street, W., 3 p.m. Mr. W. Noel Hartley, "On the Atmosphere."
Royal Society Club, Willis's Rooms, St. James's, S.W. 6 p.m.

Fri....... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Indian Section). Mr. H. G. Kennedy, "On the Ruins of Cambodia, and the Antiquities of Indo-China."
Royal United Service Institution, Whitehall-yard, 8½ p.m. Captain Frederick Trench, "On the late Russian Campaign against Khiva."
Royal Institution, Albemarle-street, W., 2 p.m. Annual Meeting; 9 p.m., Prof. Rolleston, "On the Early Inhabitants of North of England."
Geologists' Association, University College, W.C., 8 p.m.
Philological, University College, W.C., 8 p.m. Annual Meeting.
Archæological Institution, 16, New Burlington-street, W., 4 p.m.

Sat...... Royal Institution, Albemarle-street, W., 3 p.m. Prof. Seeley, "On Age of French Revolution."

[The Editor will be glad to receive notices of papers for insertion in the above list.]

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,119. VOL. XXII.

FRIDAY, MAY 1, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ECONOMICAL USE OF FUEL.

A meeting of this Committee was held at the Testing Houses, Western Annexe, International Exhibition. Present—Major-General F. Eardley-Wilmot, R.A., F.R.S. (in the chair); Mr. F. A. Abel, F.R,S.; Dr. Mann, Dr. David S. Price, Rev. A. Rigg, and Capt. Scott, R.N., with Mr. Le Neve Foster, Secretary, and Mr. S. W. Davies.

SILK SUPPLY.

The Committee have had before them specimens of English silk, the silkworms having been reared, the cocoons spun, and the silk reeled in the Exhibition, 1873. The silk was shown as a proof of the possibility of rearing the silkworm and producing a marketable result in this country, and with a view of stimulating a similar production in the Colonies, many of which, it is known, possess all the elements of success.

The silk was produced from seed obtained from Mons. A. Roland, of Orbe, Switzerland, and known as the regenerated races, bred in the open air. The seed was brought from Orbe to the International Exhibition, kept in a cool airy place, and the hatching retarded as much as possible to enable M. Roland to arrive and superintend the first stages. On the 20th May, the eggs in the Orchid-house, at the west entrance of the Exhibition, hatched at a temperature of 70 degrees Fahrenheit. They hatched well, and the worms were carefully gathered in tulle nets and placed in the magnanerie. The worms kept in perfect health, and there was no sign of sickness or disease during any of the changes, nor was there any loss of worms, which, considering the variable weather, show how strong and healthy the breed must be. During the second age about 100 worms were put out on one of the small trees, surrounded by a manchon; but smuts of the London atmosphere and from the three engines near the magnanerie working the machinery in motion, soon destroyed them. More worms were put out at the third age, but they also soon died out. The worms began to spin about July the 18th, and finished about the 26th. They were all mounted strongly, and formed their cocoons quickly and well. The cocoons were all well formed and of good size, some being very large. The cocoons were then reeled by the persons working the reeling machinery in the Exhibition, and they reported the cocoons to be very good, and that they reeled with little breakages.

This silk takes a high classification, as the following report from the eminent firm of Messrs. Dufour Brothers and Co., shows:—

"The sample of silk you have submitted to us, we find to class with the best Italian, and would be used for the same purpose as Italian silks.

"It is of good nerve, clean, and fairly reeled, and we have no hesitation in saying that, had great care been bestowed, so as to have made the thread of 10 deniers only, it would then have ranked with the choicest silk in the world.

"We roughly estimate this to be of about 12 or 14 deniers; and as regards consumption, there is practically no limit. We should experience no difficulty in disposing of any quantity at current market rates. Taking the average of the prices of the last six years the value of this silk should be about 42s. to 43s. per lb.

"If, as you lead us to suppose, this silk can be produced in the colonies, either in this form or as dried cocoons, we do not hesitate to say that a ready market can be found at Lyons or Marseilles, provided the article be sent in sufficient quantity.

(Signed) "DUFOUR BROTHERS & Co."

One hank of the silk was exhibited in the Vienna Exhibition, and has been retained for the Economie Museum just established in that city. Other portions are now exhibited in the Lace Department of the International Exhibition of the present year at South Kensington, and one hank may be seen at the House of the Society of Arts.

PROCEEDINGS OF THE SOCIETY.

THRIFT AS THE OUT-DOOR RELIEF TEST.

The adjourned discussion on Mr. G. C. T. Bartley's paper on "Thrift as the Out-door Relief Test," took place on Friday, April 24th, the Right Hon. the Earl of SHAFTESBURY, K.G., in the chair:—

Mr. Bartley said:—In opening the adjourned discussion on my paper, "Thrift as the Out-door Relief Test," it may be as well, considering the time which has elapsed since it was read, if I recapitulate the chief points I wished to raise.

In the first place, I should like to clear away a misunderstanding which has sprung up from articles in several of the newspapers, and which would suggest the idea that, in proposing thrift as the out-door relief test, I advocate that nothing but starvation should remain for all who are not thrifty. No doubt this misunderstanding has been caused by my not entering into the subject of in-door relief very fully, but it will be clear to any one reading my paper carefully that however improvident, however worthless a man may be, in a civilised country he must not be allowed to starve; he must not be allowed to pay the same penalty for his folly and recklessness which we can only require from a criminal of the worst class. He must be relieved, he must get food and shelter; but what I hold to be the wisest and the most humane proceeding with such an one, looking, not only at the man, but what is more important far, at the class to which he belongs, is to say distinctly and rigidly, that in-door relief is the only form in which assistance should be given.

I should wish this to be clearly borne in mind in considering the points I raised concerning out-door relief, which I consider a far more fruitful source of evil and pauperism than in-door relief. I endeavoured to show that the whole system of out-door relief, as now administered, is a most powerful discouragement to thrift, and a direct premium on thriftlessness. The condition on which all out-door relief is supposed to be granted is destitution, and this to my mind is the key-note of the whole of our poor-law troubles—the hinge on which they all turn. The condition of receiving all relief, of sharing in all the benefits, which might read like so many advantages of belonging to a provident club, is—Destitution. Those who wish to get these good things must, at each stage when they apply for them, be

prepared to show that they are destitute, or assert themselves to be so, so cleverly that the relieving-officer cannot ascertain, or prove, that their statement is incorrect.

It must be remembered that the gulf which separates the weekly-waged man from the pauper is but too often a very narrow one. A single step, and that of short span, usually bridges the chasm; and it but too frequently happens that, the interval being so narrow, no small effort is required to prevent a man on the independent side, when sickness or other troubles come upon him, from slipping over the boundary. Under these circumstances, the tendency of a system which debars the thrifty man, who has saved a little, from all aid, and requires a man to show himself to be destitute before he can obtain aid in distress, must surely be to discourage him from being thrifty, and to induce him to keep himself in such a state as to be always eligible for relief whenever he wants it, or as often as he can get it. At any rate, it cannot in any way directly encourage him to make an unusual effort to place himself in a better position, for by so doing it naturally seems to him he is going against his own interest, for he is practically cutting himself off from readily claiming aid, should he ever require it.

Take the example of two men, in the same trade, living next door to one another, and earning similar wages, and with a like number of children. The one, let us suppose, is thrifty and careful, his rooms are clean and tidy. By dint of pinching and management he has got together some decent furniture; he is a member of a club, and his home, though humble, is respectable.

The other is a careless, drunken spendthrift; his wife, perhaps, not much better; everything goes to the publican. His children lie about in rags, and his furniture is represented by a few broken-down chairs, a miserable bed, and a rickety table. Sickness or old age, with inability to work, comes on them both. What happens? The relieving officer is applied to. The one is relieved at once. It is well-known to all that he is badly off. Look at his miserable room! Probably charity, or rather blind almsgiving, comes to his assistance also, and the man's vices, so to speak, are his fortune. But what about his neighbour?

"What you, Jones! I always thought you well-to-do. Why your furniture must be worth a five-pound note, at least. You are a member of a club. You have been well-to-do all your life. You really cannot want help!" His club-money is but 2s. a week, and he can't live on that, now that his little savings are at an end. The very qualities which render him deserving of some extra consideration cause him to be looked upon with suspicion, when, with the utmost reluctance, he is compelled to ask for relief. He may, indeed, struggle on, pawn or sell his furniture, make his home a hovel, and thus in time, no doubt, become "eligible" for assistance.

However theoretically perfect this system may be, the effect is to discourage a struggling man, who might otherwise be careful, from desiring to be thrifty or fairly well-to-do; and what is more, it makes him object to ever being supposed to be in such a condition; in fact, the great idea throughout the country is, that saving must never be acknowledged, in however small a degree it may be practised, and that everyone must be ready to declare and prove his own complete destitution whenever any unforeseen trouble occurs. The more closely we look into the matter, the more certainly must we arrive at the conclusion that such must be the inevitable result of the present system of administering out-door relief.

We have in all parts of the country—

First.—Persons living from hand to mouth, and consequently bordering on destitution at the least difficulty, knowing that a system of relief exists which is bound by law to help them and to keep them.

Second.—Practically an unlimited supply of this out-door relief, dispensed largely at the discretion of the relieving officer, on no very definite or fixed principle beyond that which is laid down by law; namely, that only the destitute are to have it.

Can it be wondered at that the results are—

First.—That few, very few comparatively, ever think of saving and being thrifty, but naturally regard such a work as one of supererogation, the parish existing especially to look after those who neglect to look after themselves?

Second.—That those who save and are careful are so on the sly, as a thing not on any account to be known, lest they should have to spend their own money in time of sickness, &c., and be refused the parish allowance? Is it remarkable, in fact, that they are made to become, not only paupers, but hypocrites into the bargain?

The main idea I wished to suggest in my paper, and to make obvious that it can be carried out in practice is, that it shall be to a man's advantage, and not, as at present, to his disadvantage, to be careful and thrifty.

I would suggest that out-door relief in money or kind be never given, except on proof of previous thrift—that tangible evidence of thrift or the results of thrift be made the sole standard of eligibility for out-door relief. That when a person applied for relief the officer, instead of asking him whether he was destitute, or presuming him to be so, should ask him what he had saved. If the man said "I am a member of a club which allows me 2s. 6d. a week," instead of that fact disqualifying him from obtaining aid as it does now, though he cannot exist on it, it should qualify him, and from that very circumstance he should have a certain amount added to what he already had. If he showed that he had bought a deferred annuity which now brought him in say 2s. a week, then so much should be added by the parish on that very account. If an old man produced his Post-office Savings-bank book with £20 to his credit, that amount or part of it should be invested in an annuity and so much added to it by the parish.

In the case of old people there would be no difficulty in carrying this out, and children or others would also be practically encouraged to help to make up the amount, so as to enable their parents, &c., to obtain out-door relief. At the present time, children in but too many cases stand aloof, and do not help their parents, or only do so on the sly, lest the old people's parish allowance should be withdrawn.

Those who could not show any results of thrift in this way would, as a class, be the undeserving, and would have to keep off the parish altogether, as best they could, and in old age they would have no choice but to go into the Union-house.

That the idea I thus suggest is not so opposed to reason, is evident from the practical action of the Poor-law as regards members of friendly societies. By law no member can be relieved, or at least the whole of his club money must be deducted from the amount he would otherwise be eligible to obtain as out-door relief. The effect of such a law for preventing persons from joining friendly societies, and so becoming partly independent, is so obvious that the Local Government Board are obliged to wink at the infraction which is often made, that only half the friendly society's benefit shall be deducted from the parish money. This action is indeed a small step on the road to thrift as the out-door relief, but as regards medical relief, this in principle is at present administered exactly in the same way as out-door money relief. Destitution is the qualification which must be superadded to sickness before medical relief can be obtained; and every one seeks to make out the best case he can for such relief when he wants it, and it is usually given almost as a matter of course. How, then, can it be expected that provision should be made for sickness? If the breadwinner is laid up, that alone, provided his family be destitute, is sufficient qualification for medical out-door relief. Though illness comes at all times, and often without warning, it is one of those calamities which we all know we are liable to; so that

every one, by joining a club, may easily and at a trifling cost insure medical attendance for himself, should he ever want it. What good, however, can a medical club be? It merely implies a man paying voluntarily for what he now gets for nothing. It is useless to urge on persons the importance of joining provident medical clubs and such like, when they can spend the money they are asked to pay to these in any way they like; and with very little trouble, and far less personal effort, obtain in sickness out-door medical relief almost for the asking.

Would it not be possible for the parish authorities to form, through their relieving officers, provident medical clubs, working perhaps in towns in connection with some provident dispensary, and in villages independently? The rules might be very simple, and somewhat as follows:—

1. Any weekly-waged man paying monthly or quarterly a sum of [ ] in advance, to have the right, in the event of sickness, to receive medical advice.

2. The relieving officer on his visit to receive the contributions to the medical club.

3. No medical relief of any sort to be given out of the Union-house, except to members of the medical club.

The amount of payment required might vary. In populous districts a penny a week, and a reduction for several in a family, would remunerate a medical man handsomely, as compared with what the parish now pays. It might, however, be good policy, at all events at first, for the parish if necessary to supplement the payments to the doctor, so as to charge a very small sum to each one joining the club. I may give an instance of an agricultural union, respecting which I have made careful inquiries during this summer. Presuming that three-quarters of the inhabitants are of the industrial class, and supposing they all joined such a club and paid each a farthing per week, or one shilling and one penny a-year, the receipts, without a farthing from the rates, would enable the parish to treble the salaries of all the medical officers, who now receive £340 a-year between them, and to add 30 per cent. to the salaries of the relieving officers for their trouble of collecting, instead of taking, as they now do, the £340 a-year given to the medical men out of the rates.

The moral result of such a system on the people themselves would be, however, far more important than the gain to the pockets of the ratepayers; and I am bold to assert that there is not a parish in this country so poor and so distressed, but that the inhabitants could make the effort indicated, and who would not very rapidly feel and acknowledge the benefit of it were it introduced by law.

For the scheme I propose, ten or twelve years would be required before it could be completely introduced. Those who are at present receiving out-door relief on account of old age would have to be allowed to continue it, and it would also have to be granted to new applicants who are above a certain age, or whose cases, from any cause, might be considered exceptional. For younger persons, of course, it might commence sooner, and for those who are beginning life, the scheme might come into force at once, not only without hardship, but with great benefit to themselves chiefly, and to the community as well.

The scheme I have sketched out for medical relief might be more quickly introduced, and would inflict no hardship if carried out as soon as a sufficient time had elapsed to allow all a full opportunity of understanding it.

The main points I endeavoured to establish, then, in my paper were—

1. That the wage-earning classes could, if they wished, place themselves very largely out of the pale of poor-law relief.

2. That the action of the poor-law in its out-door branch, not only tends directly to prevent their depending on their own exertions, but gives them a strong motive for not doing so.

3. That by making all out-door relief depend on previous habits of thrift, a strong inducement would be given to all classes to acquire provident and careful habits, which are most essential to the general weal.

4. That as the results of thrift are tangible, so the relieving officer's duty would be rendered simple, and the increase or diminution of pauperism would not be subject, as it is largely now, to his individual judgment and discretion.

5. That if the change just referred to were made—namely, if thrift were made the qualification for out-door relief—no premium for deceit and fraud in concealing thrift would exist, but it would be the interest of all to save, to teach their children to follow their example, and for their provident habits to be known.

6. That such a system has the germ in it of the gradual reduction of out-door relief, and that by the only sound method, viz., that of the improved condition and wealth of the lowest wage-earning classes by their own individual efforts.

I trust in the discussion that will ensue, these main points will be kept in mind, and that at any rate my paper may lead many, who would not otherwise think of the subject, to go into the all-important matter—the effect of the poor-law on our country.

Major-General Orfeur Cavenagh could testify from his own experience as to the fact of men, who had been for years in the receipt of high wages, going at once upon the poor-rate in the event of their being thrown out of employment. There was, however, one exception which he would make to Mr. Bartley's recommendations. Mr. Bartley recommended that poor-law relief should be given to those only who had been subscribers to some friendly society. There were cases in which poor persons had brought up large families and educated them, without going to the guardians for relief. He held that in the event of such persons reaching the age of 60 or 70 without having received relief from the guardians, out-door relief should be afforded. But he was satisfied that, in the case of able-bodied men, a great saving would be effected for the rate-payers, and a great boon would be conferred upon the poor, by insisting that the applicants should come into the union, and have no out-door relief unless it could be shown that they only wanted some temporary relief to enable them to tide over a short time. After having examined the accounts of some small friendly societies, he believed that unthrift was due to the want of some Government officer, who should be responsible for the calculations of the smaller societies being placed on a sound basis. He was satisfied that if such a Government officer was appointed, friendly societies would multiply, especially if the relieving officers in villages were to dispense accurate knowledge on such subjects among the inhabitants. The Bengal Military Fund was managed by educated men, and its receipts exceeded expenditure, and the subscribers naturally imagined that the fund was solvent. He happened to be one of those who thought otherwise; and after a great deal of discussion an investigation was made, and it was ascertained that the subscriptions were not sufficient. It was agreed that the subscriptions should be increased, and he was happy to say that the fund had been placed upon a solvent footing. If that was the case in a fund managed by men of education, how much more would it happen with a fund which was managed by the ordinary peasantry in a village.

Captain G. H. Gordon, R.N., said that his own experience went in confirmation of what Mr. Bartley had stated in his paper. For the last eighteen months he had been endeavouring to sow the publications of the Provident Knowledge Society in his own neighbourhood in all directions, and to get people to take up the question of thrift; and he had also been trying to get them to subscribe to one of the best friendly societies in the metro-

polis, and even in the kingdom, and he had only succeeded in getting one person to join. It was a society which was established on the soundest principles by the late Mr. Thomas Lewis, a magistrate and poor-law guardian. It originally commenced with 200 members; it had now only 50; so that it was able to return to the present subscribers, according to the number of years they had belonged to it, 20, 30, or 40 per cent. of their premiums. In times of sickness, when the members were unable to follow their vocations, they received 10s. a week, and three-quarters of their medical attendance was paid; £5 was paid at their death, or at the age of 65 or 70, according to the number of years they wished to subscribe. The society was able to allow small pensions to those members who had arrived at 60 or 65 years of age, and whose time had elapsed as subscribers. They received, perhaps, as much as half-a-crown a week for the rest of their lives. The men objected to making provision by means of a benefit society, because, as Mr. Bartley stated, they said, "If we do so we shall not get any out-door relief." He had in his hand a paper containing the particulars of the relief granted by a London union. It was, he supposed, one of the most liberal unions in London. In some of these cases the relief amounted to 9s. 6d., 9s. 4d., 9s. 11d., 12s., 10s. 8d., and even 16s. 6d. a week. This was the reason which men gave for not saving. He hoped that some of the gentlemen present would open the door for some new ideas that might be taken advantage of in dealing with the poor in this respect; but his own fear was that with the present generation we should do but very little good. Our hope must be in the progress of education, the return of confidence in the clergy, and the further dissemination of the principles of the Charity Organisation Society.

The Hon. Evelyn Ashley-Cooper wished to say a word with reference to the question of Government inspection, which was recommended by the first speaker. It was, no doubt, a fact that a great number of the friendly societies of this country were in a very bad state, and that the state in which they had been discovered to be on several occasions had had a very great tendency to prevent persons from putting their money into them; but he thought that the proposal that there should be a Government official who should certify to the soundness of the societies was a bad one. In the first place, such a plan would put too much responsibility upon one man, and, in the next place, there would be a danger of the Government of the country being the guarantor of the solvency of the society.

Major-General Cavenagh said that what he proposed was merely that the subscriptions and payments should be calculated by an actuary, who should say whether the basis of the society was a sound one.

The Hon. Evelyn Ashley-Cooper said that he perfectly understood what had been meant, but he would suggest that a better plan would be the plan followed by the Government in reference to life insurance companies two or three years ago. They required that a certain schedule should be filled up and published, and there was a penalty for making false returns. When that was done, every man could judge for himself whether the society was a sound one or not. Publicity was everything in these societies. If the accounts were published, nothing would go wrong. A very curious illustration happened in the case of the county of Dorset, to which his father and he belonged. The Dorsetshire Friendly Society had been established for 15 or 20 years, and its accounts were then submitted to one of the best actuaries in London. That gentleman reported unfavourably. A meeting was called, and an investigation was made, and it was found out that the way the society had got into difficulties was through the medical officers indulging in their own humanitarian views, without regard to the interests of the society. The accounts had been adjusted, and the society would now go on in a prosperous manner. He would just add one remark to what the gentleman had said as to the absurdity of supposing that the mere fact of the excess of receipts over expenditure was a guarantee of solvency. He would support that view from his experience as a director both of a life insurance society and of an accident insurance society. Supposing 500 people were insured at 20 years of age in an accident insurance society; they became older every year, and the very fact of their getting older rendered them more liable to accidents, and therefore it was necessary to lay by a reserve fund to meet the increased demands. And if such a reserve fund was necessary in the case of an accident society, how much more necessary must it be in the case of a life insurance society. There was only one further point to which he wished to direct attention. He believed that the Post-office Savings Bank would do the greatest possible good in encouraging thrift amongst the poor, but he had come across one or two cases in which the postmasters had refused to take the small amount which was offered, and had recommended the person who offered it to go to the penny bank. As he read the Act, the postmasters were bound to take every amount that was offered, down to one shilling.

Mr. Alsager Hay Hill was afraid that there were difficulties which had hardly been regarded sufficiently in the preparation of the paper, although he thoroughly sympathised with the author in the scope of it. Though it was clear that many medical officers were underpaid, there would be a great difficulty to induce a large number of thoroughly scientific officers to act upon the principle indicated by Mr. Bartley, for they had not learned to trust in the pence of the people. The medical profession would not attempt the popular principle until they had made their calculations, in the same way as newspaper proprietors and actuaries, that a certain number of persons would avail themselves of the advantages of a cheap rate. He had the strongest possible sympathy with the locked-out labourers, but he felt that the position which was taken up by a large number of persons was completely illogical. It was stated in one case that a labourer, who had to bury one of his family, presented himself before the board of guardians to apply for a coffin, and that the board declined to grant it because the applicant was a member of the Labourers' Union. He (Mr. Hill) had no doubt that was a most improper decision on the part of the board; but what was the result? Why, the impoverished and starving labourers subscribed amongst themselves, and provided the coffin, and this proved that there was a sufficient margin over the wages they were earning to enable them to provide for the necessities of their neighbours. He thought that that very strongly supported the assertion of Captain Gardner, that at the present time there was an opportunity for almost every class of the community to live upon their earnings. He, for one, most unhesitatingly hoped and believed that the agricultural labourers, as well as other labourers, would receive at least a guinea a week; but that was beside the question. The present question was whether they had not sufficient wages to make at any rate some small provision for themselves. And then arose the question whether they would be induced, under Mr. Bartley's scheme, to enter into a co-operative medical society sufficiently strongly and unanimously to make it a success. At the present time the Government had supplied the postmasters in the most niggardly manner with papers setting forth the advantage of the savings bank, and of Government insurance. The postal department was making a great deal of money, and it could afford to spend money to make its establishment known. The agricultural unions had agents, who talked in tap-rooms and in every conceivable place about the institution to which they belonged, and they induced their neighbours to join the societies. He had often thought that it would be a very advantageous thing for the Government to extend

its principle of security to provision against illness. Objections were urged against the extension, and such objections had been urged in respect to other proposals. We knew the disastrous consequences which were to follow from the repeal of the corn-laws and the extension of the franchise. And when we asked for the extension of the facilities for saving, we were met by the same objection, and we were told that the people would rely too much upon the Government machinery and too little upon themselves, and that the extension would lead to jobbery of every conceivable sort. He could not but think that there was a great deal more said on this subject than was justifiable, and that it was highly important that there should be in every district at least two or three persons thoroughly well paid for doing their work, and thoroughly well supervised; and that could only be by making the system co-extensive with the country, and connecting the organisation with some central authority, which could enforce its decrees and produce a uniform operation. In existing circumstances there were a large number of conflicting and opposing societies, one fighting against another, and none of them doing their work particularly well. Supposing the medical society was started, no doubt there would be for a considerable time very great difficulty in getting persons to collect the small deposits, unless the Government was as liberal towards its agents as were societies like the Prudential, which went in for the pence of the people. It was not to be expected that postmasters would waste perhaps half-an-hour explaining to a man the operation of the medical society, or the Post-office Savings Bank, when a few properly-worded circulars or handbills would give all the information which was required. A postmaster ought to be enabled to get a good interest upon his activity and experience; and the Post-office department had nobody to complain of but itself in this matter. With regard to what Mr. Ashley-Cooper had said, as to the application of the same principle of publicity to benefit societies as to life insurance societies, he (Mr. Hill) begged to submit to that gentleman's consideration that in the one case they were dealing with well-educated people, who knew what a balance-sheet meant; and in the other case, with people who, when they saw that there was a balance of some kind, thought that all was right. As a member of the Charity Organisation Society he believed that the higher education of the people would be the true remedy against thriftlessness; but at the same time he could not understand why the Government could not save some of the unfortunate gudgeons from being swallowed by the sharks. He looked cheerfully forward to the extension of the Post-office system, not only for a larger banking business, but for a complete insurance for the people. Of course it would always be found that, even supposing that the Government did provide for the people, there were many who liked cream-laid paper and gilt edges, and who would not insure in the common way, and therefore there would be plenty of scope for the better class of life insurance companies.

Mr. J. Abel Smith, M.P., said that in the parish to which he belonged they did everything to encourage clubs. Their usual rule was that when a man, in consequence of illness or any other misfortune, applied for out-relief, they made up his income by such out-relief to the amount he earned in his work. But he did not think that that plan could be followed in all cases. Much would depend upon the amount of wages, and where wages were very low, he did not see how a labourer could subscribe to a club. But as wages were rising every day he hoped that that difficulty would soon be removed. He hoped also that friendly societies would improve. A Royal Commission had been inquiring into them two or three years, and he believed that we were to have a report shortly. He hoped that their would be some scheme in the report which would improve the friendly societies of the country, and help the cause of thrift.

Mr. Allerdale Grainger said the Scotch, who were remarkable for their thrift, were in some cases in receipt of very small wages, and he had yet to learn that it would be impossible for the very poorest to save out of their wages. Thrift was very much a matter of education. The Scotchman was educated to thrift, and such education was what was wanted by the working classes. He thought that it was unfair to come upon people who did not employ labour, and ask them to pay the doctor's bill for the servant of somebody else, who was really able to provide for the servant. He thought that the only way would be to pass an Act which would compel masters or employers of labour to pay a certain sum for the medical relief of his own workpeople. If the money was paid by the master before it was distributed to the men, it would be easier to keep up a proper system of medical relief.

Mr. John Carpenter quite sympathised with Mr. Bartley in his movement; but probably Mr. Bartley would find, in practice, that a great many difficulties would spring up from tho very improvements which he recommended. There was a strong opposition frequently manifested against what was called dealing harshly with the poor. There were always some people who thought that, if guardians erred at all, they ought to err on the side of the poor. He was quite certain that if they followed out more faithfully the practice of watching the position of people to find out how they regarded themselves, and aided those who aided themselves, they would be going in the right direction. Mr. Bartley made a little mistake when he asserted that the board of guardians to which he belonged refused to relieve a case in which a man had subscribed to a club in which there had been a failure, because the doctors did not agree to his ability to work. The officer was told to administer what he thought necessary during the week, and make inquiries and report next week. Therefore there had been no refusal. They frequently found that the club allowance was more than Mr. Bartley had indicated. The club allowance in sickness was mostly 10s. a week. One improvement lately introduced was of great importance—the looking up of the parents and the children of those who were receiving relief. The officers of the guardians had been active for the last two years in that matter, and they had found that the children would often provide for their parents when the guardians brought pressure to bear upon them.

Mr. Saywell said it appeared to him that the question of out-door relief was one of economy. The principle upon which out-door relief should be given was its effect upon the poor-rates, and it should be given when it would be cheaper to the ratepayers than in-door relief, rather than according to the circumstances of any individual case. There were cases in which a little out-door relief, to supplement the help of friends, would prevent a person from coming into the workhouse, and this caused a saving to the ratepayers. These were the cases in which it might be afforded. He would lay it down as a rule that the aged and the infirm should have out-door relief unless they could be more comfortable inside the workhouse. It must not be taken as a general rule that persons were discouraged from being thrifty by boards of guardians. That was not a fair statement. He believed that the guardians who undertook the work did so with a determination to act fairly and justly, both to the poor and to the ratepayers whose money they were spending. They weighed every case that came before them, and exercised their best judgment. What they complained of was that they were interfered with from time to time by the Local Government Board, and their own local knowledge was put aside altogether. They could not dismiss a single officer whom they had appointed without the approval of the Local Government Board. That was a great discouragement to men who gave up their time without any fee or reward whatever, and who studied the whole sub-

ject and entered into it thoroughly; and it was one of the greatest evils of the present poor-law system. The guardians being now elected annually by the ratepayers, he thought that the whole power might be fairly placed in their hands. Another anomaly was that the Local Government Board had the power, in the case of the metropolitan unions, of sending to the boards a certain number of members who had not been elected by the ratepayers. That was the introduction of an influence which he believed was totally opposed to the principle of representation and taxation going together. A large amount of property in this country did not contribute to the poor. The support of the poor was thrown entirely on houses and lands. He thought that the admirable manner in which the rates had been dispensed from the first spoke very well for the boards of guardians which had existed during the poor-law system.

Mr. Bartley, in reply, said that Captain Gardner had remarked that it was possible that the introduction of a scheme like that which the paper had proposed might raise the rates at first. It might appear to be so; and he must say, although he was a guardian, and some of his fellow guardians were present, he did not care nearly so much about the reduction on the rates as he did about the reduction of the poor. If they could buy up the poor by an increase on the rates he should be very glad. One of the great difficulties of introducing any change like that which was proposed, was that it did look on the face of it as if it would increase the rates. Of course every means which we took to improve the people must eventually and very rapidly reduce the rates. There was no doubt that the two went together. The higher the rates were, the greater the sufferings of the poor, and the lower the rates the better for the poor and for the ratepayers. Of course there would be exceptions in detail with any system. Of course there were some cases which might fairly receive some allowance, but he thought that those were cases which charity ought to look after. In all these matters he looked upon the poor-law as not dealing with exceptions. But, as he said at the beginning, there ought to be a system in every union such as had been tried by the Charity Organisation Society, for working poor-law relief and charitable aid together, and for taking exceptional cases out of the hands of the parish, and perhaps by an extra liberal loan, or some help of that kind, preventing persons from falling upon the rates. That was the best kind of charity. With regard to friendly societies he need not say much, as Mr. Ashley-Cooper had spoken about them. But the subject was now under the consideration of the Government; and at the present moment there was being framed a Bill which, he believed, the Chancellor of the Exchequer would bring in in the course of the next week, in order to consolidate the Acts relating to Friendly Societies; and he heard from one of the Commissioners that it was an open question whether there should not be a provision as to certifying the rules, not only as to their being compatible with the Act of Parliament, but absolutely sound as well. The present Government, and particularly Lord Derby, were quite alive to the importance of not only preventing things from being wrong at starting, but of keeping them from becoming so. As to post-office savings banks, he certainly had never heard of a postmaster refusing to take a shilling deposit. By law a postmaster was bound to open an account for a shilling. He (Mr. Bartley) only wished that Mr. Ashley-Cooper would make a complaint to the Post-office of any postmaster who refused such a sum. There was a deputation at the end of last year concerning the importance of immensely extending the post-office savings banks. His own feeling was that they should be brought to the door and elbow of every person in a village. He would undertake to organise a scheme in a month. An official ought to go into the villages at stated periods to collect the deposits. He believed that if that was done not only hundreds of thousands but millions would be taken in a very few years. The more he went into it, the more convinced he was that there would be an immense amount of thriftiness amongst the people if they had only the means of carrying it out. Wherever he managed to start a penny bank, or anything of the sort, and gave facilities for saving, money flowed in without any difficulty. At the place where he was engaged, there were three or four hundred people employed, and a man went round to them every week to collect their savings, and he took, perhaps, £20 a-week. As to the smallness of wages, he (Mr. Bartley) did not believe that was the reason the poorer classes did not save money. Nobody was more convinced than himself that many of the wages were small; and, although he did not wish to see a revolutionary change, he wished to see the agricultural labourer immensely improve his position; but he believed that the only way the labourer could improve it was by a systematic habit of thrift. Wages were paid out of the savings of a previous generation, and the only possible way in which they could be increased was by increasing the fund out of which they were paid; and that would be done by increasing the habit of thrift. If everybody in the kingdom was thrifty, no doubt everybody would be much better off. The notion that extravagance was good for trade was one of those fallacies which lay at the bottom of a good deal of trouble. If everybody was to make up his mind to be thrifty, we should very soon get over most of these troubles with regard to wages being small. If we recognised a system of supplementing small wages by various agencies, we should be practically giving extra wages in a very demoralising way. Everything which tended to prolong the system of doles of various sorts must tend to reduce wages and demoralise the people at the same time. There was present one of his fellow guardians who, he believed, was vice-chairman of the board, and whom he hoped he should get to know better before long, and that gentleman had said that one of the great difficulties which boards had to contend with was the cry of harshness. That was true, and he (Mr. Bartley) might say that although he had been elected, he believed that every clergyman in his district was against him because they looked upon him as so harsh. Now, there was a very charitable feeling which had very little charity in it, and though he did not wish to boast, he would maintain that he was as little harsh as any of the clergyman who voted against him. What we had to do was to reduce suffering to the lowest extent, and if by voluntarily giving relief we increased suffering, then, as far as the sentimental idea was concerned, we were really a great deal harsher, and more unkind and uncharitable, than if, by a firmness which grieved at the moment, we refused the relief. It often caused a conflict with one's self to refuse alms, but it was more humane to do so than to make a grant which was demoralising. He would not say a harsh word to any individual, but, though it might be with the greatest sorrow, he would refuse a beggar, because he knew that it was the kindest way of treating him. The last gentleman who spoke seemed to think that everything was right as it was. He (Mr. Bartley) must say that he did not agree with that gentleman. When we came to consider that, out of a population of twenty-five millions, one in every twenty was a pauper, and that one in every ten either had been upon the rates, or would be before he was done with, he must say that there was something radically wrong. During the last twenty years wealth had developed to an enormous extent, and yet the ratio of our paupers was the same as it was twenty years ago. To argue that all was right under such circumstances was quite out of the question. The same speaker had said that guardians carefully investigated the applications which came before them. At his (Mr. Bartley's) own board, a short time ago, they had 92 fresh cases to relieve, and they polished them all off in an hour. With due respect to the guardians, he must say that they could not attend properly to cases at the

rate of one in three-quarters of a minute. It was impossible; and each case ought to be gone into much more carefully than that time would allow.

The Chairman said that the subject for the discussion on which they had been called together, and which had formed the substance of the paper, was "Thrift as the out-door relief test." A great many other subjects had been introduced into the discussion, but he would confine himself to that single one. However sound might be the proposition which had been laid down by his friend Mr. Bartley, he was afraid that the public mind was not prepared for receiving it to the full extent. No doubt with the first proposition they would entirely agree, "That the wage-earning classes could, if they wished, place themselves very largely out of the pale of poor-law relief." He had no doubt about that, and perhaps hardly anyone would doubt it. The second proposition was, "That the action of the poor-law in its out-door branch, not only tends directly to prevent their depending on their own exertions, but gives them a strong motive for not doing so." There might be a little difference of opinion here, but he thought that the public at large would come to that resolution. The third was, "That by making all out-door relief depend on previous habits of thrift, a strong inducement would be given to all classes to acquire provident and careful habits, which are most essential to the general weal." He dared say that that might be true, and that some long experience would prove it to be so; but he was sure that the public mind had not arrived at such a point that they would concur at once in such a proposition as that. But he thought that there was a proposition somewhat short of that at which they might all arrive; and that was that, although the thrift test was not the ground upon which out-door relief was to be given, certainly the existence of thrift on the part of the person who applied for relief ought not be by any means a disqualification. If it was made a disqualification a great number of persons would be deterred from making savings in the time of prosperity, knowing that they would be shut out altogether from out-door relief through having a pound or two in the savings bank. Savings of that kind were now a disqualification; and there was no doubt that the removal of the disqualification would act as a very considerable stimulus to the accumulations of working people. There was another principle upon which we ought to act. He could not but think that it was most unwise to lay down a rule, such as was acted upon in a great many districts, that no man should receive any parish relief until he was utterly, and, apparently, hopelessly pauperised. There had come under his own knowledge very frequently cases in which persons, not being actually paupers, and having some small means of going on, might have been saved from utter destitution and pauperism by slight temporary relief at a particular moment. About a year or so ago he met with the case of a skilled artisan who had needed relief during a period of great distress in his trade, and to whom relief had been refused, even to the extent of a loaf of bread, as long as he had any tools in his possession which he could convert into money. The result was that he parted with his tools, and when trade revived and he was offered employment, he was unable to accept it, because he had no money to purchase new tools, which would cost two or three guineas. If the man had received 5s. or 10s. worth of relief, he would have been saved from that misfortune. He (the chairman) believed that there was a vast number of instances of the same kind. No doubt great care and discrimination would be required in dealing with such cases, but they ought to be left to the discretion of the guardians. If there was no principle laid down that previous thrift was an absolute disqualification, and that it was absolutely necessary and essential that persons should be pauperised before receiving relief from the rates, and if that was known to be the general principle, much would be done to remove the pressure which now lay upon the working classes. Our great object ought to be to encourage thrift among the people to the greatest possible extent. There were many obstacles in the way. He would not mention names of persons, for by doing so he would bring upon him such a shower of correspondence as would make his life a burden to him; but he knew that there were many employers who were exceedingly adverse to their work-people making any saving. He was aware that there were many philanthropic employers who desired and encouraged the habit of saving, but there were a great many stupid, heavy persons, who wished that their workmen should make no provision for the future. They thought that the men were far less manageable when they had anything to fall back upon at a period of dispute or necessity. He remembered very well when he was down at Portsmouth, and wished to do something with the naval men to induce them to provide for a day of necessity, he was told "Don't do anything of the sort. A man is not worth a straw if he has got sixpence in his pocket." Such a man might not be worth a straw for the purposes of his employer, but he was worth a great deal to his family and to the community at large. No doubt many persons were governed by the belief that if a man had made an accumulation he was not so easy to deal with, but he was sure that they proceeded upon the very worst principles. So far from its having the radical tendency to which Mr. Bartley had alluded, the attempt to elevate the position of the working people, and make them independent, so that they could hold their own, was the most conservative policy which could possibly be enunciated. He knew of nothing so conservative as a happy and prosperous condition among the people, for they then felt that if a revolution occurred they would have something to lose. He believed that the people of England, taking them altogether, had a considerable tendency and desire to accumulate. There was no doubt that, as Defoe said, we were a "dispendious" race, and that we did not accumulate so much as Continental people. Nevertheless, if fair advantages were held out to the working people, there would be found a considerable tendency to accumulate. The provident habits of the people had increased of late years, but we were not to rest satisfied with the advance we had made. There was still a great deal of improvidence, and there was still a great deal in that respect which people might be taught. With regard to the practice of saving among the agricultural classes, three things must be secured. The mode of saving must be intelligible; it must be easy; and above all, whether in town or country, it must be secure. He believed that a great deal of providence had been checked by the numerous frauds which had been perpetrated, and the manner in which the working classes had been so frequently deceived. Only give them a sense of security and an adequate return for the money invested, and a considerable stimulus would be given to the practice of accumulation. There ought to be in every hamlet some means of depositing a shilling. The poor man ought to able to invest his shilling the moment he has it. It would perhaps be put into a tea-cup and covered with an old shoe, and put into the cupboard, and unless it was soon invested it would probably be spent to pay a little bill, or to buy a cigar, or for admission to some place of amusement. One gentleman had said that the lowness of wages prevented people from saving, but there was no doubt that the moment we held out to the people the benefit of accumulating, they managed some how or other to make small accumulations. An experiment was made some years ago with the ragged schools. They were asked to avail themselves of the penny banks; and in the course of two years sixty of those schools had saved two thousand pounds. During the cotton famine in Lancashire the boys of the Red Shoe-black Brigade held a meeting entirely by themselves, and agreed to contribute 1s. to the fund for every pound which they

had saved in the bank. One boy accordingly contributed as much as 16s., he having a deposit amounting to £16. Such instances shows that savings might be effected when there was a mind to do it. The proper way was to begin to teach children early in life to save money. Children as young as eight or nine years of age might be taught to do so, and when boys reached thriteen or fourteen and began to earn wages, considerable accumulations might be made. Mr. Bartley was perfectly right in saying that the present system of out-door relief gave no stimulus to saving, but did precisely the reverse. He (Lord Shaftesbury) had made an attempt in Dorsetshire to induce his own labourers to save. In some cases the answer he received was, "No, I shall spend what I please, and let the worse come to the worst there is the workhouse." It was very necessary to endeavour to promote habits of thrift among the people, and he believed that if such habits were general, they would alter the face of the country altogether, and remove a great many difficulties and dangers which now beset us. It would be found that in France the labourers worked at the rate of a franc a day, and he had been told there was not a single labourer in that country who would not save out of that pittance. The saving habits of the French labourers had been proved by the large sums of money which had been forthcoming, whenever the Emperor or the Government required a loan from the working people. If we could create a similar spirit among our own people, we should see the security of the eountry established, and we should have the satisfaction of having helped, by God's blessing, to place them in a better condition in society.

Mr. Alsager Hay Hill proposed a vote of thanks to the Chairman, which was carried unanimously.

CHEMICAL SECTION.

A meeting of this Section was held on Friday, April 24th, Dr. Frankland, F.R.S., in the chair.

The Chairman said, in introducing to you the gentleman who is going to give us an account this evening of pyrites and the products obtainable from that substance, I must confess at the present moment to entire ignorance of the precise development which it will receive at the hands of Dr. Wright. But it is a subject which is undoubtedly one of very great importance, more especially in this country. Liebig used to say that sulphuric acid was the key to nature's storehouse, and he also said that the measure of a nation's civilisation and prosperity might be taken in the terms of the sulphuric acid which it manufactures. So might it be said that iron pyrites is the key to sulphuric acid; and just as sulphuric acid is the representative of the prosperity and of the civilisation of the nation, so we may say the quantity of pyrites at present used per day may be taken as a very fair index of the nation's prosperity. I will, however, not further forestate in any way what Dr. Wright may have to say, but at once call upon him to read his paper.

The paper read was:—

ON PYRITES AS A SOURCE OF SULPHUR, IRON, AND COPPER.

By Dr. C. R. A. Wright, F.C.S.

In introducing to your notice to-night the subject of the present paper, I fear that many of the remarks I have to make may be somewhat wanting in novelty, especially to those more peculiarly interested in the practical applications of the material in question. I have, indeed, no new discovery of scientific or commercial interest to bring before your notice, but only a brief description of some of the more important industrial processes in which the mineral plays part, and of some of the more recent improvements made in these processes.

In the first place, what is meant by pyrites? This question can only be answered by a reference to some points more closely allied to pure science than to technical industry, although not absolutely without bearing on the latter. The term "Pyrites" is applied by mineralogists to various substances more or less closely allied together in their chemical constitutions and properties generally, all of them agreeing in this point, that sulphur and iron are two principal constituents. To a particular variety, also containing copper, the term "Copper pyrites" is applied, of which more anon; of those varieties of which this metal is not an essential constituent, several distinct species may be enumerated, of which the more important are:—

1. Pyrites, *par excellence*, or yellow iron pyrites, the chief member of the group, consisting of iron and sulphur united in the proportions indicated by the following percentages:—

Iron	46·67
Sulphur	53·33
	100·00

Or more briefly by the chemical symbols $Fe\ S_2$, whence the chemical name "Iron disulphide."

2. Marcasite, or white iron pyrites, a substance possessing the same chemical composition as yellow pyrites, but differing therefrom in various particulars, *e.g.*, its colour, its crystalline form (yellow pyrites crystallising in forms belonging to the monometric system, marcasite in shapes pertaining to the trimetric system), its specific gravity (yellow pyrites having the density 5·0 to 5·2, marcasite being somewhat lighter, having the density 4·85 to 4·9—Rammelsburg). Marcasite also oxidises by exposure to air more rapidly than its isomeride, although yellow pyrites when in a finely divided state takes up oxygen with avidity, evolving a large amount of heat, so as occasionally to bring about spontaneous inflammation of mixtures of which this substance is a constituent.

3. Magnetic iron pyrites, or pyrrhotin, distinguished from the two preceding iron sulphides by containing less sulphur in relation to the iron, the composition approximating to the following percentages:—

Iron	60·49
Sulphur	39·57
	100·00

indicated by the formula $Fe_7\ S_8$, or as it may be written, $Fe\ S_2$, 6 Fe S, or $Fe_2\ S_3$, 5 Fe S.

In addition to these sulphides of iron two others are known analogous in many respects to yellow pyrites, and capable of being used for the same industrial purposes as that substance; these are iron sesquisulphide, containing—

Iron	53·85
Sulphur	46·15
	100·00

indicated by the formula $Fe_2\ S_3$; and ferrous sulphide, or iron monosulphide, containing—

Iron	63·63
Sulphur	36·37
	100·00

and indicated by the formula Fe S. These two bodies are rarely found in the free state as minerals, but when associated with the sulphides of various other metals, they form a numerous class of minerals known as double (or more complex) sulphides. Of these, the body designated as

4. Copper pyrites (towanite, chalcopyrite, kupferkies, &c.), is an example, it being a mineral possessing the percentage composition—

Iron	30·6
Sulphur	34·9
Copper	34·5
	100·0

indicated by the formula Fe Cu S_2, or otherwise Cu_2 S, Fe_2 S_3, or possibly Cu S, Fe S.

Closely allied to these different kinds of pyrites are several other minerals, consisting essentially of sulphur united to other metals, exhibiting more or less similarity to iron; of these bodies, the sulphides of copper, lead, and zinc are the most important. Thus we have cuprous sulphide, Cu_2 S, existing in copper pyrites associated with iron sesquisulphide, and also known separately as redruthite, (copper glance, vitreous copper, &c.); cupric sulphide, Cu S, known as breithauptite, (covelline, indigo copper, blue copper, &c.); lead sulphide or galena, Pb S; zinc sulphide or zinc blende, Zn S, &c.

Owing to the similar characters of these minerals and the sulphides of iron, it frequently happens that the deposits of these substances found in nature are more or less intermixed together, *e.g.*, a deposit consisting principally of iron disulphide is found also to contain more or less copper pyrites, or other copper sulphide, or some lead or zinc sulphide; or a deposit may contain copper sulphide, in conjunction with some iron sulphide, or with the sulphide of some other metal. An immense variety of substances of this character are known, some of which are mineralogically ranged as different species *e.g.*, copper pyrites, or the compound of cuprous sulphide with iron sesquisulphide. The more important substances of this kind from a commercial point of view are, however, minerals, not exhibiting any great definiteness of composition, but consisting essentially of yellow iron pyrites, intermixed with larger or smaller quantities of copper pyrites or some copper sulphide, together with more or less considerable amounts of other metallic sulphides, notably, arsenic, zinc, and lead. All these bodies are commercially designated as pyrites, and it is with substances of this class that the present paper has more especially to do. Copper pyrites and minerals approximating thereto, *i.e.*, containing more than a very few per cent. of copper, are usually treated by the metallurgical processes for smelting copper ores, and the iron and sulphur therein contained are usually not utilised in this process.

Using the term "pyrites" in this wide and somewhat loose sense, the substances met with in commerce may be divided into two classes, viz., those not containing copper in quantity greater than traces only, and those containing small quanties of the metal up to a few per cent.; the latter ores are usually termed cupreous pyrites, or preferably cupriferous pyrites or cupriferous sulphur ores.

Usually the deposits found naturally in any quantity are more or less intermixed with earthy and siliceous matters, and when the amount of such admixture becomes large, the ores are frequently rendered of little or no value. Carbonaceous substances are also present in the pyrites of the coalmeasures (coalbrasses), greatly interfering with some of its applications. In addition to these substances, the pyrites of commerce ordinarily contains small quantities of arsenic, lead, and zinc, and not unfrequently other metals and metalloids, such as silver, gold, thallium, manganese, antimony, selenium, &c.

The following tables give a general idea of the composition of some of the various kinds of pyrites in practical use, derived from various localities. Of these, the first mentioned (Huelva and Tharsis ores) possess the greatest amount of practica importance, on account of the extent of the natural deposits, the scale on which they are worked, the amount of copper contained, and the large and increasing quantities of metallic copper now actually extracted from them. The comparative freedom of these ores (viewed on the large scale) from ingredients other than iron, sulphur, and copper, and more particularly from admixed earthy and siliceous matters, also gives considerable importance to them as a source of these three substances.

ANALYST.	Huelva and Tharsis.			Belgium.	Cornwall
	Clapham.	Wedding and Ulrich.	Wright (average.)	Clapham.	Clapham.
Sulphur	47·50	48·90	49·07	42·80	34·34
Iron	41·92	43·55	44·28	36·70	32·20
Copper	4 21	3 10	2·75	...	0·80
Arsenic	0·33	0·47	0 38	0·20	0·91
Zinc	0 22	0·35	...	0·40	1·32
Lead	1·52	0·93	...	0·92	0·40
Silica (quartz, sand, &c.)	3·40	} 2·70	2·34	8·86	29·00
Oxygen, alumina, lime, and matters not determined	0 90		1·18	10.12	1·03
	100·00	100·00	100·00	100·00	100·00

ANALYST.	Wicklow.		Westphalia.	Pomerania.	Sweden.
	Thompson.	Wright (average).	Pattinson.	Browell and Marreco.	Browell and Marreco.
Sulphur	47·41	30·84	45 60	48·75	38 05
Iron	41·78	...	38·52	42·93	42·80
Copper	1·93	1·29	...	2 87	1·50
Arsenic	2·11	...	trace.	trace.	...
Zinc	2·00	...	6·00	...	...
Lead	...	...	0·64	...	...
Silica (quartz, sand, &c.)	3·93	...	8·70	3·20	12·16
Oxygen, alumina, lime, and matters not determined	0·84	...	0·54	2·25	5·49
	100·00	...	100·00	100·00	100·00

The limits of space necessarily imposed on the present paper forbid anything like an exhaustive and comprehensive view of all the various processes and improvements that have been from time to time proposed in reference to the extraction from pyrites and its allied minerals of the three constituents—sulphur, iron, and copper. A general view of the subject, with a brief sketch of some of the more important of these special processes, is all that can be attempted.

The use of pyrites, copper pyrites, and analogous minerals, such as zinc blende, in the manufacture of the different "vitriols" (green vitriol or ferrous sulphate, blue vitriol or cupric sulphate, and white vitriol or zinc sulphate), is of considerable antiquity, these salts having been known from an early period as being produced by the natural or artificial oxidation of these sulphur-containing minerals; and the use of copper pyrites, galena, and zinc blende as sources respectively of metallic copper, lead, and zinc, and their alloys, also dates from a comparatively early epoch. Moreover, it has long been known that when pyrites is heated in open vessels so as to allow free access of air, sulphur dioxide is formed, whilst more recently it has been found that when the heating is effected in closed vessels, sulphur is expelled as such, and may be collected by means of suitable condensing arrangements. It is, indeed, not improbable that some at least of the sulphur found in the free state in volcanic districts is actually derived from this source in this way, although a considerable portion of such natural sulphur is probably formed by the mutual reaction of gaseous sulphuretted hydrogen and sulphur dioxide, water and free sulphur being produced thus:—

$$2\,SO_2 + 4\,H_2S = 4\,H_2O + 3\,S_2$$

As mentioned below, advantage has also been taken of this change to obtain sulphur from pyrites commercially, one portion of the mineral being heated in contact with air so as to form sulphur dioxide by the combustion of the sulphur present, another being so treated as to give rise to sulphuretted hydrogen.

As far back as the first part of the last century, processes for the extraction of free sulphur from pyrites and analogous minerals appear to have been worked in this country. Thus in 1730, Samuel Hutchins took out a patent for "a method of extracting and preserving the sulphur contained in mundic, &c., by which this sulphur may be prepared so as to answer the end of that imported from abroad;" and in 1738, William Champion patented "a method or invention for the reducing of sulphurous British mineral and minerals into a body of metallic sulphur;" whilst in 1778, Matthew Sanderson took out a patent for "a new process for extracting a mineral sulphur from pyrites, copper, and lead ores, separating its acid, and rendering it useful for every medicinal purpose," this process being virtually a rough method of distillation of the sulphurised substances whereby a portion of the sulphur was volatilised and again condensed separately.

The extraction of free sulphur from pyrites in this way is still practised to some extent, the apparatus employed being very simple. The ore is broken into small fragments the size of nuts, and is then piled up inside a cylindrical roasting vessel capable of holding 50 to 60 tons of material; this vessel is simply a circular wall of masonry enclosing a level floor, along which pass four flues meeting in the centre in the form of a cross. Through these the requisite supply of air enters, the floor communicating with the flues by openings here and there; the heap of ore is covered over with earth and turf, an opening being left for an exit pipe along which the vapours pass to a long condensing flue. The mass is lighted at the openings of the four flues arranged as a cross, and these openings are then partially closed; the heat generated by the combustion of a portion of the sulphur present serves to expel the rest, most of which is condensed in the main condensing flue. The operation usually last about six weeks, and the amount of sulphur collected is but small as compared with the quantity that is burnt and escapes as sulphur dioxide.

When heated in a closed vessel, iron disulphide parts with about $\frac{3}{7}$ of its sulphur in the free state, the main reaction being—

$$7\,Fe\,S_2 = 3\,S_2 + Fe\,S_2\;6\,Fe\,S.$$

the product being a kind of "magnetic pyrites." Tubular clay retorts, arranged in rows and heated simultaneously by a furnace, are sometimes employed for this purpose; but only about a quarter of the sulphur present can be thus obtained with safety, as the residue is readily fusible, and cannot easily be removed from the retort if once fluxed.

In order to gain a larger yield of sulphur from pyrites various processes have been suggested; thus Gossage proposed to expel a portion of the sulphur by heat, and then to act on the residue with hydrochloric acid, whereby sulphuretted hydrogen is evolved. By the action on this of a limited quantity of air at a red heat, water is formed and sulphur set free; or by the action of sulphur dioxide, three proportions of sulphur are obtainable by virtue of the reaction—

$$2\,SO_2 + 4\,H_2S = 3\,S_2 + 4\,H_2O \text{ (Duclos' process).}$$

Dyar and Chisholm roasted the pyrites so as to obtain sulphur dioxide, and then decomposed the gas whilst still hot by hydrogen, whereby sulphur is set free and steam formed; the hydrogen for this purpose being obtained (mixed with carbonic oxide) by blowing steam through a mass of red hot coke. Newton used either carburetted hydrogen or red hot coke for the same purpose, and Spence proposed an improved arrangement in which the coke is contained in a vertical tube in the centre of the pyrites burner, so constructed that the sulphur dioxide formed must pass through the tube, the requsite heat being therefore generated by the combustion of the pyrites itself. It was subsequently found, however, that the same result may be more simply attained by charging an ordinary kiln with a mixture of pyrites and coal or coke. In all these processes the essential point is the separation of the sulphur from the non-volatile constituents of the pyrites by making it unite with oxygen, and the removal from the sulphur dioxide thus produced of the oxygen by means of some more powerful reducing agent.

Rodgers obtained free sulphur by blowing steam through the heated pyrites, when sulphuretted hydrogen is formed, from which the sulphur is obtained, as in Gossage's plan; and so on for other processes.

The chief commercial use of pyrites, however, so far as its contained sulphur is concerned, depends not on the extraction from the mineral of free sulphur, but on its transformation into compounds obtainable at a dearer rate from free sulphur; *i.e.*, on the use of pyrites, not as a source of sulphur, but as a cheap substitute for that substance. Several of these applications are of considerable antiquity; thus, by "weathering" (exposing to the oxidising action of air and moisture) yellow iron pyrites, copper pyrites, galena, blende or analogous minerals, the sulphates of the metals present are gradually formed. The formation of green, blue, and white vitriol in this way, and the production from green vitriol of Nordhausen sulphuric acid by dehydration and distillation, are manufactures of considerable antiquity in the history of chemical technology. The manufacture of alum, from alum-schist (an argillaceous rock containing a good deal of yellow iron pyrites disseminated through it) also depends on the same process. During the oxidation of pyrites, two proportions of sulphuric acid and one of ferrous oxide may be regarded as formed; of the sulphuric acid half therefore becomes converted into ferrous sulphate, whilst the other half forms sulphate of alumina by attacking the aluminous mineral in which the pyrites is imbedded. By dissolving the product obtained by gently roasting, or calcining alum schist in water, a solution of aluminium and iron sulphates is produced; and by adding to this solution chloride of potassium or ammonia, double decomposition takes place between the alkaline salt and the iron sulphate, iron chloride being formed, and potassium or ammonium sulphate, which crystallises out along with the aluminium sulphate in the form of either potassium or ammonium alum; or sulphate of potassium or ammonium may be employed in lieu of chloride.

Longmaid's well-known process for the preparation of sulphate of soda, by heating together a mixture of pyrites and common salt, partly depends on the same principles; the sulphur of the pyrites takes up oxygen, and the two unite with the sodium of the salt; simultaneously ferric chloride and its decomposition products, produced by the action of air and moisture, ferric oxide, hydrochloric acid, chlorine, &c., are formed, the latter two escaping as gases. This process, it may be noticed in passing, is virtually the parent of a number of other methods since proposed for the manufacture of sulphate of soda, chloride of copper, and chlorine. The process of Henderson for the extraction of copper from pyrites (described below); the recent method of Robinson and Hargraves for the manufacture of sulphate of soda without the use of vitriol; and, to some extent, Deacon's chlorine process, may all be regarded as deducible from Longmaid's process, the essential reactions characteristic of these various methods taking place in their common parent-process.

The most important use of pyrites, however, as a substitute for sulphur, consists in its employment on the large scale as a means of producing sulphur dioxide, for the manufacture of sulphites, hyposulphites, sulphates, antichlors, disinfectants, &c. and principally for the production of sulphuric acid and its derivatives.

The use of pyrites for this purpose, instead of sulphur, appears to have been first put in operation on the large scale in this country by Hill, of Deptford, as early as 1818. One disadvantage attending the substitution of pyrites for sulphur in the vitriol manufacture is, that to produce a given amount of vitriol, more chamber space must be allowed. When sulphur only is burnt, the resulting sulphur dioxide is diluted only with that amount of nitrogen (leaving out of consideration unchanged air) associated originally with the oxygen of the sulphur dioxide; but when pyrites is burnt, the resulting sulphur dioxide is diluted not only with this amount of nitrogen, but also with that originally associated with the oxygen taken up by the iron of the pyrites. The reactions by which the sulphur dioxide is formed are respectively indicated by the equations—

$$4\,S_2 + 8\,O_2 = 8\,S\,O_2$$
$$4\,Fe\,S_2 + 11\,O_2 = 8\,S\,O_2 + 2\,Fe_2\,O_3$$

i.e., the quantities of air requisite for burning sulphur and pyrites respectively, so as to produce the same amount of sulphur dioxide in each case, are in the proportion of 8 to 11.

Another disadvantage is the much greater degree of impurity of the acid made from pyrites owing to the volatilisation and mechanical carriage of various substances from the pyrites burner to the vitriol chamber. Of these substances arsenic is by far the most objectionable, whilst iron, zinc, thallium, selenium, &c., are frequently introduced into the vitriol. For many practical purposes these impurities are not of any consequence, but the impregnation of sulphuric acid with arsenic produces as an end result the contamination of a large number of chemical products with that deleterious substance. Saltcake, hydrochloric acid, soda ash and crystals, soap, and many other products requiring the manufacture of sulphuric acid as a step to their production, frequently contain traces and even more of arsenic derived from this source; and the widespread presence in many substances of household use, and even articles of food and medicine, of this objectionable ingredient, is in all probability not without influence on the general health of the population, besides lending additional complications in the detection of arsenic in toxicological investigations.

It is unnecessary to review in detail the various improvements made during the last half-century in the apparatus employed in the production of oil of vitriol from pyrites, and in the method of practically carrying out the manufacture. Experience shows that a slightly different form of kiln or pyrites burner is requisite, according to the nature of the sulphur ore used, in order to carry the combustion to the furthest possible extent. Slaty ores, like Wicklow pyrites, require much deeper kilns than ores containing little earthy matter-like Huelva pyrites. Ores containing more than traces of lead are very apt to flux or frit more or less, thus glazing and agglomerating the lumps, and rendering perfect combustion difficult or impossible. The same result may follow if the temperature in the kiln rise too high with certain other kinds of ores, the lower sulphides of iron first produced and the clayey and earthy matter present being frequently fusible at a sufficiently high temperature. Ores containing much earthy matter (such as Wicklow pyrites, which practi-

cally consists of a slaty mass through which pyrites is disseminated) are more difficult to burn, so as to utilise nearly the whole of the sulphur present, than ores containing little quartz or other earthy matters, such as Huelva pyrites; in any case it is practically impossible to utilise the whole of the sulphur present. On an average 100 parts of Huelva (or other analogous) ore, containing 48 per cent. of sulphur to start with, will yield, when burnt as thoroughly as is practicable on the large scale, about seventy parts of residual iron oxide, containing (besides the copper, &c., originally present) about 2·5 to 3·0 per cent. of sulphur, partly as a cupriferous kernel in the centre of each lump. Not unfrequently, however, the amount of sulphur present considerably exceeds this amount, owing to inefficient treatment during the burning of the pyrites. Hence about two parts of sulphur per 100 of original ore remain unburnt, or four parts of sulphur per 100 of sulphur originally present are not utilised. With such ores as Wicklow pyrites, containing only about 30 per cent. of sulphur to start with, a much larger quantity remains unburnt. One hundred parts of such ore, as usually burnt in the kilns, yield about 80 parts of burnt ore, containing on an average about 5 per cent. of unburnt sulphur (for the most part contained as green or unburnt mineral forming the core of the larger fragments, the smaller fragments and dust usually not containing more than 2 or 3 per cent. of sulphur, owing to the combustion being less hindered by the earthy admixtures in the case of smaller pieces). Hence about four parts of sulphur per 100 of original ore, or 13 parts per 100 of original sulphur remain unutilised. *Cæteris paribus*, the more free from earthy admixtures is the pyrites used, the less is the amount of sulphur lost by being left in the burnt pyrites. Of the portion thus left part is present as a basic persulphate of iron, part as sulphate of lime, &c., according to the nature and amount of the earthy matters present in the original ore.

The amount of sulphur left behind in the burnt ore from a given class of pyrites necessarily varies with other circumstances, such as the exact size and shape of the kilns, the methods of stoking and of removing burnt ore and of supplying green ore, and notably with the duty performed by each kiln, *i.e.*, with the quantity of pyrites passed through it in a given time; thus I have obtained the following average numbers as the results of several months' working on a uniform quality of pyrites (Huelva), 25 to 30 tons of pyrites being burnt daily—

Cwt. of pyrites per kiln per diem.	Per centage of sulphur in burnt pyrites.
5·8	2·85
6·8	2·88
7·0	3·01
7·5	3·08

The diminution in the effectiveness of the combustion as the duty becomes progressively increased is here well marked, although not very great. The following table illustrates the average composition of the burnt ore produced in the latter of these four periods as compared with that of the green ore used:—

	Green Ore.	Burnt Ore.
Iron	44·28	64·88
Sulphur	49·07	3·08
Copper	2·75	3·75
Arsenic	0·38	—
Quartz	2·34	2·90
Oxygen and matters not determined	1·18	25·39
	100·00	100·00

In the process of alkali making, the sulphur originally employed in the form of pyrites is finally rejected as a nearly valueless by-product in the form of vat-waste, consisting essentially of calcium sulphide, intermixed with oxide and carbonate, together with earthy matters. The discussion of the numerous processes proposed for the regaining of the sulphur from this source is somewhat removed from the object of the present paper. One of these, however, is sufficiently akin thereto to warrant a description; this is the method for the preparation of a factitious pyrites, patented by J. Lowthian Bell in 1852, the process utilising not only the alkali waste, but also the burnt pyrites, which (when not containing copper) forms another by-product of little value. The process, as recently described by the patentee (Transactions of the Newcastle Chemical Society, 1869, p. 117), is as follows:—A blast furnace, 25 feet high and 11 feet across the widest part, is charged with a mixture of—

	Parts.
Coke	4
Dry vat-waste (or an equivalent amount of moist)	3
Burnt pyrites	1½
Clay	2

This mixture is thus smelted in the same manner as iron ores by means of a hot-blast, heated to about 640° Fah., from 1,200 to 1,500 cubic feet of air per minute being forced in at the tuyeres; if the temperature rise too high, metallic iron almost free from sulphur makes its appearance, but when the operation is perfectly conducted fused sulphide of iron collects in the crucible of the furnace, and is drawn off from time to time at the tapping hole. The earthy matters of the burnt pyrites and the clay fuse together, forming a compact slag of vitreous fracture sufficiently hard to be a good road material. This retains some of the iron of the pyrites, and is hence black. Like the slag of an iron blast-furnace, this slag is lighter than the molten metal, and simultaneously produced, and hence floats thereon, and is thus easily separated, flowing out continually at the "slag-hole." The chemical actions taking place during this operation appear to be the conversion of the peroxide of iron into protoxide, and the reaction of this on the sulphide of calcium forming lime and ferrous sulphide. In this way a "factitious pyrites" is obtained, which when freshly fractured has a deep bronze colour, and a metallic lustre with somewhat crystalline structure; sometimes, however, it has a granular appearance, and is of a darker tint. The average composition is—

Iron	65·0
Sulphur	31·0
Oxygen	4·0
	100·0

Or ferrous sulphide intermixed with a little oxide of iron. Hence the substance is, strictly speaking, not a factitious pyrites (or iron disulphide), but only a factitious iron mono-

sulphide. This material may be employed instead of ordinary pyrites in the kilns of a vitriol works, but considerable difficulty attends its utilisation; being very hard and compact it will not burn readily by itself, and even when used intermixed with lumps of ordinary pyrites, it is difficult to make the substance yield up more than about half of sulphur in the form of sulphur dioxide, *i.e.*, the burnt residue from it contains a large quantity of sulphur. Hence, in 1853, a slight modification of the process was patented, whereby the fused sulphide is made to flow out of the furnace into water, and a black powder or slime produced. This is then formed into cakes or bricks, which after drying, burn much more readily than the hard fused masses. A peculiar mode of treatment is, however, requisite in order to obtain all the associated sulphur. The surplus peroxide of iron left after the burning is completed is used over again in the furnace to produce a fresh quantity of factitious pyrites.

Owing to the practical difficulties in burning the product, the circumstance that the interior lining of the furnace wears away rapidly necessitating frequent stoppages for repairs, and the fact that the whole of the sulphur is not regained, from 3 to 5 per cent. being present in the slag on an average, it results that at the present price of pyrites this method of regaining sulphur from vat-waste is barely remunerative; nevertheless, the process is one the difficulties of which are not insurmountable, and which might possibly be worked to advantage in case of an increase of price in the natural mineral.

Modifications of Bell's process, and processes similar thereto, have been subsequently proposed, but have not yet come into use. Thus Cookson patented, in 1854, the smelting of galena by means of impure finely-divided iron, obtained by heating burnt pyrites and carbonaceous matter; thereby lead and a kind of factitious pyrites are formed. Pattinson patented, in 1853, the use of manganese in lieu of iron, whereby a sulphide of manganese is formed.

Several other processes have been proposed of late years for the production of hyposulphites, of sulphur, or of sulphur dioxide from vat-waste. Of these many have proved commercially unsuccessful; others, notably that of Mond, have met with a considerable amount of success. These processes, however, scarcely come under the head of the subjects of the present paper.

Owing to the difficulty experienced in burning off all the sulphur present in pyrites, the impure oxide of iron thence obtained in the vitriol works has not been used to any great extent as an iron ore. Occasionally, however, the burnt pyrites of the vitriol maker is used for this purpose (when free from copper), being mixed in along with other ores. It is noticeable as a curious fact that no marked increase in the amount of sulphur present in the pig-iron made appears to be occasioned by the presence of even several per cent. of sulphur in the burnt pyrites used, at any rate when clay ironstone (Cleveland ore) is smelted therewith. As stated above, in Bell's process for making factitious pyrites, metallic iron almost free from sulphur is often obtained, instead of sulphide of iron, if the temperature rise too high in the smelting process. In an iron blast-furnace, also, direct experiment shows that the great majority of the sulphur introduced into the furnace in the materials—limestone, coke, and iron ore—issues from the furnace in the slag, only a small portion being taken up by the pig-iron.

By the process for extracting copper from burnt cupriferous pyrites, described below, a peroxide of iron tolerably pure and nearly free from sulphur is obtained as a by-product. This "purple ore" is now used as a source of metallic iron to some considerable extent, partly for the production of spongy metallic iron (obtained by heating along with coal-dust or other carbonaceous matter) used for the precipitation of copper, partly as "fettling" for the beds of puddling furnaces. As stated above, an impure metallic iron, obtained similarly from ordinary burnt pyrites, was also used by Cookson as a means of reducing galena to the metallic state.

Many kinds of pyrites yield, on burning, an impure oxide of iron of sufficiently bright tint to be used as a pigment after due washing and grinding. A considerable diversity of shades can thus be obtained, and the colouring matters possess great stability.

Until a comparatively recent period, few attempts were made to extract copper from pyrites containing only a small percentage of that metal; the ordinary methods of copper smelting being only commercially applicable to substances somewhat richer in that metal. Poor cupriferous ores were occasionally smelted in a cupola furnace, whereby a regulus was obtained, which was refined in the usual way; or preferably such ores were intermixed with richer ones, and the whole smelted together; but the quantity of copper actually derived from this source did not amount to more than a very small percentage of the total annual make. Various processes for obtaining copper from such ores have, however, been used of late, and this manufacture has now attained to very considerable dimensions.

It has long been known that by exposure to air cupriferous pyrites becomes oxidised, so that a solution of copper sulphate (*inter alia*) is obtainable by lixiviating the mass; this oxidation naturally takes place in mines where copper pyrites is raised, so that the drainage water of such mines often contains an amount of copper worth saving, the process employed being very simple, viz., causing the water to flow through vats or reservoirs containing scrap iron; the iron thus acts on the copper sulphate in virtue of the reaction

$$Cu\,S\,O_4 + Fe = Fe\,S\,O_4 + Cu.$$

metallic copper being thrown down, and a solution of ferrous sulphate produced. Most of the processes prepared within the last 35 years for the extraction of copper from cupriferous pyrites have been based on reactions similar to that naturally taking place in the copper mines, viz., the oxidation of copper sulphide to sulphate soluble in water. Thus, in 1840, Cookson took out a patent for the production of copper sulphate from cupriferous pyrites by a process of oxidation in the dry way; the pyrites was subjected to a regulated roasting, whereby the sulphur associated with the iron was burnt off, leaving an oxide of iron, whilst that combined with the copper was left unaltered; on calcining this residue at a different

temperature, the copper sulphide takes up oxygen, forming copper sulphate. The mass being lixiviated, a solution of blue vitriol is obtained, from which the crystallised substance is obtained by evaporation &c.; the purified copper sulphate may be converted into metallic copper by heating with an equivalent quantity of copper sulphide in closed vessels. Similar processes have also been proposed by several others, only differing from this in details, and not in general principles; various special roasters and calcining kilns have also been patented for this purpose.

Recently, a modification of this process has been proposed by Monier, viz., roasting cupriferous pyrites along with soda, whereby sulphates of iron, sodium, and copper are formed; on increasing this heat, the first of these is decomposed, the two other sulphates being unaltered; on lixiviation, these are dissolved out, and by crystallisation they are more or less separated. The crystals of copper sulphate thus obtained are dried and heated to redness, along with small coal; in this way a mixture of copper oxide and metallic copper is produced, which is reduced and refined in the usual way. It is stated by the inventor that the whole of the copper contained in cupriferous pyrites can thus be extracted readily, and with very little loss; from a ton of pyrites containing 85 lbs. of copper ($3\frac{3}{4}$ per cent.) $82\frac{1}{2}$ lbs. of metallic copper can be obtained, the loss being only $2\frac{1}{2}$ lbs.; *i.e.*, the copper actually extracted is 97 per cent. of that originally present, the working loss being only 3 per cent.

Leister patented in 1859 a process for the oxidation of the sulphide of copper left in burnt cupriferous pyrites by the wet process; viz., the conjoint action of the air and of perchloride or persulphate of iron solution obtained most conveniently by moistening the burnt pyrites with hydrochloric or sulphuric acid; the weathering is not absolutely indispensable in this process, much copper being dissolved out by merely digesting the burnt pyrites with hydrochloric acid or ferric chloride solution. From the solution of copper salt thus obtained, the metallic copper is precipitated by means of scrap iron, the resulting iron liquor being exposed to the air to peroxidise it, and used over again for a fresh batch of pyrites. In 1861, Mease, and also Hæffely patented analogous processes, the waste acid manganese chloride from the bleaching powder manufacture being used instead of hydrochloric acid; the latter inventor subjected the burnt pyrites to methodical lixiviations in tanks like those used in the alkali works, whereby the whole or nearly the whole of the copper was extracted at the end of a week. By adding soda waste to the copper liquor thus obtained, copper sulphide was formed as a precipitate, and from this metallic copper could be obtained by the ordinary processes; or the sulphide could be oxidised to crystallisable blue vitriol. This process had the merit of using up simultaneously what were thus three waste products, viz., vat-waste, still-liquor, and burnt pyrites.

From experiments made by myself some years ago, it appears that the action of ferric solutions on sulphide of copper is of an oxidising nature, the copper being converted into a soluble salt (sulphate and chloride), the ferric salt becoming reduced to ferrous salt; so that although at first sight such processes as that of Hæffely appear to be dissimilar in character from the natural or artificial oxidation of copper sulphide, they nevertheless really depend on the same principles. Access of air during the lixiviation of burnt pyrites with solutions of ferric salts facilitates the operation by reconverting the ferrous salt formed into ferric salt; and heating the liquor by injection of steam or otherwise causes the extraction of the copper to take place much more quickly than is the case in the cold. With ordinary calcined Huelva pyrites, I have found that the copper present can be readily extracted in this way, but little labour being required, and little loss of copper being occasioned; there, however, are practical inconveniences which have led to the adoption in preference of a somewhat different process, known as Henderson's.

Like Cookson's and Monier's processes, Henderson's method depends on the power possessed by copper sulphide to take up oxygen when heated; in this process, however, the conversion of the copper into a compound soluble in water, is facilitated by the addition to the pyrites of common salt; the chief result of roasting this mixture is the formation of sulphate of sodium and chloride of copper along with some chloride of iron. The whole process, therefore, simply consists in an adaptation of Longmaid's well-known process (described above) to pyrites, from which the great majority of the sulphur has been removed by a sort of calcination. The following is a description of the practical working of this process, which has altogether distanced its rivals as a means of extracting copper from poor cupriferous pyrites.

The ores most suitable are those of character analogous to the Huelva and Tharsis ore, *i.e.*, containing only a few per cent. of quartz or other earthy impurities, and averaging about 3 or 4 per cent. of copper after burning. The larger lumps are broken up into pieces usually not exceeding the size of a small orange, and the dust separated by screening; the "smalls" are either made up into balls with water, clay, &c., and burnt, or are roasted separately in a special kind of kiln, analogous to a blind salt cake furnace, whilst the larger lumps are passed through the ordinary pyrites kilns, at the rate of 5 to 7 cwts. per day per kiln, according to size. The burnt ore thus produced by the vitriol maker retains from $2\frac{1}{2}$ to 5 per cent. of sulphur, according to the care and skill employed in the burning. In order to extract the copper, it is usually convenient to mix various kinds of burnt ore, or even burnt ore with "green smalls" (the unburnt smalls sifted out on breaking up the lumps), in such a way as to produce a mixture containing about half as much again of sulphur as of copper, *i.e.*, for 3 per cent. of copper, $4\frac{1}{2}$ per cent of sulphur, to this is then added as much salt as represents about four times the copper present; the whole is then passed through crushing machines and thoroughly intermixed.

The moderately intimate mixture of materials in coarse powder thus produced, is subjected to a roasting process for several hours, at the end of which time most of the copper has become converted into compounds soluble in water, whilst the remainder is almost wholly soluble in dilute hydrochloric acid. Some care is necessary, especially towards the end of the operation, to

prevent the temperature rising too high, otherwise a good deal of the chloride of copper formed is partially decomposed and rendered insoluble in water. The temperature is somewhat moderated towards the end of the process, a dull red heat being maintained for the first two or three hours. About six hours usually suffice to work off a charge. The furnaces employed for this roasting resemble those employed for the manufacture of salt cake (blind salt cake furnaces), being heated either by a fireplace for the purpose or by the gases of a gas-generating furnace. Rotary furnaces are also in use in some works, whereby manual labour is saved; larger charges can also be worked off with this form of furnace. Throughout the roasting process the materials are stirred from time to time with a paddle. The progress of the action may be estimated by withdrawing a sample and treating it first with water, then with hydrochloric acid, and lastly (after washing with water) with nitric acid. On saturating with ammonia the liquors thus obtained, the relative tints of the blue cuprammonium-salt solutions produced afford a means of determining approximately the amounts of copper converted into soluble chloride, &c., products insoluble in water, but soluble in hydrochloric acid (basic chloride, &c.), and of sulphide as yet unchanged. Owing to the presence of traces of moisture in the air, &c., there is always a certain amount of hydrochloric acid gas formed, and in escaping, this carries with it a small quantity of copper chloride, the more the higher the temperature of roasting; the gases and vapours evolved are condensed by a coke tower, precisely similar to that used in the alkali works, the resulting acid liquor being used for the extraction of that part of the copper which is insoluble in water; inasmuch, however, as the liquor usually contains arsenic, antimony, &c., the copper obtained by its help, or that extracted directly from it, is less pure, and consequently of an inferior quality and value. The amount of copper thus volatilised is, however, only minute, when proper precautions are taken against over-heating during the roasting. According to Phillips, two tons of metallic copper only are practically regained from these liquors, whilst 800 tons are prepared altogether, *i.e.*, the copper volatilised is only about 0·5 per cent. of the total amount.

It is practically found undesirable to treat with salt, &c., ores containing more than 6 per cent. of copper. Richer ores require a longer period of roasting, and hence more copper salts are obtained in a form insoluble in water, but soluble in acid. It is almost always practicable to work with a nearly uniform material and by a uniform process, by suitably mixing together richer and poorer varieties, and otherwise regulating the composition of the ore employed. On an average 97 to 98 per cent. of the copper actually present is rendered soluble in either water or acid, the residual oxide of iron retaining only a minute amount of copper.

The roasting being completed, the substance is placed in tanks either of tarred wood or stone, or some analogous material, and is then lixiviated with hot water, heated by injection of steam or otherwise. The aqueous liquors thus obtained are drawn off and treated separately, the insoluble portion being washed with fresh water, and the weaker liquors thus obtained being used for the treatment of a fresh batch; the lixiviation is thus methodically conducted in much the same way as the analogous process in the case of black ash, so as to obtain liquors as concentrated as possible. The insoluble portion is then again lixiviated with dilute hydrochloric acid or with the acid liquor condensed in the coke tower. From the copper solutions thus obtained, the metal is precipitated by the simple process of allowing the liquors, clarified by standing and settling, to run into precipitating tanks constructed of wood (tarred) or stone, and filled with scrap iron, steam being injected to heat the liquor and promote the action, partly by facilitating it through the increased temperature, partly by getting up a circulation and currents.

The residue left after all the copper that can be extracted has been washed out, is the purple ore referred to above; it usually contains from 0·08 to 0·20 per cent. of copper, and 0·15 to 0.25 per cent. of sulphur, and is either sold for fettling for puddling furnaces, or is reduced by heating with small coal, &c., and the resulting spongy iron employed, instead of scrap iron, in the precipitation tanks. This spongy metal is, of course, more rapid in its action than solid malleable iron or cast-iron. According to Bischof, the copper thus thrown down by means of spongy iron is much more free from arsenic than that precipitated by solid scraps, as several hours' contact is required before the arsenic is deposited, whilst copper is thrown down immediately.

The copper precipitated from the aqueous liquors usually contains 75 per cent. and upwards of metal, and only requires melting and refining to be fit for use. The impure copper thrown down from the acid liquors or from the tower liquor is frequently of an inferior character, and is often too impure to be used directly. By melting this with green ore (unburnt pyrites) or with soda waste, a copper "regulus" is obtained, which is refined in the way ordinarily practised by the copper smelter. In this way certain objections have been obviated which originally applied to the copper obtained by Henderson's process, viz., that it was apt to contain impurities of various kinds rendering it unfit for certain purposes, *e.g.*, making brass. By treating separately the aqueous and acid liquors, the impurities present in the latter are prevented from contaminating the metal obtained from the former.

After the copper has been thrown down, the liquors contain, *inter alia*, sulphate of soda, which can be readily extracted by evaporation and crystallisation.

Some varieties of pyrites contain a notable amount of silver, though insufficient to render its extraction profitable as a separate business. Most of this valuable metal can, however, be extracted by the following modification of Henderson's process, due to Claudet. The whole of the common salt used in the roasting process is not converted into sulphate, some remaining unaltered. Thus the aqueous extract first obtained is brine, containing copper, iron, and sodium salts, &c., dissolved therein. Now the process that converts the copper compounds present in the burnt ore into chloride, also transforms any silver present into chloride, which salt is almost wholly dissolved out from the roasted mass by the agency of the brine, silver

chloride being much more soluble in this menstruum than in plain water. Silver iodide, however, is very much less soluble in brine than is silver chloride. Hence, by adding to the aqueous liquors first obtained (before separation of the metallic copper) a soluble iodide, a precipitate is formed containing most of the silver originally present in the pyrites used in the first instance.

In practically working this process the liquors containing the silver, *i.e.*, those obtained by lixiviation with water before treatment with acid, are run into a wooden settling tank. When the suspended matter has deposited, the clear liquors are drawn off into another tank, and a solution of iodide of potassium added (crude iodide solution from kelp may be used), and the whole well mixed. After 48 hours' rest, a deposit is thrown down consisting chiefly of sulphate of lead, iodide of silver, and some copper compounds, and also containing a small quantity of gold. The clear liquor is run off and precipitated by iron to extract the copper. The deposit is washed with water, and then with dilute hydrochloric acid to remove the copper compounds, and is then digested with metallic zinc, whereby the silver iodide is decomposed, metallic silver being set free and soluble zinc iodide formed. The solution of this latter salt is used over again to precipitate a fresh batch, as iodide. Most of the lead sulphate is also decomposed by the zinc, so that the resulting mass when dry has about the following composition (Claudet):—

Silver	5·95
Gold	0·06
Lead	62·28
Copper	0.60
Zinc oxide	15·46
Iron oxide	1·50
Lime	1·10
Sulphuric acid	7·68
Insoluble matter	1·75
Oxygen, loss, &c.	3·62
	100·00

From this mass the silver and the gold are separated by the ordinary process in use in the refining of these materials.

Usually the deposit of silver iodide, &c., is not removed at once from the depositing tank, but is allowed to remain in while successive batches are worked off, whereby labour is saved, the deposit being only treated with zinc, &c., at intervals as it accumulates.

The cupriferous pyrites of Spain and Portugal contain from 0·002 to 0·003 per cent. of gold and silver; from 16,300 tons of such ore, after burning off most of the sulphur in the vitriol works, 739 lbs. of silver and 7 lbs. of gold were extracted at Widnes, or about 340 grains ($\frac{3}{4}$ oz. avoirdupoise) per ton. The cost of preparation of this, including 300 lbs. of iodine* consumed during the operation, was £416, leaving a clear gain of £3,250 (Claudet).

The high degree of perfection now attained by the processes in use for utilising the valuable constituents of pyrites, and the great industrial importance of these operations thus briefly and imperfectly described, afford a proof, were any such needed, of the advantages to be gained in the arts and manufactures generally by an attentive study of the principles of pure abstract science, and the modes of thought and methods of experimental investigation associated therewith. Each new fact observed and each new principle established by the labour of purely scientific experiments, no matter how apparently far removed from manufacturing operations, is yet of high value, not only on its own account as increasing the common stock of knowledge, but from its indirect influence on other branches of inquiry more immediately susceptible of adaptation to the wants and necessities of mankind, independently of which it can never be affirmed that even the most abstruse experimental inquiries, and those having apparently nothing whatever in common with ordinary industries, may not at a future period afford the starting-point for processes and manufactures of great commercial value. "From nothing nought comes," has long been an axiom; conversely it may be truthfully said that "nothing leads to nought," and of all things experimental inquiry into the secrets of Nature has the least tendency to lead to valueless consequences.

* The price of iodine has risen considerably since 1871, when these figures were obtained.

DISCUSSION.

Mr. Coggins said he had listened very attentively to the able paper of Dr. Wright. He had also listened with very great pleasure to the words of the president, as to the opinion of Liebig of the influence exercised on a nation's prosperity by its manufacture of sulphuric acid, and that the interest and success which attended a nation almost depended entirely upon the amount which it used. In looking over the paper he was very glad to see that Dr. Wright had excluded certain older analyses. He had taken the results of Mr. Clapham, and another gentleman, and himself, and they very nearly agreed in their analyses as to the proportions in which the various compounds were found in pyrites. The old analysts greatly disagreed, which rendered their analyses of little value. When scientific men agreed in regard to an ordinary commercial analysis, it was a proof that their conclusions were accurate, and enhanced the value of them. As to the question of sulphuric acid making, Dr. Wright had well described that, and of the oxidation of sulphur in the first stage. The residue was a very important point to all practical men, and the lecturer had hinted at the very serious difficulty which manufacturers had to stop the tricks of their men to prevent their having a fair chance of really getting good samples from which accurate data could be obtained. It was with the greatest amount of really hard work that he could succeed in getting a proper sample. He thought Dr. Wright's analysis of the percentage of sulphur in the burnt ore at 3·08 was rather low. He had a very large experience in burning pyrites, but he thought no manufacturer burnt his ore absolutely to 3·08 of sulphur existing as sulphur. A gentleman was present who he thought could tell from his own experience and analyses that there was a certain quantity always existing as sulphate, and when men said they could burn the pyrites to 3·08 he begged most respectfully to differ from them, and to tell them to take the samples for themselves and see whether it could be done. The man who takes the samples might blunder. He found the average to be from 4 to 5, and there was certainly from $1\frac{1}{2}$ to 2 per cent. as calcio-sulphate. There was also one point with regard to the contamination of sulphuric acid with arsenic. Every chemist knows well it is one of the greatest difficulties to obtain pure sulphuric acid. Sulphur contains more or less arsenic in the common way, and possibly through the sulphuric acid the arsenic did find its way into some articles or

ordinary consumption, but when it was maintained, as Dr. Wright had said it was, by some physiologists that arsenic was a normal constituent of the human system, he should very much like to know who they were. It was a very strange thing when they came to examine the water to ascertain what compounds were taken which contained it, how very few there were. A little vinegar perhaps might be detected, but he thought the chemist would be hardly able to recognise it. Then there were certain metallic compounds, but he did not think they would make up for what these physiologists had said. He thought the learned Doctor in his observations had put the matter a little too strongly when he said that the arsenic existing in these compounds might find its way directly into the system and there be traced. No doubt in all toxicological investigations sulphuric acid of the greatest purity was used. They would surely be careful of that, and he really did not think because a certain amount of arsenic existed in sulphur that therefore it goes into our system. With regard to getting rid of arsenic, no doubt it was one of the very great difficulties which the practical manufacturer had to deal with. Mr. Vivian, at Swansea, in his smelting process, had erected some very long tunnels, and he placed his chambers at a very considerable distance away from his business, and by that process doubtless a great deal of the arsenic becomes deposited, but not all of it. In conclusion, he would say that his experience was that gentlemen who had only lately been using pyrites and had never used it before, were now convinced after they had given it a fair trial, that for most practical purposes it produced very pure acid, but he regretted to say there was a large mass of the grossest ignorance on this and kindred subjects, and it only proved the necessity for more real education in this country in the matter of science.

Mr. Newland desired to say a word in regard to the discrepancies which existed in the analyses given by different chemists. The reason of that was, in his opinion, simply that they were not sufficiently paid to enable them to give that skill and attention by which alone a correct and accurate analysis could be obtained. With regard to the question of the amount of sulphur in burnt pyrites, he thought that in a great majority of cases the estimate was different from what had been given. In the numerous instances that had come under his notice, it was far greater than 2 per cent., it was nearer 6 per cent.; and, in fact, he found, from very carefully taken samples of cargoes which had been ground up, that it had averaged from 3 to 17 per cent. It was evident, therefore, that the chemist must have been out of the works at the time. As to the question of the danger arising from arsenic in vitriol, he thought it was more imaginary than real. He coincided with the observations of Mr. Coggins as to the difficulty of getting a good sample, and also the great ignorance on scientific subjects, which was frequently found amongst the owners and managers of these large chemical works, and gave instances which had come within his own knowledge of the results of this ignorance. There was one method of extracting copper from burnt ore, and that was with ammonia, which had not been mentioned. He had used it himself, and found that by means of ammonia you could extract fully two-thirds of copper very readily indeed. But he believed that the reason this process was not more in use was mainly on account of the loss of ammonia. With regard to the little knobs which occur in the middle of the pieces of burnt ore which had been spoken of, he had found the copper in the inside in much larger proportions; in fact, the whole of the copper on the outside did not amount to more than one per cent., while in the interior he had found it as much as 38 per cent.

Mr. Hughes desired to know whether in the percentage given by Dr. Wright, he took into account the amount of sulphuric acid present as sulphate of lime; where the average rises above 5 per cent., it was generally due to the presence of sulphate of lime. That was a point which had been rather overlooked in the many analyses of burnt ore. He quite agreed in the remarks which had been made by Mr. Coggins on the manufacture of sulphuric acid, and the amount of sulphur which was generally left in the burnt ore. He had examined a great many samples from very large works, and had found that in the best samples which had been selected with great care, the smallest quantities he found had been 2 per cent. of sulphur, but he very frequently found as much as 8 per cent. of sulphur present, in the form of sulphate of lime, which had been overlooked, and in many estimations it would amount to 7 or 8 per cent. of total sulphur. He should like to be informed with regard to this particular matter, which was of very great importance to manufacturers.

The Chairman remarked that among the variety of suggestions which had been made to them by the author of the paper, there was perhaps none which ought to make such an impression as that alluding to the difficulty which was experienced, up to the present moment, of applying the most simple chemical fact so as to make it a commercial success and the foundation of an industrial process. The composition of pyrites had been known—he was almost afraid to say for how long; and that sulphur could be obtained from it was known from the beginning of the last century; yet we were now only beginning to realise the number of things for which it could be utilised. Up to a very few years ago it had been regarded as an almost worthless material. We are told now that we get out of this material, besides a variety of salts, sulphuric acid, which was by far the most important of the products obtainable from it, although the reader of the paper, knowing that the manufacture of this product was well understood, had omitted to dwell upon it. They got also elementary sulphur itself in very large quantities. These pyrites being used almost exclusively for the manufacture of sulphuric acid, and that being used to a very great extent in the manufacture of salt cake in connection with the manufacture of carbonate of soda, there was produced an alkali waste, which contained the whole of the sulphur which was first converted into sulphuric acid, and very large quantities of this sulphur—he would not say a large proportion of the total amount, but still a quantity amounting to six, seven, eight, or nine tons per week in a single chemical works—were now being extracted from the pyrites which were first employed in the manufacture of sulphuric acid. But in addition to these chief products there were also considerable quantities of copper extracted from it, and also of iron and other substances. He might adduce many other similar instances in addition to those already quoted in which a want of scientific knowledge on the part of a foreman or manager had delayed the application of abstract scientific truths. He would only mention as an illustration the paraffine industry. The whole of the paraffine industry was in the year 1832 laid at the feet of manufacturing chemists by Reichenbach, but it was not only not utilised at the time, but completely forgotten and had to be re-discovered and brought into use by Young, who was very justly regarded as the second inventor of the method of obtaining the paraffine product from coal and coal shale, although as far back as 1831 and 1832 Reichenbach taught how this was to be obtained by distilling coal at a low temperature, and how he proposed to extract paraffine and make it into candles and use the oil for lubricating purposes; in fact, there was hardly a purpose to which this industry is now applied which he did not mention. And so it was at the present day. What we wanted was a more systematic method of technical training both for manufacturers first of all, and also for their foremen and workmen. He feared at the present day we diffused our selves over too great a field of knowledge. We wanted

more concentration of purpose, especially in youths above the age of 17 or 18. The knowledge which has now to be acquired is so enormous that even a portion of one science was quite enough for most men to learn; and he believed a great deal more would be achieved in this particular direction, if we concentrated ourselves more upon one subject, and worked up that more in detail with a view to its practical application than was done at the present moment. He had great hopes that this branch or section of the Society of Arts would have some considerable influence in that direction, and would bring men who were making abstract discoveries together with men who were anxious and ready to apply those discoveries in the arts. Good must come of that, and if only an intelligent set of workmen could be got who were capable of being entrusted with processes which become yearly more delicate, we might trust that this exceedingly slow progress of the application of chemical science to the industrial arts would remain as it is no longer, but would soon be greatly increased. With regard to one or two matters which had transpired during the discussion, he must say as to the diffusion of arsenic it was a matter no doubt which was going on to a much greater extent than was commonly imagined. He did not think himself that it had much sanitary consequence. It was a matter of his own knowledge that large communities were at the present moment drinking water which contained a marked quantity of arsenic without apparent effect. He would not mention the names of the communities, for no doubt they would begin to feel the effect directly they knew it. There was one case that had been brought forward by Professor Church many years ago of a little village on the west coast of Cumberland, where a fraction of a grain of arsenic per gallon had been found in the water, yet the people there lived to a good old age, and they did not complain of any evil effects arising from it; and he was informed that pilgrims came on purpose to drink of this water, which was used in all the domestic appliances in the district. Yet fish would not live in the stream, and ducks could not be kept upon it; but men and ducks differed very much in their habits, as also did fish. Ducks have the habit of picking up fragments of stone or rock present in the bed of a rivulet, and using them, he supposed, for grinding their food. This water came from an old cobalt mine and these pieces of rock had some arsenical traces, which proved fatal to the ducks. The fish probably did the same thing, and thus got traces of arsenic from the rock in the bed of the stream, for he had proved that fish could live for months in a box in this stream, if they were preserved from contact with the bed of the stream. That looked very much as if it were the rocks in the bed of of the stream and not the water itself that was fatal to them. Whilst, however, the diffusion of arsenic in this way through the products which we consume in domestic use, through drinking water, through the atmosphere of our towns (for the smoke of London invariably contains arsenic), whilst he did not think that this diffusion of arsenic at all affected the health of the community, no doubt it might interpose obstacles in the way of the detection of poison, and it was desirable if possible that it should be avoided. As to the complaints about the analyses which were made, one remark seemed to him necessary, that however poor the pay might be, it did not justify the man in making a careless analysis.

Dr. Wright, in replying, said he had but little to add to what had been elicited during the discussion. With regard to Mr. Coggin's remarks as to the percentage of sulphur that was left in the burnt pyrites, the numbers given on his diagram were those which represented the average amount of total sulphur, including sulphates, sulphides, and every form of sulphur combination. It was the total amount left in a quantity of burnt pyrites obtained from the Huelva pyrites which represented upwards of a year's consumption of between 25 and 30 tons per day, representing upwards of 10,000 tons in the year. As to the distinction between the sulphur occurring in combination with the metal, either iron or copper, and sulphur as a sulphate, there was no doubt about one point, and that was that if burnt pyrites be treated with water or an acid such as hydrochloric, and the solution be then filtered, and the ordinary tests of sulphate applied to it, very frequently sulphate would be found to be rendered soluble. If the temperature in the kilns did not rise to a sufficiently high extent where the iron became roasted, and the temperature was not sufficiently high to burn it off frequently, a very considerable amount of loss might be occasioned in that way. But the numbers represented the averages from samples taken actually from the heap of burnt pyrites, at the moment that it was being carried off for shipment or railway conveyance for the purpose of the extraction of copper elsewhere; the samples were taken in the usual way as the truck was going along, and a sample taken from every third or fourth load. The method of analysis employed would necessarily obtain the whole of the sulphur present. Moreover, he was informed some years ago by the manager of Tennent's works at Glasgow, that he contrived to get out of the pyrites, instead of 306¼ tons of oil of vitriol per 100 tons of sulphur, some 294 or 295 out of 300 tons of pyrites, and 12 of loss, or about 4 per cent. Now, out of 50 per cent. of sulphur in the ore that would represent not much more than 2 per cent., or even less, including all sorts of leakage in the chambers to boot. He had also been informed by those connected with Henderson's process, that very frequently large consignments of burnt ore of the Huelva description came to hand, which contained less than 2½ per cent. of sulphur, and required sulphur to be added to it to make Henderson's process available, for if there was too little sulphur more sulphur must be added, and that frequently was the case in the burnt Huelva ore, so that large quantities of it contained on an average less than 2½ per cent. total sulphur. As regards the sulphate of calcium in that description of pyrites, it was seldom that the presence of calcium was detected in the ore at all. He had frequently tested average ship-loads, but had never been able to find more than traces of lime, and sometimes not even that to an appreciable amount. As to the presence of arsenic, it certainly was hardly fair to single out any one article as the sole source of its introduction into articles of food or into things of domestic use. Recently a lot of experiments had been made on various products, and such things as soap, bicarbonate of soda, and other things of household use, and arsenic had been very frequently found to an appreciable amount. It had been shown to occur in common sulphuric acid in such great quantities that the mass of crystals of sulphate of ammonia obtainable by acting upon gas liquor with it, instead of being white and saleable, were perfectly yellow from sulphide of arsenic, and actually rendered unsaleable. Various manures were made by its agency, such as superphosphates, and in that way possibly it might get into food, for the arsenic would get into the superphosphate, and that being thrown on the land it would be taken up by the soil, and so find its way into corn and get into articles of food. Various drugs were actually found to contain traces of arsenic, even after the materials from which these drugs were obtained had been subjected to various processes and separated from their impurities. But although it may not be found present in water or food, yet in articles of clothing it was frequently found in such quantities as to cause serious injury to health, and even death had been caused by the use of silk dresses dyed with aniline dyes. And as regards wall papers coloured green, that was a matter so well-known and so clearly proved, that it was unnecessary to enter further upon it. The method for extracting copper by means of ammonia was a method he had heard spoken of, but he had not been able to get any information

as to the carrying it into practice, or any of the details regarding it. If it were possible he should like to ask the nature of the material operated upon in the partially burnt pyrites. The copper which was present does not seem to exist as oxide. Whatever sulphur there is, is associated with copper, and not with iron; and if there was more sulphur present than was required to combine with the iron, there would be no sulphur remaining, the rest being a sulphite. With reference to the Chairman's remarks on the extraction of sulphur indirectly from pyrites, through the recovery of sulphur from vat-waste, he feared to entrench too long by doing more than just naming it. The process certainly was one gaining ground to a greater extent, and appeared to have a great future before it. It depended on the weathering, so to speak, of the vat-waste, so as to convert the sulphide of calcium present, not into a sulphate exactly, but into a compound which contains various bodies. This mixture of various bodies retains a certain quantity of sulphide of calcium in solution, sulphite, hypersulphite, and perhaps other salts of calcium, and when the weathering has been carried to a certain point (the most convenient method of oxidising being to blow air through a box with holes); when the partially oxidised mass was treated with water and a solution is obtained, of such a character, that by the addition of an acid to it the compounds which are contained are decomposed by the acid in such a way that the acids are set free, and the sulphur precipitated. By heating the precipitated sulphur under pressure with steam it could be fused, and readily obtained in cakes, or dried and used for vtriol; but these processes were required to be repeated two or three times before the actual amount of sulphur present could be utilised. As to the shortcomings of anlaysts, he certainly quite agreed with the president that no matter what the fee might be, it was no reason for scamping the work. At the same time, manufacturers and the general public must know that money and time must be spent in getting an education such as will enable a man to perform such work, and a large amount of time must be taken in carrying out the process of analysis, and if the work was ill-paid for, either the principal did not do the work himself, but left it in the hands of an ill-educated assistant, and so made the profit out of it that way, or if he took the work himself he could not give sufficient time to get out trustworthy results. It would certainly be an improvement if a uniform scale of charges were arranged, so that a thoroughly trained and educated analyist should be paid sufficiently to enable him to live comfortably, and a bad man spotted and brought down and prevented from exercising his voeation. The remarks as to the advantages to be derived by manufacturers from the study of subjects from a scientific point of view, and also the advantage to be derived from concentrating their energies upon one point, he fully coincided with, and need not enlarge upon. It would be a great advantage if the rising generation of manufacturers were more especially trained in purely scientific modes of thought; he would not say that they would all become Faradays and Isaac Newtons, but such knowledge would be of very great advantage to a man. Sometimes little difficulties cropped up which might speedily be removed if the manufacturer had a little chemical knowledge; but owing to a want of familiarity with general process and so on, he had seen several instances where considerable amounts had been lost, all of which were wholly due to the fact that the manufacturer was not sufficiently educated in science to proceed with the experiments. As to the great ignorance spoken of, he could mention many amusing instances of that in his experience. He had known a case where the manager of the works—a man who could not write, and who could barely read print—was under the impression that, inasmuch as he could make a weak sulphuric acid by blowing tseam into the leaden chamber where it was made, he would be able to make very much stronger acid if he cut the steam off altogether; and so the master had a special chamber constructed at a cost of upwards of £2,000 in accordance with the man's ideas. At first the trial, the lead was melted through by the heat, the foul gases escaped, and the neighbourhood was nearly poisoned, so that the firm narrowly escaped being indicted for a nuisance.

A vote of thanks, on the motion of the Chairman, to Dr. Wright concluded the proceedings.

AFRICAN SECTION.

A meeting of this Section was held on Tueday, the 28th April, Vice-Admiral ERASMUS OMMANNEY, C.B., F.R.S., in the chair.

The paper read was:—

ON THE HISTORY, PROGRESS, TRADE, AND PROSPECTS OF SOUTH AFRICA.

By Col. J. C. Gawler.

Under the namé of South Africa we understand the southern portion of the African Continent, well enough defined by the ocean on the east, south, and west, but somewhat undefined as to its northern limits. For the purposes of this lecture, however, the Zambesi will probably suffice in that direction; and within these boundaries the parent of the whole of our possessions is the Cape Colony, the southern extremity of which, at Cape Town, was first colonised by the Dutch about 1650.

In the 17th century, the Dutch were the leading maritime power in Europe. They possessed numerous settlements, forts, and factories in India, Ceylon, and the Malay archipelago, and required the Cape as a half-way house to protect and facilitate their trade with the East, while its excellent climate and the having nothing to fear from the ill-armed natives (Hottentots) encouraged large numbers of settlers from Europe.

The European wars of those times gave us opportunities of taking leaves from our neighbours' books as to supporting our commerce, and I must do ourselves the justice to say that we had as a rule a very good eye to business. We aimed at supplanting our neighbours' trade by our own, and as a necessary means to that end, we endeavoured as a rule to secure the command of all the highways. I say "as a rule," because, as will often happen, a political party would come into power who would either from mischief or ignorance throw away with the stroke of a pen all the advantages which the sagacity of their predecessors had secured with years of anxious toil and watching, and perhaps more or less good hard fighting.

The Cape Colony was captured by us from the Dutch in 1795, was restored at the peace of Amiens in 1802, and captured again in 1806, since which time it has remained a British colony.

The present Cape Colony is divided into the eastern and western provinces. Its old northern boundary, as we received it from the Dutch, is the Orange River, which traverses four-fifths of the width of the continent westward. It is bounded on the west and south by the ocean, but the eastern boundary was for many years variable, during frequent wars with the warlike Kaffir tribes of the Amaxosa race.

The Dutch had mostly avoided the intricate, bushy country sloping from the edge of the inland basin towards the sea, and in 1819 the British Government invited a considerable number of settlers from England to occupy this eastern frontier as a barrier to the Kaffir tribes, who had pushed back the Hottentots and penetrated as far as George Town.

These new British settlers occupied Lower Albany, which borders on the Fish River, and founded Graham's Town, the capital of the eastern province; and thus the Fish River, the Keiskamma, and of late years the Kei, have given the general line of the eastern boundary.

During their rule the Dutch had destroyed, enslaved, or driven to long distances, or into fastnesses of mountains or wilderness, the Hottentot races who peopled the south of Africa. The Cape border Dutch always were, and uncontrolled, always will be a slave-holding people. We found slavery existing when we took possession of the Cape, and it continued so under us until 1833.

The slaves were principally Hottentots and Malays. The latter, whose descendants are a thrifty, shrewd, clean, industrious people, were mostly criminals from among the then desperate, turbulent, piratical tribes of Java, Sumatra, and other places of the Malay archipelago. It was, I have been informed, the Dutch plan of carrying out penal servitude, to send the criminals of one colony into apprenticeship in another—a system which might have great advantages if carried out conscientiously, but, owing to sundry defects in human nature, open to great abuse. The plan of transplanting bodily a restless, turbulent people is a very old one, and, so far as history teaches us, and my own observation goes, has been attended with the best results. It is a checkmate for the adults, and the rising generation is brought up in a subdued and entirely different and more healthy atmosphere.

There is no doubt that our taking possession of the Cape was principally strategical, *i.e.*, for the security of our communications with the East; for, until within the last few years, the Cape was a poor colony, of very limited resources. The towns are small, and the European population scattered over a wide extent of country, on sheep and cattle farms. There are many choice and beautiful spots, no doubt, but to an English farmer the general appearance of the country, dry, rugged, and stony, is heartbreaking.

However, except during droughts, even the dry places are excellent sheep farms, and there is no more hardy, active, intelligent, and serviceable animal than the Cape horse.

In 1849, when I first went out, the colony appeared most flourishing, but it was on an artificial basis. Wool, hides, and horns, ostrich feathers, a few horses, and a few cattle were the chief exports; but there was a large military expenditure. There were at Cape Town alone the head quarters of two regiments, a troop of Cape Corps, and a battery of Artillery, and three more regiments on the frontier. Indian officers, civil and military, in large numbers, with large salaries, spent their long leaves there, and usually took back with them one or two first-class horses.

But the troubles of the Cape set in all at once. The British public got wearied with three Kaffir wars within 20 years; the Egytian route had been opened between Europe and India, and Indian furlough rules were altered, so that officers were not restricted to the Cape, but might spend their leaves in Europe on the same terms; horse and cattle sickness swept over the colony with great severity, clearing out some farms completely; drought succeeded drought until people began to wonder whether it would ever rain again; and in the western province a fire, resembling a prairie fire in America, passed over hundreds of miles of country, consuming stock and homesteads, and in many instances giving the occupants barely time to escape with their lives.

While all looked thus black and discouraging, it had become the fashion with many in England, with much unkindness, and a great deal of ignorance, to talk of the colonies generally as being more trouble than they were worth. About this time also it was notified to the Cape Legislature that they must, within a given time, contribute towards their military defence at what was called "the Australian rate" (viz., £40 per annum for every infantry soldier, and £70 for every artilleryman), or the troops would be withdrawn. Though the principle is sound, it seemed particularly hard at that time. Our relations with the Kaffir tribes, which had always been entirely in the hands of the Governor as High Commissioner, were not very promising, and yet the same demand was made upon the Cape as upon the wealthy Australians, who have no natives to cause them anxiety.

The recovery of the Cape from its misfortunes, at a time when the last straw threatened to break it down, was like an interposition of Providence. There can be little doubt, I think, that its recovery is owing in the first instance to the discovery of diamonds; and the prospect of permanent benefit has been increased by the introduction of responsible government, which, I think will be more progressive and better capable of dealing with fresh discoveries, and, I hope, of opening up the interior of Africa, though old treaties and old blunders perpetuated in bygone days embarrass them at every step like a contracted sinew or wooden leg. There may be, as was observed by the Governor in a letter to the Secretary of State in 1870, some question as to "the justice and humanity of handing over a large native population to the uncontrolled management of a legislature composed of those whose habits, interests, and prejudices are entirely different;" but any one who has studied any of the debates in the Cape assembly, on native matters, and has noted the tone and principles of the great majority, will see that justice and humanity are quite as strong there as in any other body of Englishmen; and that being better informed on local matters, they are not liable to those dreadful mistakes which often inflict the grossest injustice on the natives, and which in South Africa have been productive of wholesale murders, rapine, and slavery, as I shall presently show.

I have said that the border Dutch were always a slave-holding people, and that slavery was abolished by us in 1833. This, and an unnecessary concession by us to the Kaffirs, so annoyed them that between 1835 and 1837 upwards of 1,500 Dutch farmers sold their farms for what they could get, and moved off with their waggons,

families, and stock, in two or three large bodies, across our boundary, the Orange River, *taking their slaves with them.* The excitement at that period was thus described, in 1838, by the great hunter, Captain Harris, of the East India Company Service, who was an eye-witness :—

"The promise of land unlimited, and of relief from taxation, tempted hundreds whose remoteness from the border had smothered the incentives which actuated the original projectors of the scheme. Another class who, like the bat in the fable, had been prudently watching the turn that affairs would take, now openly avowed their abhorrence of the English rule, and freed themselves from its trammels.... For several weeks the whole of the frontier line was in a state of ferment and commotion, and large caravans were daily to be seen hurrying across the border, and flocking to the standard of their expatriated countrymen. Such, in a few words, is the history of the emigration of the border colonists, an event which, while it has materially weakened the northeastern frontier, has kindled a flame in tbo interior which can only be quenched with blood. Taking a political view of this important feature in the colonial history, it cannot but appear extraordinary that so large a body of disaffected subjects should have been permitted to detach themselves from their allegiance, and cross the frontier in open defiance of existing laws, taking with them their slaves, and forcibly entering the territories of an ally for tho avowed purpose of establishing themselves in a position where they might shortly become the most formidable of our enemies. Thus far their course has been marked with blood, and with blood it must be traced to its termination, either in their own destruction, or in that of thousands of the native population of Southern Africa."

For the truth of this opinion, uttered in 1838, I need only point to the present extent of the South African Republic, and to the revelations contained in the Blue Books up to 1872.

But to return to the history. The Dutch, having crossed our boundary and called themselves independent, extended themselves to the northward, and soon made their way round Basuto-land to the first practicable pass to Natal, where they thought they had found a seaport. After several shifts of policy and some hostilities, wc eventuatly forced them to abandon Natal, appropriating it ourselves, while they retired by treaty back again across the Drakensberg to their inland territory. When the Boers entered Natal it was almost without inhabitants, from the devastations committed by Chaka and Dingaan, kings of the Zulus. The country recently annexed to Natal, on the west, bore the name of No-man's-land, from its being literally without inhabitant.

In 1848, Sir H. Smith called upon the Dutch beyond the Orange River to acknowledge their allegiance to the Queen, telling them that they were British subjects, and that their merely crossing a boundary could not denationalise them. They objected; Sir H. Smith marched against them, and fought at Boemplaats, tried and shot their leader, Pretorius, and annexed all the territory as far as the Vaal River, calling it the "Orange River Sovereignty."

But sundry Dutch adventurers had, as early as 1836, crept along the mountains north of the Vaal River, and explored what was then Moselekatze's country, nearly to the Limpopo. Moselekatze, who was perfectly civil and friendly to English missionaries, as well as to Captain Harris, whom he allowed to shoot all over his country, resented these reconnoitring expeditions of the Boers, as well as their squatting in his country without leave. Many sharp encounters took place, in which the Boers often suffered severely; but firearms eventually prevailed over assegais, and Moselekatze's tribe, the Matabili, retired some three or four degrees of latitude, to a country between the Limpopo and Zambesi. These Matabili are Zulus from the neighbourhood of Natal, which is an important point in considering the wealth of the country they now occupy, and is greatly in our favour. The Dutch destroyed, enslaved, and pushed before them the ill-armed tribes, who were no match for them in an open, easy country ; and by a convention dated January, 1852, the British Government granted those Boers who were already north of the Vaal River permission "to manage their own affairs." We disclaimed all alliances with the natives north of the Vaal River, and on their part, the emigrant farmers were "not to permit the practice of slavery!" What a convention to enter into with a community who had thrown off their allegiance, and left us (*taking their slaves with them*) solely because we had abolished slavery in our dominions, and whose servants at the date of the convention were all slaves!

Thus was formed the Transvaal, or South African Republic.

The ink of the convention was scarcely dry when 400 of them attacked the mission station of the late Dr. Livingstone at Kolobeng. At page 39 of his "Travels in South Africa," Dr. Livingstone says:—

"Boasting that the English had given up all the blacks into their power, they assaulted the Bakwains, and besides killing a considerable number of adults, carried off 200 of our school children into slavery. . . . My stock of medicines was smashed, and all our furniture and clothing carried off and sold at public auction to pay the expenses of the foray" (this in 1852). And previous to that time, "for eight years," says Dr. Livingstone (page 37), "no winter passed without one or two tribes in the east country being plundered of both cattle and children by the Boers."

The Boers, in fact, were a community little removed in education and habits from the savages whom they had pushed out, and succeeding generations were still more ignorant and barbarous. "Boers told me," says Livingstone, "that I might as well teach the baboons on the rocks as the Africans, but declined the test which I proposed, namely, to examine whether they or my native attendants could read best."

As regards the extension of their territories, for a long time they kept on the inside, or to the west, of the Drakensberg Mountains. In 1854 I went on a shooting expedition towards Delagoa Bay. My route lay through the uplands of what was then Zululand, along the eastern slopes of the Drakensberg. For the first part of the journey the country on our left towards the mountains was uninhabited and devoid of bush, but a few miles to our right, *i.e.*, towards the coast, the Zulu kraals were pretty thick. During the latter part of our journey we came among the Amaswazi, a large tribe, but scattered over a large extent of country bordering on Zululand, on Delagoa Bay, and extending for some distance northwards. The chief of the Amaswazi had for years been thinning his tribe by selling the women and children to the Dutch and Portuguese for blankets, European clothes, and powder. Vast tracts, covered with traces of kraals not many years vacated, were now only tenanted by game.

The chief of the Amaswazi sent my companion and me a boy and girl, about ten or twelve years of age, as a present, with a polite message, and asked for a suitable return. We sent him a handsome present in blankets and clothing, but sent back the children with a civil message saying that the English never bought or sold people, and urged him to discontinue the practice and to take more care of those under him. In a day or two he sent his nephew to turn us out of his country. We turned this envoy and his counsellors out of our camp, amid the laughter of our forty "shikarries" and carriers, who were all his own people, but who did not say a word on his behalf. He sat on a hill and cursed us until dusk, when, becoming afraid of the lions, which were numerous, he changed his wrath to a piteous wail, as the nearest kraals were many miles distant. When we thought he was sufficiently cowed, we admitted him and his counsellors into our camp for the night, on condition of their not being insolent again. A day or two later we fell in with a Boer, who had come like ourselves to shoot, and saw the identical boy and girl whom we had rejected at his waggon duly installed as his property, for some trifling return present of cotton blankets, value about 15s. I believe, however, that this thinning of a tribe by its own chief is exceptional.

Along our whole route from Natal to our furthest point in the latitude of Delagoa Bay there were no European residents east of the Drakensberg. In the Blue Book of 1871 I see a letter from Sir P. Wodehouse, Governor of the Cape, to the Secretary of State, dated July, 1869, stating that the Zulus were urging upon the Natal Government their acceptance of this very strip of country, in order to form a barrier for them against any further encroachments of the Boers; but it was not sanctioned from home, and, according to recent accounts, it would appear that it is all now in the possession of the Boers.

Moreover, in the Blue Book of 1869, I see a proclamation by President Pretorius, of the Transvaal, annexing the whole of the country of the Amaswazi from the Pongola, securing an outlet at Delagoa Bay, and defining the boundary between themselves and the Portuguese up to the Limpopo. To this I will refer presently.

The enslaving of the Amaswazi tribe by the Dutch and Portuguese, was many years ago the subject of much correspondence with the Colonial-office, but in the Blue Books of 1869 to 1872, there are disclosures of raids, wholesale cold-blooded murders, brutality, and slavery, almost unequalled, certainly unsurpassed, by anything that Sir S. Baker has told us of the Arabs further north. Children, whose parents had been shot down in raids, were sold for from £15 to £22 10s. per head, or exchanged for stock; and when these things became too glaring, and the Governor of the Cape asked for explanation, the President endeavoured to satisfy him by quoting the wholesome laws existing for the care and guardianship of "orphan children," under, what is termed, "apprenticeship" for 25 years!

In 1871, it was estimated that about 4,000 women and children were in slavery in the Transvaal; and, commencing with the Griquas on the west of the Free State, northward to the Limpopo and across it, thence eastward towards the coast, and then southward to and including the Zulus bordering on Natal, all the tribes were imploring the Governments of Natal and of the Cape Colony to take them as British subjects, and to send British officers among them, that they might only be allowed peace, and be delivered from the dreadful hourly terror in which they lived.

This idea of saving themselves and their country, by becoming British subjects, had been started by the Chief Moshesh of the Basutos. He, seeing the encroachments made on his country by the Free State Boers, and foreseeing that the whole of his tribe and country would in course of time be blotted out, implored, besought, and adjured the British Government, in a series of most earnest and touching letters, that her Majesty would take his country, and make his people British subjects. The letters were written for him, no doubt, though from their style I should say that the ideas and arguments were his own.

The British Government, wisely I think, and justly, acceded to his request; and a gentleman, a magistrate from one of the districts of the colony, was sent as superintendent. Of course, there was great wrath amongst the Dutch at being deprived of what they considered their legitimate prey; but Moshesh's foresight has saved his country and his people.

We also subsequently acceded to the request of a Griqua tribe, and annexed their territory, but only because diamonds had been discovered there, Now Moshesh and the Griquas always had powder, and were near British territory, and were in comparatively little danger; but, as Livingstone remarks in one of his last letters, "the Dutch are always bravest when the natives have no guns," and it was the more northerly tribes bordering around the South African Republic who were in real suffering; and to all of their appeals we turned a deaf ear.

Now, I submit to any unbiassed person, or to men like Sir Bartle Frere and Sir Samuel Baker, who have striven to crush slavery, or to those who have professed to be interested in their efforts, who must constitute nearly the whole British nation, whom I adjure, moreover by their reverence and affection for the memory of the great man recently entombed among us, who sacrificed himself for the cause in Africa, and whose evidence I have already quoted, whether—since it was the British Government who, by releasing certain of its subjects from their allegiance, let loose a demon power which preys upon the lives, liberties, and properties of the natives of the interior of Africa—it is not the duty of this country to devise some means of providing those natives with adequate protection? The presence of a duly accredited British resident either in the Transvaal or with the natives would suffice, and it is the least that could be done. It is not for the Cape Colony or Natal to bear this expense, for it is the mother country, and not the colony, which is responsible for the convention which released a band of discontented men from all control. Strange to say, the natives hail with satisfaction the advent of the diggers, if only because they are English, though there is not much guarantee for order. In the Blue Book of 1871, I find two diggers joining with the natives and demanding

the release of 150 women and children of their tribe who were in slavery in the Transvaal; and only deterred from attacking the Boers by a caution from Mr. Campbell, the British magistrate at the diamond fields. Of course it is right in a Government to control its *subjects*, but it seemed hard on the natives for a British magistrate to interfere with them, if they thought they had an opportunity of releasing their families.

Accounts received this month from the Transvaal represent the Boer element as only waiting to see how the gold fields turn out; and if the English diggers flock in, the Boers talk of selling their farms and moving off further north, past Lake N'gami, towards Livingstone's old friends the Makololo. Out of such a proceeding, which seems highly probable, two questions arise.

Here is that community whom we absolved from their allegiance about to take up fresh ground in a rich country near a fine river, navigable for some distance, communicating both on the east and west with the Portuguese, whose right to hold slaves we acknowledge, their export only being against the treaty. Livingstone speaks favourably and kindly of the Portuguese whom he met with on both coasts, but if their officers were to exchange ideas on commercial matters with an aggressive people like the Dutch, the wretched natives would be doubly the sufferers. And must that continue to the end of the chapter?

The next question is, if the Boers, the governing element with whom the convention was made, decamp from the Transvaal, selling their farms to English, are the purchasers, in virtue of holding those lands, also absolved from their allegiance, and as free as the Boers were to do as they like? Or if not, what becomes of the South African Republic? Will it live still in the migratory Boers?

It seems to me, after the evidence furnished during the last 25 years, including the testimony of Livingstone (himself an eye-witness and sufferer), and of the governors and legislatures of the Cape Colony and Natal, as to the propensities and principles of the border Dutch, that it is our solemn duty to take measures to place the recurrence of such wrong beyond the bounds of possibility, and this, I think, as things are at present, can only be done by appointing some competent officer as resident with the native tribes, and by heading the contemplated movement of the Boers by an establishment on the Zambesi. From such a position anti-slavery efforts could be made both towards the north and south. But it does seem strange, comparing what we have done to crush the slave trade in Zanzibar, that we should have completely overlooked deeds as bad, or even worse, perpetrated almost on our own premises, and that we should as yet have taken no steps finally and decidedly to prevent their recurrence. Letters from the Governors of the Cape and Natal to the President of the Transvaal, asking (three or four months after the occurrences) for explanation of the reports that had reached them of wholesale murders and kidnapping, may make the Boers more cautious, but cannot eradicate an inborn principle, nor do such letters afford the natives any real protection or satisfaction.

In the latest Blue Book (1872) I notice that the Governor of the Cape, in a letter dated August 1871, reminds the President of Transvaal that the explanations asked for in the previous year, relative to natives in slavery, had not been furnished by him, nor had his (the Governor's) subsequent letters on the subject been acknowledged.

There are persons who will tell you, on behalf of the border Dutch, that the slavery is not so bad as it is represented; and I admit that these slave children are treated by their masters and mistresses with as much care and kindness as a shrewd man usually bestows on any portion of his property in proportion to its value, but they are nevertheless slaves; and as to the method of obtaining them, besides the testimony of Livingstone already quoted, the Blue Books teem with statements of eye-witnesses, which at any rate satisfied not only the Governors of the Cape and Natal, but also the members of both the legislative assemblies. Some of the accounts are very horrible, but I will leave those who are interested to study them and form their own conclusions.

At p. 127 of the Blue Book of 1869, I find the following resolutions, passed by the Legislative Council of Natal on 10th August, 1868:—

"That ever since the annexation of the Orange River sovereignty (since abandoned) in 1848, the emigrant farmers who settled over the Vaal River, and formed a government of their own under the style of the South African Republic, have carried on a system of slavery under the guise of 'child apprenticeship,' such children being the result of raids carried on against native tribes, whose men are slaughtered, but whose children and property are seized, the one being enslaved and sold as apprentices, the other appropriated.

"That the existence of the system of slavery, attended as it is by indescribable atrocities and evils, is a notorious fact to all persons acquainted with the Transvaal Republic, that these so called destitute children are bought and sold under the denomination of 'black ivory.'"

That as a *bona fide* inquiry, to be instituted by the government of the Transvaal Republic, would be, under the circumstances, quite impracticable, it is highly important that her Majesty's Government should take other steps to ascertain the truth and to put a stop to the trade which, however profitable to the Boers, is a direct breach of the treaty entered into with her Majesty's Commissioners." . . .

As regards the impracticability of ascertaining anything from the authorities of the Republic, in July 1868, Mr. Layard, writing to Lord Stanley (p. 41, Blue Book, 1868, kidnapping) says:—

"I fear from the records of former transactions that Mr. —— is right in saying that, unless a commission is sent to investigate the subject on the spot, no information will be got from the authorities; as witness the conduct of the officials sent by the Free State, ostensibly for the purpose of aiding the British Commissioner to investigate the charges preferred in 1855. These very men purchased children while on their mission, and threw every impediment in the way of the truth being ascertained."

I submit that a nation cannot release a mere handful of subjects from their allegiance, and that, notwithstanding any agreement it may have entered into with such released subjects, it continues still responsible to the rest of mankind for their actions.

In 1868, the President of the Transvaal, by proclamation, extended the boundaries of the republic westward to about the 22nd degree of longitude, thus assuming possession of our line of trade with the interior, northward to the Lake N'gami, and eastward he annexed the Amaswazi country and south part of Delagoa Bay. Although we declined to acknowledge this boundary, the Portuguese Consul the next year arranged with President Pretorius the boundary between the Republic and

Portuguese territory, from Delagoa Bay to the Limpopo. In July, 1871, the Treaty of 1869, between Portugal and the Transvaal Republic was ratified, and a road was commenced from both ends to unite Delagoa Bay with Leydenburg, where the gold has been more recently discovered. Our claim to the southern portion of Delagoa Bay was opposed by the Portuguese, who maintained that it all belonged to them, under the name of Lorenzo Marques, and this point has been submitted to the arbitration of Marshal MacMahon, and is, I believe, to be decided during the approaching autumn.

I will now continue the history of that country between the Orange and Vaal rivers already mentioned as being annexed by Sir H. Smith, and called the Orange River Sovereignty. In 1854, after the Kaffir war, three Commissioners came out from England, and, in accordance with the popular outcry at home, said that we had too much territory to look after. The Orange River Sovereignty was therefore given back to its inhabitants, principally Dutch, who thereupon set up the "Orange River Free State."

Now when Sir H. Smith annexed the Orange River Sovereignty and proclaimed its boundaries, he was not only tolerably distinct, but he sent home a map, which appears in the Blue Book of 1851, which distinctly makes the boundary of British territory on the west to be the Vaal River to its junction with the Orange River. But then we always respected the existing rights of natives, and merely exercised sovereignty over them without turning them out. Not so the new possessors, who had little idea of sharing with the natives what they regarded as a gift to themselves; for we made no stipulation on behalf of the natives, except in the case of a chief named Adam Kok, who was wise enough to remind us of our duty, and a corner between the Vaal and Orange Rivers, now notorious as the best part of the diamond fields, had belonged really for years to the Griquas, under the chief Waterboer; and when that chief, following Moshesh's example, asked us to annex his country, and to take him and his tribe as British subjects, to save them from the rush of Europeans to the diamond fields, we stepped in with great alacrity, and thus was formed Griqua-land West, under a lieutenant-governor. Judging, however, from our refusal about the same period to entertain similar requests preferred in heartrending appeals by victims of the Transvaal Republic, it would seem that we can often witness great enormities with much complacency without raising a finger, *when there are no diamonds.*

The English element in the Free State is now considerable, and there are strong ties between it and the Cape Colony.

The farms in the Free State and Transvaal are splendid for horses, cattle, and sheep. Grain thrives well in the Free State, but is admirable in the Transvaal. The Free State has its diamonds, and the Transvaal gold, lead, and copper. Another source of profit is ostrich farming, which was first I think commenced in the Cape Colony. I have myself seen a dozen ostriches driven along a public road as tame as a flock of geese.

The news of the discovery of gold in the Bokkeveldt in the western province, is I hope true, and I think it likely that by these researches more copper will be found. But it is towards the rich northern regions that the railways must run, though these again will develop and open up fresh resources of the older provinces, which the want of good communication has hitherto restricted.

I have already partially touched on the history of Natal, which we appropriated in 1843 from the Dutch, the greater part of whom retired again to their inland territory. The boundaries of the colony were then from the Tugela River to the Umkomas, but within the last eight years the country I have spoken of as No-man's-land to the Umtamfuna on the south-west was annexed.

Near the coast it is semi-tropical, and sugar-cane, indigo, arrowroot, cotton, ginger, and coffee will grow there. Inland, it is mostly stock-farms, which, as in other parts of South Africa, are of large extent, causing a very widely-scattered population.

A good deal has been spent on main roads, but, like most parts of South Africa, roads are not a success, and bridges are much wanted, but scarce. Hence the resources of the country are not opened up. There are copper and coal, but the transport at present would probably absorb all the profits.

One of the most important subjects in Natal I think is the native question.

The secretary for native affairs is a man who knows the natives thoroughly, and in whom they themselves have the most complete confidence; but the Natal system is peculiar, and I cannot help thinking that the natives are managed too much for their own sakes, without sufficient regard to the interests of the community at large.

When we first took the country there were very few natives in it, and those, generally clustering about the Europeans, being refugees from the Zulus. The natives never showed any great disposition to work, in the sense that an Englishman understands the term. They will come with their own definite object, which is never very remote, and which may be the possession of a wife, or a cow or two. That attained they leave, and if tolerably lucky never work again for a European for the remainder of their lives. Stock increases, wives multiply, and so do children. Wives and children manage the gardens, while the father sits in the kraal and talks scandal.

Very large tracts of the original colony were set aside for native purposes, which I have always regarded as a very great mistake. Had we forced ourselves among the natives, we should have been bound in justice to see that their locations were marked off in a most liberal manner. But the Natal natives have no such claim; they were in very small numbers, though the lands reserved for them would have sufficed for 30 or 40 times their original number. Now, what has been the result? Natives flock in from Zululand, from the countries conquered by the Boers, and from beyond the Limpopo, to work with their own object for a short period. This done, they seldom return to their homes, but obtain their cows and their wives, and settle down in one of the locations in Natal, merely to swell the native population, without being of any use to the colony.

If the colony had been formed as a home for the destitute, or to atone for the crimes of the Boers, I could understand it. But, though the Kaffirs

outnumber the European population by 17 to 1, labour is so scarce that the colony is doing all it can to import coolies from Mauritius and China. I do not think that the Kaffirs are being civilised by this process. To work for a European for two or three years, which is a long time, does not civilise a man. Moreover, we encourage polygamy, by licensing it and legislating for it, instead of discouraging it. It would have been better, to my mind, to allow them to come and work by all means, but not to allow them, under some considerable time, to settle afterwards on terms which would be denied to European labourers. Civilisation and idleness will not thrive together, and if they value the security and order of civilised society, let them stay and work, and welcome, amassing as much property as they please, but do not admit them to those privileges simply to bask in the sunshine in indolence and vice at their locations. If they do not wish to continue at work, let them return home with the property they have acquired, and with their ideas fresh as to the advantages of civilisation, security of life and property, order, cleanliness, &c., and be succeeded by others who stay for longer or shorter periods and return home to tell the same tale. Thus we should have secured a constant stream of reliable information as to the doings in the interior; the natives would have become accustomed to and thoroughly acquainted with the best routes; intercourse would have been thoroughly established with the countries beyond, and even commodities might have been exchanged. The minds of these people would have been developed by their occupation, enterprise, and enlarged sphere, and they would thus in a way have become the pioneers of their own civilisation and commerce. We should in fact have been giving them power to bear their own burden, instead of, as we seem to have done, taking them up on our own shoulders; for, last but not least, their own countries would not have been thinned of their best men, whereby the task of the Dutch in subduing the remainder has been rendered so much easier.

As it is, however, Kaffirs who have grown fat forget that they were once suppliants. Witness Langalibelali, himself once a refugee. Now, I argue that if he could get 15,000 followers, all more or less under a debt of gratitude to the British Government, to second him in a restive fit which led to bloodshed, there would be nothing extraordinary, if the occasion offered, if the shoe pinched anywhere, or if something occurred to cause discontent or excitement, in the whole native population rising to assert their strength as 17 to 1 against the whites. This is the view I take, after long residence among the Kaffirs of the Cape and Natal. I like them much as a race; I think them very fair specimens of crude human nature, but shockingly wanting in foresight.

In 1857 the native population of Natal was 120,000, in 1872 it was 280,000.

In the western province a railway already exists from Cape Town to Worcester, some 70 or 80 miles. This is to be extended northward by the Colonial Government, which has purchased it.

In the northern provinces there are two lines in progress. One a short line from Port Elizabeth to Uitenhage undertaken by a private company; the other, a main line undertaken by the Government, to connect Port Elizabeth with the north and north-eastern part of the colony and the regions beyond. It is, I believe, as yet uncertain whether this line will take in Graham's Town. There is another line also projected by the colony, to start from East London and join the central main line.

In Natal, the Government have entered into negotiations with a company for the construction of a railway from D'Urban through Maritzburg to the mountains, I believe to the coal seams. A large tract of country will be ceded to the company, and the colony will pay a subsidy.

Thus there are projected (if not already commenced) a great central line from Port Elizabeth, which will I hope eventually run through the centre of the Free State and Transvaal, and two branch lines joining it from East London and Natal. Eventually, perhaps, there will be a third, joining it from Delagoa Bay, while the main line may bifurcate to St. Paul de Loanda and to Zambesi Mouth.

But the best prospects of South Africa lie, I think, in the development of the region between the Limpopo and the Zambesi. The gold fields reported in 1867 by Carl Mauch and others were known to the Portuguese 300 years ago. I have read at the Cape the account of the Portuguese abbé who first ascended the Zambesi in 1553. He established the trading fort at Tete, and then went higher up and established Zumbo, where Livingstone in 1854 found a broken bell and some ruins, but no inhabitant to tell him the name of the place. The abbé then returned to Tete, whence he took an expedition ten days' journey to the south-west. "Here," says he, "I established another trading post, and the natives brought in gold in such quantities that I thought we must have discovered the ancient Ophir."

But legitimate trade fell off, and the country was cursed because the slave trade proved temporarily more profitable. Carl Mauch asserts that a vast belt of gold country lies between the Limpopo and the Zambesi. Old Portuguese accounts also mention gold and copper north of the Zambesi.

In the papers of the Geographical Society published last year, I find an account by Capt. Elton of an exploration of the Limpopo River to its mouth. His starting point was a place called the Tati Settlement, considerably to the north of the Limpopo, in about lat. 21° 35′ S. and long. 27° 45′ E., leased by the London and Limpopo Mining Company from the Matabili Chief, "No Benguele," who I imagine is successor to the redoubted "Moselekatze."

The Matabili tribe seem to have retained the prestige they held forty years ago, when living three degrees further south, which is now the middle of the Transvaal; but east and west of them the tribes are weaker, and it is by such means that the Dutch penetrate a country.

It is gratifying to find an English settlement in this country, and if it were only followed up by an accredited British resident, matters would be more favourable. The rush from the diamond fields to Leydenberg has brought an army of diggers in this direction, and the accounts of gold and ivory may prove too much for armed Englishmen, and collisions with the Matabili may result,

at which the Boers will be only too delighted. Leydenberg is equidistant from Port Natal and the mouth of the Zambesi.

Captain Elton followed the Limpopo to its mouth, and found that it emptied itself about 40 miles above Delagoa Bay.

In the Blue Book of 1869, I find a chief named Langa, whose country lay on both banks of the Limpopo, appealing to the Natal Government for a British resident, or for protection in some shape against the Boers, who, he says, are continually shooting down his people and carrying off his children. He says :—

"Langa's country produces grain of different kinds in great abundance, cattle, sheep, and goats; four metals, one of which is iron and the other copper ; the other two are white metals, one of which is like that used for making bullets, and the other whiter and harder (probably tin). The country abounds also in game of all descriptions. But what are all these if peace is not to be had ?"

Livingstone also mentions nine seams of coal in the neighbourhood of Tete, on the Zambesi, so that it probably exists in other parts of the country. We have here, therefore, the richest country yet discovered in South Africa, containing gold, copper, lead, coal, and iron, and probably tin, and producing in abundance cotton, indigo, ground nuts, and many kind of grain, beeswax, palm oil, and coffee ; also abundance of ivory (the trade in which I would remark seems passing out of our hands, as Germany has found that she can get into Africa viâ Egypt). The most powerful tribe in the country have maintained for 40 years and upwards an unbroken friendship with the English, and their language is that of the natives of Natal.

The Portuguese settlement of Loanda was, in 1854, comparatively flourishing, though with still vast room for development, but down the Zambesi and on the East Coast they were reduced to great straits; the forts in ruins, the trade nothing worth mentioning, and the possessors too few and neglected to resist the attacks and demands of the natives. The seaboard of the East Coast is claimed by the Portuguese as far as Lorenzo Marquez.

The northern arm of the Zambesi, forming the Delta, and which runs near the settlement of Quillimane, according to Livingstone, is not navigable, while the southern arm is, and there the Portuguese have no settlement. Livingstone, it will be recollected, as well as Bishop Mackenzie's mission, both entered by this arm in steamers. The mission was unfortunate. They tried to do too much. They entered the Zambesi, ascended one of its tributaries, northwards to Lake Nyassa, and lost all their quinine. They underwent great toil and exposure in getting to an out-of-the-way place, and Bishop Mackenzie and one or two of the mission died.

Our first settlement on the Zambesi should be under an officer empowered to deal politically with the native tribes, and should be furnished with suitable machinery for the maintenance of law and order. It should be at some healthy position as near the Delta as possible, to control the commerce, and to serve as a base for fresh settlements westwards, up the river, each tapping the countries on both banks. There are plenty of healthy elevated positions up the river; and, as regards the Delta itself, Lieut. Hoskins, R.N., reports having had not more than two mild cases of fever in a boat's crew of fourteen men, although he was about the Delta in an open boat, frequently for a month and six weeks at a time, during eighteen months at all times of the year. It might be made advantageous to the Portuguese to concentrate their energies on their more flourishing settlements of the West Coast, and to lease to us any rights necessary for our undertaking on the East Coast.

The commercial advantages of such a position to our South African Colonies and to this country are manifest, and it would further enable the Government effectually to intercept and control the movements and actions of the migratory Boers and other unprincipled borderers, who, at no distant period, must otherwise become embarrassing to the Portuguese, who, if they possess the inclination, do not maintain the force necessary to control them. The Boers will obtain unlimited supplies, and a brisk revival of the slave-trade, and eventual complete extermination of the natives must be the result. Such a policy as I have advocated would be realising the hopes and aims of Livingstone expressed sixteen years ago.

I observe that Lord Carnarvon, in 1867, contemplated declaring the Convention with the Boers of 1852 as terminated, the authorities of the republic having broken their engagement regarding slavery. His lordship, however, went out of office, and his successor did not carry out his views, although the Cape Colony and Natal, as well as the most respectable of the residents in both republics, were most anxious for annexation.

The idea of a confederation of the Cape Colony, Natal, and the two Republics, has been brought forward from time to time, and this would undoubtedly be the best organisation for the management of South Africa. The two republics would become British without any additional responsibility or expense to the Imperial Government.

It must be "responsible government" for the whole, in which the healthy tone and principles of the older colonies would bring the mere handful of borderers, principally Dutch, to reason ; development of commerce would not be checked, nor manifest opportunities neglected, as has often resulted from the policy being controlled from home, where want of complete local knowledge often naturally causes the Government to shrink from incurring responsibility before the British public. I of course mean that they would manage and be responsible for their own external policy with the natives. I do not mean to say that no Cape colonist would over-reach a native, any more than I could attribute so much virtue to every inhabitant of London or Westminster ; but I do mean to say that the element of justice and honesty is as strong as it is in England, and that representatives of the Cape Colony and Natal, or of the wider South African Confederation, would be as reliable as any British Parliament to prevent any injustice to the surrounding tribes.

The governors form a sufficient link between the Colonies and the Imperial Government to bring anything forward that they might think would be disapproved of by the nation.

When a community attains the dimensions of the South African colonies, it may safely be

allowed to manage its external native policy, but not so a small community; and I confess I should view with apprehension the chartering of companies, as has been proposed, after the manner of the Old East India Company.

In a small community of such a nature there would be no conflicting interests, no unprejudiced independent minds, to check the grasping propensities of human nature; and as a trading company are merely one party to a series of bargains, it would be unsafe and unjust to give them powers over the other party (the weaker in every sense), of framing laws and treaties, and of interpreting and enforcing them, and therefore of making war. But no modern British Government, I think, will venture to grant such charters to trading companies, though I hope to see equivalent powers granted to the confederation of South African states or colonies.

An honourable resting-place for the remains of Livingstone, and sculptured marble to his memory, are a just tribute, but it is emblematical of the man that his heart lies buried in Africa, and such honours are empty and incomplete unless these words, called to mind by Dean Stanley in his funeral sermon, are cherished and acted upon by the nation:—"I know," said Livingstone, "that in a few years I shall be cut off. I go back to Africa to make an open path for commerce and Christianity—do you carry out the work I have begun."

DISCUSSION.

Dr. Mann said he agreed most cordially in one remark of Col. Gawler, that the future of that part of South Africa, the district immediately around Natal, was essentially dependent upon two things, the management of the natives and railways. As to the first point, the first formation of the native reserves in Natal was a thing hardly possible to avoid. It was done in the interests of the colonists, because at the time Europeans first got a holding there the natives were living in a series of tribes or clans, and were part of a community that would not assimilate with the habits of white men, and at that time there was nothing else to do but to place them apart in the hope that they would come forward and get civilised. But, unfortunately, this had not been the case, for the refugees kept coming forward; and ultimately resolutions were come to by the Government of the colony that no one should be allowed to come in without giving three years' service. It would be readily understood that it was not easy to carry out those plans, for the native population had increased from 20,000 to 300,000. He had spoken in that room very recently of the secretary for native affairs, Mr. Shepstone. He went to Zululand, and managed to break the connection between the chiefs; and ultimately to make the principal chief of the Zulus a friend of the colonists. With regard to the question of railways, the difficulty was that if they were made, there was no traffic to make them profitable. Along the coast where there were plantations of sugar and coffee, they would pay very well, but when they came to make them from Natal into the interior it would be different. The Dutch Boers had opened up the country, but the time was passing away when they would continue to do as they had hitherto done. He entirely agreed with the remarks of Col. Gawler, and thought the plan sketched out was the only feasible one for improving South Africa.

Mr. Trelawny Saunders said Col. Gawler objected to the employment of British merchants by whom alone an administration could be established calculated to promote the objects of British merchants, and therefore he hoped that gentleman or someone else would point out some other method likely to be effective. No instrumentality was so likely to carry out this object as a commercial instrumentality, which would not be affected by the superintending control of the Imperial Government. It was not because the Government chose the instrumentality of merchants, as in the case of the Gold Coast under Mr. Maclean, that therefore it abandoned its own controlling functions. It was impossible to expect good results from men who were indifferent as to the success of their plans, whose objects and ends were not in unison; and he thought what was wanted could only be done through the instrumentality of commercial men. With reference to the control which Col. Gawler wished to exercise over the Dutch Boers, he thought it must be a territorial one. What was to be the administration through which British enterprise, British merchants, British trade, British civilisation, and manners were to penetrate into the heart of Africa from all points? That was applicable to the East and West Coast of Africa; and if they could by discussion throw any light upon the question in Parliament at the present moment, the Society of Arts would be rendering very great assistance to the country at large, and helping to promote a solution of the great question that Livingstone died to solve. In Africa there were 90 millions of people untouched by European habits and enterprise; they had a climate and soil calculated to produce the very crops and articles of merchandise that were now running short in European markets; and therefore he would point to Africa on one side and the growing want of coffee on the other, as a reason why everyone should take an interest in development of commerce in Africa.

Mr. Moodie said from his long residence in Natal he could agree with a great deal of what Col. Gawler had said, more particularly with regard to the utter want of policy pursued in the colonisation of South Africa generally. A great deal had been said upon slavery existing in the Transvaal as a reason why Government should interfere. He had lived in that place, and might say that no doubt in former times there had been irregularities the same as in other countries, but they no longer existed; slavery had entirely ceased, and the laws were more effectually administered. British residents were coming into the country and mixing with the people in the Transvaal, schools were springing up in all directions, and civilisation was rapidly spreading. There was a talk of a further emigration, but he did not think it would take place, and in course of time he hoped better legislation would prevail.

Mr. Cooper agreed with the last speaker, and spoke from his own experience of traces of a former semi-civilisation which still existed in the Transvaal Republic. There were fragments of architectural remains said to be scattered over a considerable tract of country, and were supposed to have been the remains of monumental buildings, showing that a dense population must once have existed there. Probably it would be found that the tradition which assigned Ophir to this region was not altogether mythical.

Mr. H. M. Stanley said the last words of Col. Gawler's paper contained a sentence uttered by Dr. Livingstone, "I go to open a path for commerce; I hope that you in England will also do your duty." Mr. Saunders had asked how this was to be done, and the path kept open. Now three symbols might be selected to represent three courses of action—the Bible, the sword, and the bag of money. Any one of the three by itself, however, would fail, but by combining two together, commerce and the gospel, success would be certain. The plan tried by Sir Samuel Baker of taking soldiers would fail,—as it deserved. Livingstone had opened up avenues to his countrymen in Africa, and if he had only lived to return he would have appealed far more forcibly to Englishmen to take advantage of them. Some

had asked him what had Livingstone done in Africa, but the question could only arise from ignorance of the interior of Africa. He had discovered a magnificent chain of water communication 1,500 miles in length, consisting partly of lakes from 100 to 300 miles long and 40 to 50 wide, and partly of rivers 400 to 600 yards wide; but how was this to be taken advantage of? Not by asking for Government aid, but by forming a co-operative society and doing the work properly, sending the merchant and the missionary together. All around Lake Nyassa was a vast population, possessing large quantities of ivory, worth at the present moment more than its weight in silver, and it was only waiting for such a society to go and fetch it. Right across the narrowest part of the lake was the path of the slave traders, who came up from Zanzibar and collected ivory and slaves, making a profit of 100 per cent., but leaving behind them burning houses and desolation. What he wanted to see was a company of English traders who should leave behind them a tract of smiling villages and cultivated fields, and set up stores along a wide open road made and kept clear into the interior. By such means, not only would the traders become enriched, but the natives might be taught to read the Bible and invited to share the same Gospel privileges on which Englishmen so much prided themselves. Government would not then be invoked to put down the slave trade, for it would disappear of itself. Only forty miles of overland carriage were required to reach this lake, and this could readily be got over by constructing a steamer in sections ready to put together, and launch on the Upper River, whence she would float right into the lake. This would be not only profitable, but in the truest sense benevolent towards the natives, who might be invited to subscribe their mite towards the undertaking, and aid in the good work. This, and this only, he believed, was the way to continue what Livingstone had begun.

The Chairman said the discussion had materially added to the value of the paper; for instance, Dr. Mann had given material information with regard to the colony with which he was best acquainted, and it was likewise an advantage to her representatives present from even the more distant regions of the Free State to speak on its behalf. Having many friends in the South African colonies he took a deep interest in them, and had been much pleased to hear a friendly feeling expressed towards the Hollanders, especially, as some of Col. Gawler's remarks were rather severe. The whole of the Dutch must not be confounded with the Boers on the frontier, for many were excellent colonists, and amongst the best members of the community; and it was desirable that a friendly feeling rather than one of hostility should be encouraged towards them. They played an important part in several British colonies, and it was to be hoped they would hereafter form part of the great African confederation which would no doubt be formed, as had been the case in Canada, and probably would be in Australia. It was well, too, that the character of the Malay population should have been vindicated as it had been by Colonel Gawler, though he stated that they were originally criminals; it must be remembered, however, that many of them were sent to the Cape for piracy and such like offences, which were different to those arising from debased and vicious habits. The proceedings of Sir Samuel Baker had been canvassed, and it was to be hoped that his successor, Colonel Gordon, would not persevere in the same policy; indeed, he felt sure that if that gentleman saw that such was the policy laid down by the Pacha, he would retire from the service. He was a man of high moral qualities, and would no doubt carry out on the Nile the same qualities as he would have displayed had he been appointed to command the Ashantee expedition instead of Sir Garnet Wolseley. That evening's discussion took place most opportunely, at a time when the question of the existence of a large part of the colonial empire was being discussed in Parliament, and actually trembling in the balance. No doubt there were periods in history when there was a desire to evade political duties, as there was in society a desire to avoid the fulfilling of social duties; but this only proved the weakness, not the strength of the public conscience, though there was a natural tendency arising from the homage always paid by vice to virtue to give this moral weakness the high sounding name of fortitude. At the present moment, our relations with native populations in our colonies were very different to what they were in former times, when the reproaches sometimes made now might have been justly applied. In fact, England was much in the situation of the United States, engaged in reclaiming large tracts of country for the benefit of the world; we no longer engaged in wars for the purpose of ambition, or to build up an Indian empire in contest with the French, but England's mission was to use those gifts which the Almighty had bestowed upon her for the advancement of mankind at large, the cultivation of the world, and the promotion of civilisation amongst savage races. Such had not always been the temper of politicians, and possibly from want of sufficient support by public opinion, or misled by the tone of newspaper articles, there might be a disposition not simply to abandon a territory, but to abandon a whole population to slavery and to barbarism. They knew not what might be the fate of Western African settlements in a few days; and the history of South Africa showed what difficulties the colonists had to contend with in establishing these settlements, which were now beginning to be looked upon as some of the brightest promises of the empire. Natal would have been abandoned had not the Government been forced by public opinion to take charge of it, and the like had happened elsewhere. Only step by step had the recognition of New Zealand been obtained; the white inhabitants of Fiji were now seeking, perhaps in vain, to obtain the benefits of a settled Government, and Australia was urging the extension of English relations in New Guinea, to promote civilisation and commerce for the benefit of the people and the advantage of the world. Mr. Stanley had taught one valuable lesson, that their objects should not be purely single or national, but for the benefit of mankind, and in so saying, Mr. Stanley, he believed, only gave an expression to the opinion of millions of his countrymen in the western world. Dr. Livingstone had naturally been referred to, for in that room he had spoken on the subject of African commerce; and one of the functions of the African Section, instead of welcoming him as they had hoped amongst their ranks, had been to send a deputation representing them and the Society of Arts, to attend his funeral. After all, the great question was, should Africa be held or abandoned, and no doubt the views now expressed would not be without their effect in the discussion of this important question. He could not bring his remaks more appropriately to a close, than by moving a cordial vote of thanks to Colonel Gowler for the valuable paper he had read.

Col. Gawler, in reply, said—I thank the meeting for the kindness and patience with which they have listened to me, and I feel much gratified by the kind observations that have fallen from many gentlemen. With reference to what the Chairman has said, I would observe that I guarded myself throughout by speaking of the border Dutch. My remarks therefore must not be misunderstood as applying to the whole Dutch community in South Africa, nor indeed at all as to those in the older colonies. Mr. Trelawny Saunders upholds chartered companies, and says that civilisation must be spread by commerce. I may misunderstand the nature of chartered companies; my views are quite as commercial as Mr. Saunders could desire, and my proposed settlements on the Zambesi are all commercial, but I conceive that they must be provided with independent machinery for the maintenance of justice between merchants and the natives. I cannot concur with him in thinking the

Boers desirable pioneers. To do so after studying the Blue Books would be to participate, in spirit, in the bloodshed and violence therein recorded. Their pioneering consists simply in clearing out a country completely. Mr. Moodie has told us that these things are now put a stop to in the Transvaal. The information as to their existence derived from the Blue Books alone, however, brings us up to a very recent date; and is Mr. Moodie able to tell us that within the last two years all the women and children sold and apprenticed at various times for many years past, and whose husbands and fathers were shot down, have been released and restored to their people? Mr. Moodie also says that such violence must be the case wherever there is a sparse frontier population, but I can state from experience that such is not the case as a rule with Englishmen, who go among the natives, trade with them, and preserve the most friendly intercourse. On the other hand, I don't think there exists such a thing as a Dutch trader with the natives. Friendly intercourse between border Boers and natives is the very great exception, and violence the rule. And what guarantee is there for a change of principles in the great body of the border Boers who contemplate moving northward to get as far away as possible from anything like English control and influence.

The Chairman, in concluding the proceedings, said this was the last meeting of the Section for the session, but he had no doubt another series would be commenced in the autumn.

TWENTIETH ORDINARY MEETING.

Wednesday, April 29th, 1874; ROBERT RAWLINSON, Esq., C.B., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Brown, J. T., 3, Chesham-villas, Sudbury, Harrow.
Cownley, A. J., 7, Oxford-terrace, New Peckham, S.E.
Hanbury, Cornelius, Plough-court, Lombard-street, E.C.
Higgins, Clement, M.A., F.C.S., 2, Dr. Johnson's-buildings, E.C., and 103, Holland-road, W.
King, Joseph, Trelearen-house, Blundell-sands, Liverpool.
Penney, Edward, 17, Lime-street, E.C.
Roberts, Isaac, Rock-park, Rockferry, Cheshire.
Vine, Daniel Charles, 1, Marden-villas, Ashley-road, Upper Hornsey-rise, N.

The following candidates were balloted for and duly elected members of the Society:—

Bell, J. Carter, care of S. Kipping, Kersal Clough, Higher Broughton, Manchester.
Brocklehurst, William Walter, 4, Leinster-square, W.
Caffall, Robert May, Alton, Hants, and 75, Fleet-street, E.C.
Chance, Henry, Sherborne-house, Warwick.
Clabby, Nicolas Frederic, 2, Derngate, Northampton.
Fordham, John W., M.R.C.S., 78, Mile-end-road, E.
Maybury, C. W., 90, King-street, Manchester, and Brook-house, Alexandra-park, Manchester.
Palmer, Charles M., M.P., 45, Grosvenor-square, W.
Rippingville, E. A., 118, Holborn, W.C.
Rothwell, Peter, 78, Hampstead-road, N.W.
Schlieper, Charles, 18, Sydenham-park, Sydenham, S.E.
Starnes, John Sampson, 13, Broad-street, Ratcliff, E.
Walker, William, 119, Bunhill-row, E.C.
Weldon, Walter, Abbey-lodge, Merton, Surrey.
Williams, Cyril Faithfull, Queen's Bench-offices, Temple, E.C.

The Paper read was:—

ON SOME RECENT INVENTIONS AND APPLICATIONS OF LAMBETH STONEWARE, TERRA COTTA, AND OTHER POTTERY FOR INTERNAL AND EXTERNAL DECORATIONS.

By John Sparkes.

One of the most neglected branches of study in the potter's art, now become so important, is that which relates to the so-called Flemish grey ware of the fifteenth and sixteenth centuries.

It is, in fact, a rare thing to find anyone who can indicate, with any pretention to accuracy, the manufactory from whence any particular piece of ware has come. The general term "Grès de Flandres" covers all the productions of this class, and the ordinary admirer of the beauties of this ware is content with a term which, although it may not satisfy his conscience, is a convenient one, and marks nearly enough the kind of ware he wishes to indicate.

In fact this manufacture of stoneware was one of the most flourishing branches of art-work in the sixteenth and seventeenth centuries. Its productions were so prolific as to supply the home demand and the wants of the foreigner in Germany, England, France, the Netherlands, Denmark, Norway, and Sweden, Switzerland, and other places. The seat of manufacture was the Rhine exclusively; the principal places where potteries were at full work were Siegburg, Raeren, Titfeld, Neudorf, Merols, Frechen, Hoehr, and Grenzhausen.

It was a manufacture of deep interest, whether regarded as a pottery, that is as the source of mere glazed forms of vessels, or regarded as a field of archæological remains, in which relation it yields a rich treasure of facts in genealogy, heraldry, costume history, customs, and folk-lore. It is almost unbroken ground, but a history of this German art should occupy some of the many investigators of these subjects.

It is right at the outset of this paper to say, that the ware with which the recent revival of art interest in Lambeth is concerned is *stoneware*, a peculiar product of the potter's art, a kind of ware sufficiently difficult to define. I take it, however, that the definition from the official hand-book to the Exhibition of 1851 is accurate in general terms. It stands thus—"Stoneware is a dense and highly vitrified material, impervious to the action of acids, and of peculiar strength; it differs from all other kinds of glazed earthenware in this important respect, that the glazing is the actual material itself fused together." In Staffordshire, stoneware is always considered to mean a vitreous impermeable body. A porous body is never admitted to be stoneware.

The difference between stoneware and porcelain appears to be this, that the vitreous change in the porcelain is carried farther than in stoneware until it approaches a condition of glass, while earthenware contrasts with both materials in respect to its more or less porous body and dry fracture, also in being absorbent.

The old ware was made from clay which is still found extensively distributed over the country between Mayence to Cologne, in beds deposited in the lateral valleys which open on to the Rhine, and all are doubtless due to the washing down of the disintegrated rocky masses which,

where they remain, still give to this interesting region its picturesque character. This clay gives either white, pale grey, pale yellow-brown, or dark grey ware, as it is free from iron, or has that constituent in its texture.

The ware made from the same clay at the present time gives the same general impression to the eye as the old vessels, and a visit to one of the old seats of the ancient manufacture gives a fair idea of the condition of the trade in mediæval times.

There is a potter's village at Hoehr, on the opposite bank of the Rhine from Coblenz, and north of Ehrenbreitstein, whence come shiploads of butter pots, Seltzer-water bottles, pitchers, and the numberless and miscellaneous wares that are sold in Holland, Belgium, France, and Switzerland. The clay is found in hollows, a few miles further inland from the Rhine than the pottery. Very primitive kilns still abound, some horizontal, some vertical, all fired with wood as fuel. The wheels of the throwers are for the most part hand-driven, some are still moved by the feet of the thrower, none by machinery. The decoration of the ware is done by the wives and daughters of the workmen, and is either scratched with a reed, stamped with a tin stamp, such as confectioners use for pastry, simply painted with traditional patterns in cobalt, or a combination of all these at once. I show here some pots decorated by these methods. The scratching in of the pattern before the application of the colour is seldom done now, only in cases where the ware is made for special markets. It was not a little startling to hear that China was one of the markets for Rhenish stoneware. The pot I now show you is one of some remainders that the potter had left on his hands, after filling a Dutch schooner, which had sailed to the flowery land with a cargo, mainly or entirely made up of those vessels.

The revival of art in this age is generally felt all over the Continent, but was not, until recently, so commonly met with in Germany as with ourselves. Nevertheless, a central Museum for Art and Industries followed in the steps of the South Kensington collection, and the promoters have carried out the example of that great institution, by endeavouring to make good collections of ancient works which may stimulate the modern worker to follow in the path of his predecessors. They have thus gathered numerous and good specimens of Rhenish ware of all manufactories and all kinds. It was thought that it might prove helpful to the modern industries of the Rhine to send some of the examples thus collected to Hoehr, to show the potter of to-day what his forefathers had done, and thus to raise his standard and help him to perceive the excellent principles which guided the ancient manufacture.

The laudable experiment failed; the lack of education, which the least of our art schools might have supplied, led to the failure. The modern worker moulded the old pots in plaster of Paris, pressed clay into the moulds, and thus made in some sense a copy of the pieces, but that was all. The potters of to-day showed no real perception of the principles which had produced the lovely old work. These pots are examples of what has been done in this spiritless attempt at reproduction. It was the same with all the loan articles; but the astonishing thing is that these poor copies sold well. The Jews bought them; and many a tourist has added these works to his collection, in firm faith regarding their antiquity and beauty. This spurious manufacture has spread widely. I saw, a few days ago, a number of them at Guildford.

I show you some examples of modern Rhenish ware for everyday use, and with them are placed some similar vessels for like utilitarian ends, from the Lambeth Pottery. They contrast principally in colour. The blue grey, or warm grey, of the Rhenish clay is not found in the Lambeth ware, which takes a warmer, yellower, more sienna tone for its range of colour.

In the search for the old grey colour a very interesting experiment was made, the result of which I here exhibit. These are two Rhenish pots. One is an old jug, of 17th century manufacture. It was grey, fine of surface, with decoration by scratched lines, and by stamped applied ornament, sharp, delicate, and clearly defined. The other is a modern imitation from Hoehr, made from the same clay as the old example. It is made by the slovenly process I have just described, pressed out of a mould, not thrown on the wheel. It was decorated by some applied medallions of a deeper grey clay than the body. The whole pot had a general resemblance to the ancient ware in colour. These two vessels were passed through the same fiery ordeal that our Lambeth ware has to endure, with these results. The grey colour is changed to a colour indistinguishable from the ordinary Lambeth body. The shrinkage has been considerable, and the intense and long-continued heat has developed a tendency to "stunt," as it is called in the Potteries. It is a kind of suicidal condition of the pot atoms which tends to disintegration. In this state, a pot sheds its mouldings, its applied ornament, its handles, and usually ends its course by rending itself into pieces. The change in the colour of the body has of course caused a corresponding change in the colour of the blue, which is so great a source of beauty in the old so-called "Grès de Flandres" pottery. It is clearly not so good as the colour on the Lambeth ware. It is thus made manifest that the tender blue colour of the old grès is due to the wood fires by which it was burned, and that the presence of sulphur or other product of coal changes the colour to the ordinary Lambeth tint. No doubt the peculiar purple glossy tint of the old Rhenish pieces is due to the same absence of harmful chemical products ensured by the use of wood as fuel. It will probably be a matter of future consideration whether the conservation of the grey body of the clay in the ware is worth the expense of returning to the wood fires.

Before going into detail respecting the forms or principles that have guided the manufacture of the various pieces you see exhibited here, it is necessary to explain a peculiarity which is the characteristic of stoneware. The glazing of this ware is different to that of any other known ware. In all other glazed pottery whatsoever the body is first fired, it is taken from the kiln in a more or less porous state, and is called "biscuit." The biscuit is now dipped into a creamy fluid, which is made by reducing the various materials of which the glaze is made to a fine powder, and by mixing them with water. The ware thus coated with composition is returned again to the kiln, and after

being fired a second time, comes out covered with its glaze or film of glass.

This is not the method followed in order to glaze the ware I am now describing. It is fired and glazed in one operation. During the first firing, which converts the brittle, useless clay into impervious ware, and when an intense white heat is reached, salt is thrown into the kiln, either from above, through holes in the crown of the kiln, or into the fire-holes, or both. The intense heat decomposes the salt, which is changed into a gaseous fume or steam. One constituent of the salt, the chlorine, escapes out of the kiln as vapour. Another portion however, the soda, as it flies through the kiln, meets with the white hot ware, in which is always a portion of silex or flint, and forms with it a silicate of soda, or soda glass. This subtle aëry glazing is thin, transparent, intensely hard, and almost indestructible, and does not coat the finest line or scratch so thickly as to obliterate it. It is on this account, from an artistic point of view, the perfection of glaze.

But the disadvantages are numerous. Few colours can stand the trial they are subjected to in the intense heat. The ware is brought, by the same agency, into a pasty, softened condition in the kiln; this almost necessitates the sometimes clumsy thickness of the vessels made in stoneware, for very thin ones often lose shape seriously.

The more or less accidental impact of the fire, which has its currents of more or less intense heat streaming through it from the fire-hole to the crown of the kiln, produces various unforeseen effects on the colour of the ware, and on the colour of the pigment used in its decoration. The accidental path taken by the salt in its downward course from the crown of the kiln to the ware also produces great and unanticipated results in the colour of the ware, and leads to a bleaching or washing out of even strong colours, such as cobalt, which not unfrequently change to grey or brown under the excitement of this downpour of chemical matter. It may be noted that a certain security against imperfect burning is attained by salt glazing, inasmuch as the salt will not volatilise at a lower temperature than suffices to make the ware white hot.

Such is the method of glazing stoneware with salt, which has been practised for hundreds of years; indeed, it is one of the unanswered questions of the art when ware was first glazed with salt.

It is certain that the earliest Staffordshire ware was all salt-glazed. It is equally certain that at an early date Dutch potters, also using this method of glazing, settled in Lambeth. Probably individuals of the same nation founded the Fulham potteries, as the early ware of that factory is called Cologne ware. It is now sure that the Lambeth potteries were fully at work in 1668, for the evidence given in a trial which took place in 1693 went to prove that potteries had been established in Lambeth for over twenty-five years before that date.

In 1671, letters patent were granted to a Dutchman, John Ariens van Hamme, for making tiles and porcelain, and other earthenware, after the way practised in Holland.

Dutch potters were frequent settlers in this country in the seventeenth century. The art they planted here was the manufacture of Delft ware; and evidences of this old-world industry are constantly coming to light. No excavation is made at Lambeth that does not bring to the surface some fragments of Dutch wasters. The manufacture of Delft ware continued down to a recent date; at any rate forty years ago it still existed, though at that time of decadence, pill slabs and pomatum pots were the staple of the manufacture, which was totally inartistic.

The history of the more recent development of stoneware decoration is this. In 1854, the Lambeth School of Art was established by Canon Gregory, with the intention of giving his parishioners a means of gratifying their taste for drawing in its most elementary form. It was thought that the potters of Lambeth would take advantage of their opportunities in this matter. This part of his plan, however, cannot be said to have come to any large practical result, as only one potter entered the school.

In 1856 I took charge of the school, and through the introduction of my potter student, obtained access to some of the Lambeth kilns. I made a series of experiments with the view of ascertaining whether colouring matter could not be made to adhere into incised lines, and whether the principle of stopping out, with a greasy pigment, that should dissolve and disappear in the kiln, could be applied. These and other experiments all answered to a certain point, and only wanted the practical energy of a manufacturer interested in the artistic perfection of his ware to have been brought to a successful issue.

A few years later I obtained an introduction to the firm of Messrs. Doulton, and was able to assist them in the execution of certain heads which were modelled in the Art School by Percival Ball, who subsequently obtained the highest distinction in the Royal Academy, and is now a rising sculptor in Florence.

After this, the Paris Exhibition of 1867 made its demand on the skill and enterprise of the English manufacturer, and the firm made some jugs and ornamental forms of vases with extra care, but with no great attempt to produce any work of the highest class. It was at this period that Mr. Edward Cresy, a friend of Mr. Doulton, suggested several of the forms and gave designs for some of the jugs that were sent to Paris. The moulded shape I have here, and this classic shape are examples of his work. His culture and high taste enabled him to suggest to Mr. Doulton the line that the decoration of his material should naturally take. I am glad to be able thus publicly to acknowledge the deep obligations I owe to his ready aid, his accurate knowledge, his practical grasp of all questions of art or industry. I, among many friends, mourn his untimely death; we deeply regret that a life so useful, not only to this particular development of which I am speaking, but to the whole metropolis, should have been so suddenly cut short. It is a constant grief to us, as one beautiful thing after another is brought from the kilns, that Edward Cresy cannot share with us the delight we experience. I cannot withhold this feeble tribute to the memory of as true an artist as ever lived. The character of the ware exhibited in Paris was perhaps due to the fact that the highest practical excellence in manu-

facture had been reached. Vessels indispensable to chemical manufactories of the country, and others valuable as useful additions to the comforts and necessities of household demands, were produced at this time with a perfection in manufacture never before attained.

But the art-field was as yet uncultivated. A few desultory experiments made by scratching the green clay, done by two or three students of the Art School, were always being made. These are all lost; but comparatively simple as the ware in the Paris Exhibition was, it attracted wide recognition, which stimulated Mr. Doulton's efforts to further production. This hearty recognition of the attempts to ornament a simple material was, no doubt, due to the fact that the utmost simplicity of means was prescribed, and for the most part a graceful form was covered with concentric lines of parallel "runners." I show you an example of this kind of decoration.

The experience thus gained, through the friendly criticisms of the foreign press, was soon to be utilised. The first International Exhibition at South Kensington, in 1871, was the spur to new trials.

The necessity of producing patterns really artistic, but with the full recognition of the colour and peculiar character of the Lambeth ware, led to the adoption of the scratching in of patterns on the ordinary brown stoneware body and filling in the scratched lines with colour.

The exhibition of these simply-decorated wares attracted attention, and the critics, and amongst them I believe Mr. Drury Fortnum, called the production Sgraffito ware. It was found convenient to retain the name; it had the recommendation of describing the method used in its decoration. This early name has been supplanted by another. The whole class, whether scratched in lines or ornamented by applied forms, is now called Doulton ware.

The various plans open to the artist in producing the effects you see here attained are briefly these:—

1. By scratching in the pattern while the pot is still wet, very soon after it is removed from the thrower's wheel. The line is scratched with a point which leaves a burr raised up on each side. This is useful, and serves to limit the flow of any colour that is applied, either within the pattern or to the ground that surrounds it.

2. At a later period, when the vessel has left the wheel twenty-four hours, the clay is too hard for this treatment. In this condition a burr is not turned up, but breaks off and leaves a broken blurred edge. When in this state the ware is scratched with an implement which scoops out a line, and delivers the clay that is removed cleanly away from the cut. It makes a clear incised depression, with no burr; it too has its own beauty and subserves a use. Colour applied to the pattern, or to the ground, flows into it, fills it up, and is darkened by its deeper thickness at the place where a line crosses it. Fig. 1.

3. Carving away a moulding or collar that is left on the ware by the thrower or turner is a fruitful source of excellent light-and-shade effects. This system is not only applicable to mouldings but also to flatter members, as for instance, where a row of leaves is first turned in a mass and carved in detail. Fig. 2.

Fig. 1.

4. Another method is by whitening the body. But the material used for this purpose is of too short a texture to allow of ornamentation by the

Fig. 2.

first method, viz., by scratching the wet clay with a point when half-dry; however, it is tough enough to be decorated with patterns taken out with the excised line. In this body we observe a difference

from the ordinary brown ware body. It has a less affinity for the soda in the process of glazing with salt. It does not shine with the full glaze, as the brown ware does; and it has what is called a "smear" by potters. On the other hand, it takes the blue colour much more kindly, from the circumstance that the yellow or burnt sienna-coloured body of the ordinary ware is absent, and also that a certain natural relationship exists between the blue grey of the body and the deeper cobalt blue with which it is decorated. There is a harmony of likeness between them. This, too, is doubtless the cause of the pure deep blue on the old Rhenish ware.

5. Another system becomes imperative when a vessel of ordinary dark brown clay is dipped into a slip, or coating, of a white colour. It is obvious that a cut made on such a vessel would expose the brown colour of the body made visible by the removal of the white covering. This method offers many varieties of treatment, with or without the addition of colour to the cut surface (Fig. 3.)

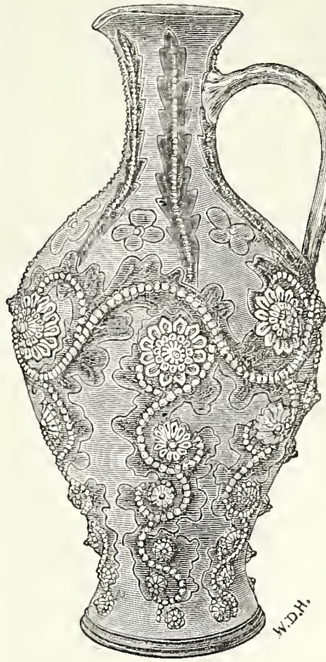
FIG. 3.

6. Now, in addition to those various methods, there is still another, which was extensively used by the old Rhenish potters; it is by the application of dots, discs, flowers, borders, &c., by a process of sealing on a form of clay usually of a different colour from the ground, from a mould, much in the same way as the impression of a seal is made in wax, with this difference, that the clay seal is made to adhere to the surface on which it is pressed; the clay (or wax) being spread on the seal, not on the ware (or paper).

7. Similar in principle is the method of cutting in patterns from a mould; such lines of sharp environment serve to set bounds to the little rivulets of flowing colours, when fused and fluid by the intense heat of the kiln; they seem to limit the flow, which, if not thus checked, would run down the surface of the vessel.

8. Again, it is quite possible to stamp or seal on a disc or series of dots with such a material that it will burn away with the fierce heat, and leave a small circular inlay of beautiful crystallised brown-grey substance, flush with the surface of the ware.

FIG. 4.



This method opens up a new field of decoration not yet developed.

These eight heads of methods seem to classify the schemes of decoration applied to the Doulton ware up to the present time, but scarcely a kiln is burnt off that does not yield a suggestion of a new line of trial for new systems, and these are stored to be taken up in the future as the demand for newer methods is made.

In the course of the growth of this new branch of manufacture, there have been one or two clear principles laid down for the guidance of all engaged in it. One is, that there shall be no copy of old work. We have taken old work, it is true, as our guides as to processes, as to the methods of scratching in of patterns, as to the sticking on of dots or bosses, and as to the plan of colour, but there our dependance on the old work has ceased. The endeavour has been constant to work on the principles observed in the works of the old potters, to use their experience in their treatment of soft clay, to start with all the advantage their practice gave us, but to imitate nothing.

The second principle was to make no duplicates. It was felt that the art value of each piece would be found in the thought and skill bestowed on it. Neither thought nor skill, nor the finest perception of beauty, can make their mark on a piece of pottery that is mechanically reproduced. Thus each piece is unique, and its artistic value is not, nor ever can be lessened by the repetition of its decoration on the same or other forms. The sole exceptions to this rule are found when a pair of vases is required, or when a copy of a fine piece is required to make good the loss of the original.

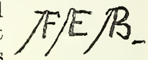
It is the deliberate aim of all, those who plan the work and those who execute it, to bring about the greatest amount of variety and originality; but other causes besides deliberate intention come into play to aid us in giving the originality to the ware we so much desire to see. These are accidental, from numerous causes difficult to classify; more or less exposure to the fire, more or less shelter from a draught in the kiln, more or less salt in the glazing process; all these causes, and others, may, and do sometimes set at nought the most elaborate plan of colour, and ruin the best intentions. But there is a set off in this, for it not unfrequently happens that some of the very best effects of colour we have obtained have come from the partial burning away of the pigment. It is especially beautiful when the blue burns at the edges, and comes from the kiln with its exposed edges, fading into green or brown. These accidental effects are often exquisite.

These accidents are principally due to the use of coal as fuel. The old ware was much more even in its tones, and no doubt the painter on stoneware in the seventeenth century knew pretty nearly what his work would look like when it came from the kiln. His difficulties were fewer than ours have been; but, as I have already remarked, the set-off to the losses from the action of strange coal or unexpected inequality of heat is, that the more intense heat develops more intense colour, and makes this modern Doulton ware far more durable than the old "Grès de Flandres."

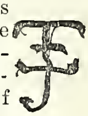
Under difficulties that were never met by the old potters, these results have been brought about, and I cannot but think that a development so new in its effects, so beautiful in itself, and so interesting, as being based on a body possessing in itself no other claim to our regard beyond its durability, should be recorded in detail at this time, when it has made its claim to the consideration of artists and lovers of a beautiful thing. It often happens that in 20 years, still more frequently after 100 years, all who really worked with head and hands to the establishment of an art industry, are forgotten; all record of their work perishes with them, and the reverence that should attach to their memories is transferred into a dilletante appreciation of their handicraft. This should not be. I therefore wish to speak of the artists and others whose invention and patient perseverance have made such a truly original art manufacture possible, for it is obvious that the ware may be decorated with exquisite form, the colour may be arranged with care, and all may easily come to grief in the kiln. At every joint of the long chain of processes, exceeding care must be exercised. From the first throwing on the wheel, to the turner's part of the work, to the handler's bench, to the artist's studio, to the painter's room, to the setting in to the kiln, and more especially in the firing, even to the unsetting of the kiln, through all these processes extreme care is necessary; without it all the pains bestowed on the previous part of the work would be in vain. A piece of ware brought to a successful end represents an accumulative amount of careful interest, extending over some weeks, and culminating in the anxious watching of fires and skilful testing of kilns, which sometimes robs the fireman of rest for several nights in succession. I hold it a duty to all those who have had their share of painstaking and effort, thus publicly to acknowledge their part in the success that has been achieved.

The artist who has given to the new ware one of its strongest characters is Miss Hannah B. Barlow. She was introduced to me some six years ago, by Miss Rogers, a lady who has written a most charming little work on "Domestic Life in Palestine," and the daughter of Mr. Rogers, the well-known wood-carver. An artist herself, she had an artist's quickness to perceive that her young friend, Miss Barlow, was destined to do good work in art. Miss Barlow's quick sketches of the creatures you see here show an intense feeling for the spirit of the beasts and birds represented. These etched out figures are, so to speak, instantaneous photographs of the animals. She possesses a certain Japanese faculty of representing the largest amount of fact in the fewest lines, all correct, and all embodying in a high degree the essential character of her subject. Yet there is little tendency to run into a picturesque treatment, but the fitness of her work for the manufacture, the recognition of the limitations under which the designs are made, are eminently kept in view in all her work. Her mark is shown in the margin.

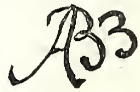
Miss Florence E. Barlow, sister to the lady I have just mentioned, is another lady who gives great promise of a gift for animal drawing. Her work is at present somewhat undeveloped. Her mark is here shown.



Another lady artist is Miss Emily J. Edwards. Her work is ornament, made up of an ingenious mixture of classical or conventional forms with natural growths. There is usually great flatness of treatment in her work, with which elaborately diapered backgrounds in no wise interfere. The colour clings to the small stamped patterns on these backgrounds, and flows into the deeper depressions, to the manifest enrichment of the piece. She often gives indication of close study of antique methods of decoration. Her mark is figured at the side.

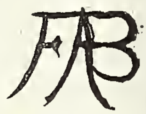


Another artist, whose skill has done very much for the ware I am describing, is Mr. Arthur B. Barlow. He has taken an entirely different line from that followed by his sister. His ornament is original—a flowing, tumbling wealth of vegetable form wreaths around the jug, now and then fixed by a boss, or pinned down by a point of modelled form. His education in the Art School as a modeller has been of vast assistance to him, and has given him many methods of dealing with the plastic form that comes under his hands. The occasional use of a gouge, or carver's chisel, or other carving tool, gives frequent evidence of what resources are his. He, too, has carried the system of bossing, or stamping with points, dots, and discs to its fullest development. His good taste and perfect mechanical ingenuity have carried his art into fields of decoration of unexpected beauty. His work is marked as shown.



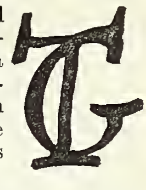
Another artist who has made his mark on the ware by the originality of his forms, is Frank A. Butler. He is quite deaf and almost dumb. He is one of many thus heavily afflicted who have passed

through the school. He began his artistic life as a designer of stained glass, but his invention was not needed, nor, I dare say, discovered in the practice of an art which is almost traditional. I introduced him to the new work, and in a few months he brought out many new thoughts from the silent seclusion of his mind. A bold originality of treatment and the gift of invention, are characteristic of his work. He has struck out many new paths. A certain massing together of floral forms, and ingenious treatment of discs, dots, and interlacing lines indicate his hand. His mark is that shown in the margin.



The artist who has done greatest service to the arts of all kinds in Lambeth is George Tinworth. He was originally brought up as a wheelwright under his father's mastership. He had early tendencies to be a sculptor. These were shown by his untutored carvings of Garibaldi and other heroes of the time. The carving of these things formed the occupation of his midnight leisure. His father, deeming these works of art dangerous, as likely to prove a bar to the proper attention his son ought to give to his wheelwright business, broke them to pieces whenever he found them. An arduous childhood has educated in him a deep patience which has borne wonderful fruit. After his father's death, he tried to carry on the business single-handed, but he was unsuited to the work, mentally and physically. He had entered the Art School some time before this, and I was happy in being able to introduce him to Mr. Doulton as a modeller suited to his needs. His first works were some large medallions modelled from some Syracusan and Terina coins. These were done with astonishing spirit. When the demand for artistic stoneware came, his general grasp of the intention enabled him to do works that were more than equal to the occasion, and since that time he has done some of the best pieces the factory has produced. He prefers the clay soft from the thrower's wheel, so soft as to be too tender to handle. His delight is a spiral band or ornamental ribbon, sometimes deeply interdigitated, or elaborately frilled. The ornament usually covers as much surface as the ground, and creeps or flies over the surface in wild luxuriance; bosses, belts, or bands of plain or carved moulding keep this wild growth to its work, put it in its place, and subject it to its use. No two pots are alike, and although he has done quite a thousand, all different, he will still produce them in endless variety out of the same materials. Of course no one could produce such ever new combinations unless he had invention. In his art as a modeller he has achieved marked success; and I trust the forthcoming exhibition of the Royal Academy will prove his right to recognition as an exponent of religious art, such as seldom arises in any community in the present day.

I call your attention to the large jug here exhibited, where he has worked a kind of gallery round the shoulder, and placed alternate groups from the history of the Passion of our Lord, and small niches of single figures from the Old Testament, which have a bearing on the groups they separate. The earnestness of the actors in these little scenes, and the expression of their faces and hands, will repay close examination. Apart from the detailed richness of the high art work on this jug, the vessel, as a whole, is perhaps the finest piece of decorated stoneware that has ever been produced in the modern age. If it has a rival, it is in a similar one, but somewhat smaller, that was exhibited in Vienna last year, and is now in the Museum of Arts and Manufactures in Edinburgh. His mark on jugs is given here.



I have said that the utmost care and the greatest artistic skill would be simply valueless if the actual details of manufacture were not equally cared for. This, however, has been done in a remarkable manner by those by whom Mr. Doulton has surrounded himself, for from the foreman, Mr. Bryant, who has selected and mixed the clays for the bodies, downwards, all have worked with most zealous spirit. All that has been accomplished in colour is due to Mr. Rix, who, by incessant experiments and cautious intelligence has produced blues and browns which equal the ancient ware, and are in some senses superior to them. He has also introduced some new tints, notably a pink and green, which have the rare merit of withstanding the intense heat of stoneware kilns and the decomposing vapours of the salt. He too, has organised the class of young girls who do the subordinate part of the work, such as the sealing on of dots and bosses, and has thus rendered it possible to produce these highly-finished hand-works at reasonable prices.

I personally feel under deep obligation to him for the zeal and interest he has shown at all times when new experiments were to be made, either in the body of the ware, the decoration, or the colouring of it. Without him the manufacture would not at this time have reached the point it has done in public estimation.

The forms on which all this elaboration and decoration is placed are first "thrown" on the potter's wheel. The art of throwing is in danger of becoming extinct in Staffordshire, and was in use in Lambeth principally for the purpose of producing only the simplest wares, such as ink bottles, blacking bottles, jars, &c. The demand for beauty and accuracy of form found its supply in the works of Thomas Ellis, who has thrown all the forms you see here. His most skilful handicraft has done not a little to help on the fame of the new ware.

Many of these forms here exhibited are thrown roughly on the wheel, and then when green hard are shaved, that is, are turned in a lathe; this gives them a fine, true, highly polished surface. In this part of the process accuracy of hand and eye are both demanded. The earlier forms were shaved by Robert Atkins, who unfortunately died. His successor, George Martin, who has put the final surface on many of the examples here exhibited, has done his work in the spirit of an artist.

But, as I have before remarked, the skill of the thrower, the handiness of the turner, the gifts of the artist, the knowledge and science of the colourist, are all in vain if the intelligence which keeps guard over the kilns, where all these works of beauty are tried in the fire, is unequal to the task of urging the heat to the proper pitch of intensity, of staying his hand when this has been

attained, of knowing by instinct, as it appears to me, when the critical instant has arrived when the ware will take the salt. The gift of thus piercing the secrets of the fiery furnace, whence emerge either things of beauty that live for ever, or amorphous masses of "wasters," belongs eminently to William Speer. He spares himself no sacrifice of comfort or health to give up from the kilns the objects of loveliness that have been entrusted to his care to pass through the most critical period of their existence in the white heat of the furnace.

I hold it a duty accomplished to have acknowledged in this paper the part that all the persons I have mentioned have taken in the carrying out of the necessarily difficult task of inventing a new art and a new science, without special appliances (for to this day all the ornamental ware is fired in the ordinary kilns), and in the face of a tradition adverse to the employment of art in Lambeth stoneware. It has been most interesting to observe how a love of the work has been developed, and how genuine the delight of all concerned is when a kiln of good ware is drawn.

I have now indicated slightly enough the history of a revival of Lambeth art ware. My endeavour has been to put on record the facts concerning it at this, the youngest period of its growth, when only such a statement that is to reward the research of the coming art pottery historian can be made. I now turn for a few moments to explain what has been attempted in architectural decoration with the same material as is used for these works of art. There are here exhibited various capitals, bases, and shafts for the decoration of window openings, some balusters, and the jamb lining of a window. I call your attention to an architectural composition of terra cotta and stoneware; a figure in pale terra cotta is framed in the same material, but red; the columns, panels, bosses, and mouldings are of glazed stoneware. The effect of the whole is such as to make an artist long to see much of the same ware in our houses and public buildings. It is all the work of George Tinworth, and has every character of the new ware. Brilliant, rich, and glossy, it gives relief to the surfaces it decorates; it is full of the charm of mystery in colour; from the blending of rich, velvety browns and blues, the white discs give brilliancy to the moulded forms; in short, there is a combination of colours and qualities of surface that makes a perfect foil to the ordinary materials used in building. Such a medium for the architect's use, with which he can touch up his building and give point and emphasis to his soberer work, has never till now been provided for him, and I venture to bespeak for this glorious material a great future.

Never has there been a decoration so permanent, so totally indestructible, or one so plastic in the hands of its master, or so applicable to any surface he may place it on. Discs and bosses may be inlaid in stone or terra cotta, so as to form a rough mosaic of coloured jewels. And as with these vases, pots, and jugs, infinite variety of detail is certain. I cannot give a better proof of this than by saying that Mr. and Miss Barlow have, in the past three years, made more than 9,000 pots, all different and all original.

A more recent development of art manufacture at Lambeth has taken place in another direction. Terra cotta has long been made in the Potteries. It is naturally the material with which we must heighten the dull effects of our brick buildings. The introduction of colour, other than that obtained by different coloured clays, has been made the subject of experiment, and a more or less successful result has been attained. It is necessary to remark that the application of colour to the raw terra cotta is only done by a second burning, and the colours of finer range can only be fired in a kiln of different construction to those used for the ordinary purposes of the pottery. The difference is great, for in the one kind the fire plays directly on to the ware, whereas in the other the ware is enclosed in a fire-clay box, the heat is applied outside this box, and does not come in contact with the ware at all. Moreover, the kiln I am describing must be absolutely closed against the entrance of any fumes of sulphur into it, or the delicacy of many of the colours would be destroyed. This second burning in a "muffle" kiln is, if possible, to be avoided, on the ground of cost, and can be done away with as regards certain colours when these are placed on a material which will allow them to be properly reduced. I show you a slab that has been fired in the ordinary kiln, exposed to the open fire. This method of decoration has no other limit than is practically imposed by the difficulty of making slabs of the body or ground on which the painting is to come. One point which I think recommends this system is, that the slabs of clay can be made to assume any curve, so as to be applied as the lining of niches, domes, curved walls, soffits, &c. The burning fixes these forms and curves unalterably, the painter decorates them, they are glazed, and then whatever the painter has designed in colour is secure against all chance of injury, fixed behind and incorporated with the film of glass. To make this ware perfectly able to withstand the effects of atmospheric attack, two points are necessary to be attended to; one is that the body and the glaze shall be so perfectly fitted for each other that there shall be no uneven and different contraction. Crazing, as it is called, on glazed ware, is the effect of two materials that do not pull together, so to speak, and is to be avoided. The second point is to secure a body that has been honestly fired, so as to be of close texture, and, as far as possible, unabsorbent. Under these two conditions, external coloured terra cotta may last in this climate for centuries.

Near akin to this material, but of finer sort, is that which has been adopted for the finer kind of ware, which, indeed is a Lambeth faïence. You see here some examples of this most recent application of a new material to new uses. We here have to deal with a totally different thing to the stoneware I have described. The painting is indeed under glaze, and the body is fine enough to take the most delicate touches of the artist's pencil. A miniature could be most perfectly executed on this body, and it is obvious that we have here the groundwork of a future fictile art that may exceed or absorb all others. I need not enlarge on the permanence of these works, their imperishable surface and constitution, their brilliancy and pleasant texture; all these qualities

are appreciated at a glance; but a deeper interest lies in the fact, that on these plaques and dishes, on these walls and slabs, the artist sees his ideas grow under his hand, and feels that his art is not a mere luxury, but is the useful attendant on the architect, who with its aid cheers up a dark passage with its patterned brightness, or quiets down some glaring wall with a sober gloss of deep tones. The artist on faïence feels his freedom, and can either tell some tale of Venetian grandeur, or give point to the association of the house he decorates, by bringing out some family or household history, or may lay the whole field of nature under contribution for forms of loveliness and grace. The feeling for the work will be all the more profound from the conviction that his work is doomed to be everlasting. No fragment can disappear unless it is wilfully destroyed, no fading of fugitive colours, no drying up of pigments, no rotting canvass to destroy his work; all his surfaces must remain fresh till the New Zealander of the far future excavates them from the overwhelmed cities of the north.

I call your attention to a slab with a figure of the lady in the wood, from Comus, to several plaques, plates, slabs, and to these stove tiles, which are intended to form a decoration worthy of a fine room, and serve the more useful end of warming it at the same time.

A recent writer has justly remarked:—

"The one thing wanting doubtless, or rather the one thing not abundant, is invention. This has led our people to divert their technical knowledge and capacity into imitations. The Majolica and Palissy wares have been travestied rather than copied, and English potters have not feared to attempt to imitate the quite inimitable faïence of "Henri Deux," but our great potters have done worthier things than these, and much admirable and even original work is annually turned out from their kilns. Painting on faïence, plates, dishes, and plaques, is perhaps the direction in which our English pottery art is likely most to excel. If the public will school itself to see the truest merit in a quiet harmonious colouring, in flowing lines, in simple subjects not over elaborated, in a broad treatment of light and shadow, in short, in a style suited, as all true styles should be, to the exigencies of the materials employed, then we may hope that the painters will give up a certain forcible, jaunty, flashy mode of decoration, with gaudy, garish colouring which has begun to prevail, and that British pottery will continue to hold its present supremacy.*

Thus out of this newest material we may expect a growth of new systems of decoration, external and internal. Many communities have painted their houses outside. Genoa, Verona, and Venice all in their day had painted houses. No trace, or not more than a trace, remains to this day. If we can conceive painted cities coming into existence again, what a rich store of contemporaneous history and incident we might lay up for the future by painting on our public buildings or private houses the events of our day. If this could be done, we should change the character of our architecture at once; and I cannot but hope the day will come when the depressing and lifeless miles and miles of streets in our great towns will be less repellent to the man of taste than they now are; or, without going so far as a Venetian, who would gladly have painted the glories of his republic all over his house, inside and out, we can well imagine how changed would be the aspect of our streets if rich and bright colour alone, without pictures, could be grafted on to our ordinary brick construction. I am convinced that we have no adequate idea of what changes we should originate in our comfort and our external effects if we could vanquish the national antipathy to colour, which has led us to glory in the soot-grimed architecture of our streets, and which has led the average householder to consider a white and gold drawing-room the height and depth of elegant taste. It may be said that this universal production of coloured decoration, of figure painting, and ornament everywhere, inside and outside our houses, is a Utopian dream; that the artists competent to carry out this work could never be found, or if found could only work at such a high rate of payment as practically to prohibit the application of colour in the way I long to see it done.

The answer to this objection is simple. The Lambeth School of Art has produced all that you see here, and a hundred times more than you see here; not one of those stoneware pots but is the distinct production of our students; not one bit of faïence but has been painted by them; and I am happy to reflect that Mr. Doulton has made no demand on us that we have been unable to supply. It goes much farther still. When the success of these stoneware pots was assured, after 1871, a manufacturer attempted to make them, and share with Messrs. Doulton the success their ware had achieved. His artist was a Lambeth student. The Fulham potteries are now producing excellent stoneware vessels, ornamented with taste, and decorated with delicate modelling. The artist and modeller, and his relatives, who do these works, are Lambeth students, so we may claim not only to have educated artists for our own requirements, but to have educated them for all the trade.

There is no mystery in this. There is cleverness enough in England, there is exquisite taste, and endless invention in Englishmen and English women. There is high aim and steady application to make these gifts useful to themselves and their nation, but they lack education. The South Kensington Art School system has failed to develop the splendid resources of this country's artistic-minded people.

It will fail to the end of the chapter, so long as the conception of a theoretical art school is made at South Kensington; and all schools, whether they are in Lambeth or Oxford, in Glasgow or Cheltenham, in Limerick or Edinburgh, are forced to fit that conception, or pay for it, in the shape of short subsidies, adverse reports, and the many little signs of having fallen out of favour with the authorities.

What a small school in a Lambeth lane has done under all kinds of adverse circumstances surely could be done, in a different form no doubt, by every school in the country, and would be done if masters and managers had the self-dependence that would allow them to say they would have no regard for a South Kensington regulation if it went clearly against the best interests of their school—a self-dependence that would lead them to consider, first, the welfare of their students and the demands of local manufactures, and last of all, whether their students were to be worked down to the South Kensington standard, on which it grants its "payments on results."

It is unfortunately the case that the manufac-

* Ludwig Ritter, "New Quarterly," January, 1874.

tures and the art school are, in nearly every case I know of, antagonists. South Kensington does not take account of manufactures. The aim of too many art-masters, for whom every excuse is to be made, is to work their students to the South Kensington standard, for payments on results; that done, all is well. They get a handsome subsidy, and a congratulatory report from head-quarters. But what have the students got, and how is the manufacturers' demand for artistic help met?

The secret of this failure to meet the wants of the day lies in a nutshell. All great schools of ornamental art have either grown up side by side with great high-art schools in painting, sculpture, or architecture, or they have been actually produced by the active life of one or all of these great arts. The study of the human figure is the only basis on which a truly great school of art can ever rest. The greater includes the less. The training in many arts that the figure painter goes through produces at the same time the designer of ornament. He has but to change his practice; his principles are common to both sections of art.

A law so universally recognised in all European States where art is cultivated is unknown at South Kensington. I scarcely expect to be believed when I say that of the ten great gold medals offered to the schools, two are for still-life painting; not one for drawing from the life; or that if an art school student should happen to take a medal in the Royal Academy, he may not compete for any figure prize at South Kensington.

South Kensington never produced a figure designer yet. I have heard it said in this room that it had never produced an ornamental designer. Then what is this great institution doing? It is "paying on results," provided they are not too good. Until this state of things is changed, we shall find French modellers giving the work of the largest Staffordshire potters a European fame; French modellers making the works of our great silversmith and electrotypist; Belgian stone-carvers cutting Romanism into Protestant reredos; and Germans, whose name is "Legion," and whose motto is *Ubique*, filling our drawing offices all over the country.

These things should not be. They need not be. Our English hands are as skilful, our heads as clear, our thoughts as poetical, our lives as high as any other people who fill our best paid artistic offices in our largest manufacturing houses.

There is no other reason for their presence than this—we are uneducated; we have thought, but are dumb, and art-language has not been taught us. The proof lies before you. Not one of those students who has done the least thing on that table, covered as it is with objects of endless originality and invention, but has been brought up, or is now being brought up, to draw the figure.

The Art School is necessary; the study of the figure is necessary; hard work on the part of masters and students is necessary; but these receive the full reward for their labour, when the manufacturer takes possession, so to speak, of the power that has been educated for him, when he comes to a school and asks, as he has a perfect right to ask, for trained minds and skilful hands, who will enter into his plans, and take an unselfish interest in his efforts to beautify his wares for the sake of the art that both master and student should love. And happy the school if it can find a manufacturer who is willing to pay the artist liberally for his graceful thoughts, large minded enough to acknowledge the influence the work of the artist has had on his productions, and generous in proclaiming the manner and gifts of his workmen. I say happy are the members of that school who can see the practical end of their study opened to them by the appreciative encouragement of the local manufacturer. I too am happy in thus publicly recognising the debt we owe, masters and students alike of Lambeth School of Art, to Mr. Henry Doulton.

DISCUSSION.

The Chairman said he could not refrain from bearing his tribute of thanks to Mr. Henry Doulton, and the Doulton family generally, for the great encouragement they had given to that particular art. It had been his pleasure to have the honour of Mr. Henry Doulton's acquaintance for many years in connection with the manufacture of materials of a very rude and useful kind connected with sanitary works, and he had also had the honour of being acquainted with Mr. Cresy, referred to in the paper. Without Mr. Doulton, the commencement of the art could not have been made; there might have been the genius in individuals, but if there had not been the will to produce the articles, and perseverance in presenting them, there could have been no growth. Mr. Doulton was fortunate in having the valuable assistance of Mr. Sparkes, a man endowed with the true love and fire for genius in the art, as the paper read that evening showed. Pottery was about the oldest art known; it was at least as old as history, for in the first written records of art mention was made of the potter's wheel. As the clay was moulded under the hands of artists in the earliest times, so was it now; and only within the last 20 years had the idea of power, other than the human hands, been brought in to give the rotatory motion to the wheel. Twenty years ago, when in Staffordshire, nothing of the kind was known, but at Messrs. Doulton's steam-power was now in use, and probably elsewhere. The manufacture of pottery was practised years ago in China, Hindustan, and Japan, the latter place producing some most exquisite decorated porcelain work. Everyone knew that pottery existed in Etruria, and the Etrurian Empire was known more at the present day by its buried pottery than by its buildings remaining on the surface of the earth; for the specimens which were being continually dug up, as sound as on the day when they were buried, shewed the extent of the empire. Mr. Doulton, by his works, was writing history in a more permanent and tangible form than the most eloquent historian could ever do, for in the growth of his manufacture and in the beautiful specimens on the table he was putting into shape a material which would endure long after the most superb marble that decorated the metropolis had crumbled into ruins; and many of these articles being placed below the surface, would endure as long as the present state of things lasted. With regard to colour, he quite agreed with Mr. Sparkes that they had too little of refined taste in this country. It was a disputed point whether or not the Greek temples were painted; but one of the first German architects had told him that he was of opinion that all the exquisite temples, the ruins of which alone remained, were in their days of glory enriched with colour; and that he believed the Greeks used marble chiefly because it was a good material to paint upon. It was well known that Gibson was thought to have gone too far in venturing to colour some of his beautiful statues, but still he thought he was

improving his work by the application of colour to a certain extent.

Mr. Bailey handed the Chairman two old manuscript books, which had been discovered under rather curious circumstances at the Fulham Pottery, of which he was the director. They gave various receipts for a number of mixtures of clay; amongst others one for china, which he had tried at the request of the lady who found these books, and found it answer very well. The books were dated 1692, and 1698, and the manufactory at Fulham could be traced back as early as 1650, as was shown in a recent work by Professor Jewitt. He was endeavouring to follow out in some degree the artistic productions of Mr. Doulton, and though he could not yet equal him, he yet had some skilful artists, especially M. Casin, formerly director of the School of Art at Tours, and Mr. Martin. Mr. Stinton, whom he saw present, formerly connected with the Royal Worcester Porcelain Works, had given him many valuable hints and much valuable advice in the works he had undertaken.

Mr. G. Wallis said it must be a source of unmixed satisfaction to every advocate of art education, and especially art education as applied to industry in this country, to see and hear what had been brought forward that evening. For many years he had watched the gradual progress and development of the pottery manufacture, and he felt that Mr. Sparkes had a field of operation before him which, although at first sight it did not appear very promising, was to his mind a subject of envy to other men similarly engaged in the business. He had been connected with schools of art for 30 years, and had always maintained that one of the great hindrances to all progress in design was what he might call the traditions of the market and workshops, which could only be removed by popular teaching. He had been the head-master of the schools of art at Spitalfields, Manchester, and Birmingham, and had always found the same difficulty existing in workshops, viz., men who had been brought up in the trade, who knew very little of science, and cared less about art, and who influenced those whose business it was to sell the wares. These persons did not like the idea of young men attending art schools, and ultimately supplanting themselves in their business. He had heard complaints from young men on this subject which had astonished him. To illustrate this, he asked them to imagine a large factory at Lambeth for the manufacture of Toby jugs and stoneware uglies, that Messrs. Doulton had an interest to the extent of many hundreds of thousands of pounds a year in the continual production and sale of these jugs throughout the country, and they might then imagine the state of things which he found existing in Manchester in 1843, and in Birmingham in 1851. Most people could remember the traditional brass chandelier in the shape of a gooseberry-bush turned upside down, an immense mass of brass work neither ornamental or useful, in which the question of applicability to use seemed not considered at all. Such, happily, was not the case now. The same thing applied to the case of calico printing in Manchester, where some years ago a man told him he had invented a machine to print fourteen colours at once, expecting to be congratulated, but his reply was that he had about eleven colours too many. Lambeth was not a particularly pleasant place, but he thought in relation to this question that the lines of Mr. Sparkes had fallen in pleasant places, because he had not been met by the old traditions but had been aided by Mr. Doulton in every way, and no doubt the latter gentleman would receive his reward. He thought they should congratulate Mr. Doulton, Mr. Sparkes, and the students, upon the success of their great effort. It had been a work of great perseverance, and he was glad to hear that they specially avoided imitations. The encouragement given to talented young men by sending them to the National Gallery to copy pictures was a great mistake. They should be sent into the fields to copy nature if they were ever to produce anything original. Every piece of pottery in itself showed a harmony of colour, and if a number of pieces were put together, as a whole, they also produced a harmonious result. The words which most struck him in the paper were, "Happy are the members of that school who can see the practical end of their study opened to them by the appreciative encouragement of the local manufacturers." If the various manufacturers would unite for the encouragement of art, then much more would be done than at present, but in two many instances manufactures hung back, fearing if they helped themselves they would also assist their rivals. There had however been noble exceptions, notably in the case of Herbert Minton, who founded the school at Stoke, and Mr. Heghman who founded the School of Art at Nottingham for the manufacture of lace. He hoped that manufacturers would unite together in this good work, since by so doing they would do good to the country and elevate themselves, their neighbours, and all mankind.

Mr. Stinton said he had hardly ever been so gratified in his life as he had been by Mr. Sparkes' address, which showed throughout the fire of genius and a genuine love and knowledge of art. He was sorry to say true artistic principles were yet far from being generally acknowledged, for he had lately visited the Albert Memorial, and he considered the vast mass of white around the base, and the bas-reliefs, in anything but good taste. Such things were not to be found in nature. The lily of the field, the cloud in the sky, and the kine in the meadow, all were beautiful, and well worthy of study, and all pleased and satisfied the eye, but he could not say as much for the base of the beautiful work in Kensington-gardens. A little colour was required to relieve it in some way. The proper mode of treatment, especially in regard to colour, was best ascertained by a reverent study of nature; but he was very much pleased with the harmonious effect of the various objects displayed that evening.

The Chairman then proposed a cordial vote of thanks to Mr. Sparkes, and also to Messrs. Doulton, for the way in which they had taken up and encouraged this important application of art to manufactures. He had long had the pleasure of Mr. Henry Doulton's acquaintance, and he knew that one of the main objects of that gentleman's ambition was to leave behind him, not riches, but the reputation of having spent a useful life.

Mr. Doulton said he had been much pleased at the recognition which Mr. Sparkes had given of the labours of the various artists who had been engaged in the production of the articles now exhibited; and he could only say for himself, that it had been a source of deep pleasure to himself to be associated with those who took so deep an interest in their work. This was a mechanical and scientific, rather than an artistic age, leading naturally to constant repetition, but when he found, as he did, that all engaged in this kind of work threw their whole energies into it, and seemed to take a pleasure in doing their best, he could but do what in him lay to aid their efforts in bringing about the results which were now before the meeting. He always experienced a feeling almost of shame at the want of decoration in our public buildings after a visit to the Continent, and had therefore been turning his attention lately, with the aid of Mr. Sparkes and Mr. Tinworth, to the production of something suitable for architectural purposes and to the English climate. Their success might already be partially appreciated; and he hoped that architects would soon introduce some of this material, which would defy time and weather, into their structures. Mr. Wallis had referred to the Lambeth works as exceptional, but he could assure him there had been an immense amount of *vis inertiæ* to overcome; and even at the present day he was constantly asked by his travellers to produce a new variety of the Toby jug, so great was the demand for that article. One of his greatest sources of satisfaction was to notice the progress made by the Lambeth

School of Art students, one at least of whom he believed would yet make for himself a brilliant reputation in the highest walks of art.

COMMITTEE ON THE MEANS OF PROTECTING THE METROPOLIS AGAINST CONFLAGRATION.

Mr. Tozer, the superintendent of the Manchester Fire Brigade, gives evidence as follows:—

Q.—For how many years were you the chief clerk to Mr. Braidwood, the organiser of the Fire Brigade in London?

A.—My father was in the service before me, and I, as a youth, used, of my own accord, to attend fires. I joined the London Fire Brigade in 1851, and remained there until 1862, when I took this place. I was employed by the Government to take charge of the fire-engines for the protection of the hospitals at Scutari, and to drill the cavalry in the use of them.

Q.—Now, what are the chief differences of the organisation of the brigade in Manchester, as compared with the present organisation in London, there being in Manchester a constant system of supply of water at high pressure, and that supply maintained as a public service under the municipality?

A.—The police and the fire-brigade are under the Watch Committee, and the forces act together, and, under one general command, render to each other mutual assistance, with great advantage over the separate organisation in London.

Q.—Then you would be of opinion that, for efficiency in London, the fire-brigade or fire organisation should be comprised in the police organisation.

A.—Yes, certainly, it should be under the management of the police authorities. People run here naturally, on the occurrence of any calamity, for aid to the police; and here at every police-station is a hose cart or a fire-escape on wheels, each containing a hose of 200 yards, and all the necessary appliances to attain two effective streams of water from the mains, that is to say, a power equal to two hand-engines of seven-inch cylinders.

Q.—What is the distance of the police-stations from each other?

A.—Half-a-mile. Then, in addition to the central station, where two steam-engines are kept, we have at two police-stations, hand-fire-engines; and, in the mill district there is a fire-station, where two hand-engines are kept. At each fire-station, the firemen reside with their families, and there is also a large stock of hose and apparatus at each, to be used in case of the need of higher pressure than that given in the water-main.

Q.—What is the proportion of these minor police-stations to the combined engine and police-stations, with steam or hand-power engines?

A.—About three to one.

Q.—Now, what is the result of this arrangement in the extinction of fire? In what proportion does the smaller and nearer engine, for attaching the hose to the main, suffice?

A.—In the twelve months, ending 29th September, 1872, there were 306 fires, and in only eight cases was it necessary to use the engines to assist the smaller appliances.

Q.—Is this a common proportion?

A.—Yes. In the three years preceding there were 841 fires, and it was only necessary in 21 cases to use the engines for a high-pressure supply.

Q.—What would be the average height of the jet?

A.—About 80 feet.

Q.—What description of hose do you use?

A.—Flaxen. In London they use leather hose.

Q.—What do you find to be the advantages of the flaxen hose?

A.—One advantage is its portability; thus, 50 yards of flaxen hose with one connection weighs 35lbs.; the same length in leather weighs 250lbs., with four connections. It would take one man more than four times as long to run out the same length of leather hose with the four connections that it takes to run out the lighter flaxen hose with one connection. For fire extinction, lightness of apparatus and rapid movement of men is the great *desideratum*. Another advantage of canvas hose is the comparative ease with which it can be kept in order. Canvas hose simply requires to be kept thoroughly dry, whereas leather hose requires to be well oiled and brushed frequently to be kept in order.

Q.—In a new arrangement, how near to each other for fire prevention would you place the hydrants?

A.—In the neighbourhood of serious risks, not more than thirty yards. In ordinary risks, that is of shops and residences, from fifty to one hundred yards.

Q.—It has been proposed in London that for street cleansing there should be a hydrant at every fifty yards in constant use. that it may be constantly ready for fire, and the hose kept near so that the policeman who first saw the fire, or anyone else, might apply the jet at once. What is your opinion of that suggestion?

A.—If that were accomplished, London would be very well protected indeed.

Q.—What is the result in Manchester of your system in preventing the total destruction of houses?

A.—There has not been one case of the total destruction of a property in three years.

Q.—What has been the loss of life in Manchester as compared with the loss of life from fire in London?

A.—We have had but three cases of the loss of life from a building taking fire during the last twelve years. During the last year there were 297 fires, of which 275 were slight and 23 serious. Of these 275 fires, 1 was extinguished by the larger engines and firemen; 7 by the hand-engines and firemen, 44 by the hand-pumps and firemen, 65 by the firemen and police, 41 by the police alone, and 82 by the owners and other persons. Where more than one-sixth of the property is destroyed it is ranked as serious, and the proportion so classed is three per cent.

The opinion of Mr. Tozer, derived from his long experience in the metropolis, as well as in Manchester, being requested on the evidence received, he transmitted the following letter in answer:—

Chief Fire Station, Jackson's-row, Manchester, September, 1873.

Sir,—I beg to acknowledge the receipt of your note of the 28th ult., inclosing evidence eollected by the Committee on the Means of Protecting the Metropolis from Conflagration, and to state as follows:—

I have carefully read over the whole of the evidence collected by your Committee, and I think if some of the suggestions were carried out in the present organisation for the protection of London from fire, more especially two, viz., 1stly, to lay a main of communication between each water company's supply; and, 2ndly, to have the turncock of each district residing at the fire-engine station, serious losses by fire would then be less frequent.

In reference to that part of your note, asking me to state what, in my experience and observation, are the chief causes of fire to be guarded against—1st. by administrative means; 2nd. by structural means—I can corroborate the evidence of Mr. Swanton; but may in addition observe that about 33 per cent. of the fires in London are due to carelessness; 33 per cent. to accident; and about 33 per cent. are wilful or the causes not ascertained.

The following is a list of the most common causes of fires:—

Carelessness with candles, lamps, and moveable lights, not gas.—*Prevention*—More caution.

Sparks from fire.—*Prevention*—Wire spark-guards.

Curtains too near, or blown into lights.—*Prevention*—Close windows before lighting up; not to have moveable

gas-brackets near curtains without being protected with glass shades or wire-guards.

Flues and fire-places improperly constructed.—*Prevention*—Not to have any timher nearer than twelve inches thereto; not to convert ordinary flues into furnace flues; not to allow the flue, or fireplace, to get defective; not to fire a chimney; not to allow ashes to accumulate upon hearths; not to be without a fender.

Gas-fittings defective, or carelessless of fitters.—*Prevention*—All work to be examined and passed by a puhlic inspector; all pipes to be exposed; all moveahle lights to have guards; all fittings and meters to be examined frequently.

Leaving fire and lights near children and drunken persons.—*Prevention*—Remove the cause.

The classification of goods in buildings for their safe keeping appears to me not to have had sufficient consideration. We often find very great carelessness, and in some instances ignorance in the storing of goods not of themselves dangerous, but in contact with others liable to spontaneous ignition. Many fires, especially in docks and warehouses, occur from these causes, such as a mixture of oil, jute, or other vegetable fibres in one building. I would recommend for consideration that goods not inflammable be stored in ordinary buildings, brick-built, and slated roofs, with ordinary wood floors, joists, and doors.

Goods inflammable, not combustible.—Brick-built and slated roofs, 3-inch plank floors, 3-inch oak doors, ordinary wood staircase, with oak treads, and doors on every landing; all partitions to be of brick or oak; 18-inch party walls, carried three feet above ridge of roof.

Goods combustible of a solid nature, detached wooden shed buildings, not nearer than fifty yards from any dwelling-house, and on the highest ground in the neighbourhood.

Goods combustible of a liquid nature, in brick vaults below street level, with openings, closed by grids, to main sewer, and in the lowest ground of the district. All liquid goods should be stored below the level of the street.

To severely punish by fine or imprisonment any person causing a fire by gross carelesness (see Geo. III., cap. 78, sec. 84).

It would benefit the public if all the present Building Acts were repealed in the United Kingdom, and one General Building and Fire Prevention Act was passed, after consulting some of the most experienced engineers, architects, and firemen.

The legislature would, no doubt, he recommended to frame restrictions to guard against the carelessness of plumbers, gas-fitters, and builders in drawing out their plans, and ignorance on the part of many of their workmen, also in having the work inspected during its progress, and after completion.

In the said Act the fire-brigade and water companies should have their powers strictly defined. There should also be some restriction placed upon insurance companies, as regards the careless way in which risks are often taken. It is no uncommon thing for a man to effect an insurance (without an inspection of the risk) for more than double the value of the property. The question is, what is the object? I will admit, sometimes it is ignorance, but may that not lead to temptation? The man finds husiness is slack, stock is old, bills to meet, notice to quit, a chance of making a few pounds, the spark is applied, the fire is not discovered in time, it spreads, he gets his claim, and, sooner or later, he will try it again.

Fire insurance, as a rule, makes people careless, but if a man was not allowed to have more than two-thirds of his loss covered, I have no doubt that 25 per cent. of all the fires that occur would not have happened.

The general public appear to me not to have given that consideration to the causes from which fires are likely to arise in certain trades they ought to have done. If they had, so many instances of serious fires occurring in all parts of the country, from a want of suitable precaution, might have been prevented. The opportunity to go into a subject on which I have devoted much thought is my excuse for this long letter.—I am, &c.,

ALFRED TOZER, Superintendent.

Mr. T. H. BERREY, of the Manchester Corporation Water Works, gave evidence as follows:—

Q.—You have at Manchester directed the change of system from an intermittent to a constant supply of water. You will oblige the Committee by informing them at what average expense the change was accomplished?

A.—The change from an intermittent to a constant supply was made gradually, the existing water fittings being simply put into good repair. The cost of this work did not exceed, on the average, ten shillings per house.

Q.—You are well acquainted with the general condition of the metropolis and of its water supply. Do you see any difficulty in accomplishing the like change, at the like cost, or with large contracts at a less cost?

A.—If the same plan were pursued, and no additional apparatus introduced, I see no difficulty, with a proper inspection, in carrying out the constant supply in the metropolis, and at a similar cost; but I am strongly of opinion that the introduction of the water-closet supply cistern, as now used in Manchester, with the establishment of a testing and stamping office, as now also in existence here (wherehy inferior water fittings would be prevented being fixed), would tend very greatly to prevent waste, and would, under proper and experienced management, be more heneficial to the water companies, as much less water would then be used under the constant supply than the intermittent.

Q.—Do you perceive any insuperable difficulties in differences of pressure in the different districts of the metropolis?

A.—The difficulties are considerably less in the metropolis than in Manchester, as the pressure is much less in the former than in the latter place.

Q.—Do you concur in the opinion, as respects the metropolis, that the entire water supply should be under unity of management and regulation for the prevention of fire, and for other public purposes, and that management a responsible public one?

A.—I am clearly of that opinion, from a long experience, and that the water supply would he the most efficient if all the companies were united and placed under public control. The cost of management and distribution also would unquestionably be very considerably diminished.

Q.—In respect to the question of the prevention of fires, you have seen the information given by Mr. Tozer; could you add anything to it?

A.—I quite concur in the information given by Mr. Tozer; hut may, in addition, state that the water in Manchester being constantly on at high pressure, it is indispensahle that the improved hydrants in use here should be at once fixed to the mains in the metropolis, in order that the water may he immediately ohtained, in case of fire, without the delay and loss now caused by the use of the antiquated fire-plugs connected to the water mains in the metropolis.

Q.—The question of the constant supply for the prevention of fires opens up the whole question of the constant supply for domestic, sanitary, and other purposes. Will you state the advantages derived in Manchester from the change of system to a public service, and the advantages derivahle to the metropolis from a like change?

A.—Previous to the water works becoming the property of the Corporation, they were in the hands of a company, who supplied the city on the intermittent system, the minimum time of delivery being ten minutes, and the maximum five hours. This company was unable to provide for the public wants of the city, and any

increase of the supply was quite out of the question, in consequence of the limited nature of their works. The Corporation then purchased such works, and constructed new and important works at Woodhead, of which J. F. Bateman, Esq., C.E., was the engineer. The result has been the introduction of an abundant supply of the best water in the country, at constant high pressure, and this has enabled the fire brigade, as a rule, to extinquish fires from the mains without the aid of a fire-engine. The public advantages also have been very great, as the water is supplied constantly for domestic purposes at 9d. in the £ on the poor-rate assessment, this being less than any other town in the United Kingdom. Under these circumstances, why should not the metropolis possess similar advantages?

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

The Committee for Wine held its tenth meeting on Saturday, 25th April, at the Royal Albert Hall. The following gentlemen were present:—Lord Skelmersdale, Sir Daniel Cooper, Bart., Mr. Robert Gray, Mr. C. H. Kayser, Mr. C. L. de Luc, Mr. H. Matthiessen, Mr. E. Apps Smith, and Mr. Cole, C.B. The Committee recommended that the Wine Exhibition should be open on May 1st, and that the public be admitted to the cellars between the hours of 12 and 5.

The following is the returns of admissions for the third week, ending April 25:—Season tickets, 1,061; payment, 10,599; total, 11,660.

The French Galleries, the Indian Court, and the exhibition of wine in the vaults of the Royal Albert Hall are still in course of arrangement. They will be opened to the public on the earliest day possible.

COMMISSION ON SCIENTIFIC EDUCATION.

Fourth Report.

(*Continued from page* 526.)

After dealing with the British Museum, the National Botanical Gardens, and the Museum of the College of Surgeons, as detailed in the last number of the *Journal*, the report goes on to discuss the Museum of Practical Geology and the South Kensington Museum.

(IV.) The Museum of Practical Geology.

The Museum of Practical Geology is administered by a Director, who is responsible to the Lords of the Committee of Privy Council on Education. Its primary object is to exhibit the industrial applications of geology and the kindred sciences, with special reference to the mineral resources of this country and its dependencies; and the collection of British fossil and rock specimens, illustrating the Geological Survey of Great Britain. The ollowing collections are comprised in the Museum:—

(*a*.) Specimens of British stones and marbles used for constructive and decorative purposes.

(*b*.) A collection of British, colonial, and foreign minerals, specially selected for their economic value, or for their importance to the student of mineralogy, geology, and mining.

(*c*.) Metallurgical series, comprising specimens illustrating the smelting of ores and the industrial applications of metals and metallurgical products.

(*d*.) Models of mines, mining machinery, ore-dressing apparatus, furnaces, and metallurgical appliances, with geological and topographical models of special localities.

(*e*.) A collection of specimens showing the technological applications of clays, and the history and present position of British ceramic art; with illustrations of manufactures in glass and enamels.

(*f*.) The Palæontological Collections, embracing a large series of British fossils.

(*g*.) A Petrological Collection, comprising specimens of the rocks of Great Britain.

(*h*.) A Library of upwards of 20,000 volumes.

The Museum is open gratuitously to the public twice a week, from 10 a.m. till 10 p.m., and three times a week from 10 a.m. till 4 or 5 p.m., with one month's vacation. According to the evidence, the evening opening of this Museum is attended with considerable expense without corresponding advantage. Professor N. Story-Maskelyne, the present Keeper of the Mineralogical Department of the British Museum, expresses the opinion that the Mineralogical Collections from the British Museum might find a more suitable resting-place in the Geological Museum than at South Kensington. While calling attention to this opinion, the Commissioners decline to base any recommendation upon it. In connection with this subject they merely "refer to the insufficiency of the accommodation in the museum in Jermyn-street for the staff of the Geological Survey of Great Britan."

(V.) The South Kensington Museum, and its Branch Museum at Bethnal Green.

The following is the full text of the account given by the Commission of the Museum and its dependendencies:—

The South Kensington Museum is administered by a Director, who is responsible to the Lords of the Committee of Privy Council on Education.

Though, from special circumstances, the Art Collections of this Museum have been up to the present time most developed, it has contained, from its earliest days, several collections of a scientific nature. Those at present existing are:—

1. The Food Collection.
2. The Animal Products Collection.
3. The Structure and Building Materials Collection.
4. Models of Machinery, Ships, and Military and Naval Appliances.
5. Collections illustrating Economic Entomology and Forestry.
6. Collections illustrating Fish Culture.
7. The Educational Collections.
8. The Patent Museum.

The Food Collection.—This collection, which was commenced in 1858, has been formed with a view to showing first, the chemical composition of the various substances used as food; secondly, the sources from which all varieties of food are obtained; and, thirdly, the various substances used for adulteration, and the best methods of detecting them.

A duplicate collection of the chemical analyses of food is used for circulation among country schools, and large descriptive labels are supplied to the managers of country museums who may apply for them.

The Animal Products Collection.—This collection was established by the Commissioners for the Exhibition of 1851, who observed that, whilst the public possessed, in the Museums of Kew and Jermyn-street, collections illustrative of the economic applications of mineral and vegetable substances, there was no representation of the uses of the animal kingdom. The collection consists of animal substances employed in textile manufactures and clothing; substances used for domestic and ornamental purposes; pigments and dyes yielded by animals; animal substances used in pharmacy and in perfumery; and the application of waste matters, together with illustrations of the processes of manufacture.

We have been informed that, for want of space, this collection has been but little developed of late years.

Construction and Building Materials Collection.—This collection had its origin in a large number of models and specimens which were presented to the Commissioners for the Exhibition of 1851 at its close. In 1859 the collection had become so extensive from gifts, especially from the exhibitions in London and Paris, that the classified catalogue formed a most useful book of reference on the subject, and was largely sold as such.

The collection consists of the following objects:—Building stones, marbles and slates, cements and plasters, bricks of every description, tiles for roofing, flooring, and wall decoration, terra cottas, drain pipes, asphalte and bitumen, iron and metal work, woods applicable to building purposes, glass and its application, models of buildings and construction, paper hangings, papier-mâché work, architectural drawings and plans.

In connexion with this Museum, numerous experiments on the strength of materials have been carried on, the results of which have been published in the catalogues.

Models of Machinery, Ships, and Military and Naval Appliances.—

This collection consists principally of models of marine engines, ships, and guns. But there are also specimens and models of machinery of a different character, such as the Jacquard loom, the Whitworth measuring machine, and the Babbage calculating machine.

Collections illustrating Economic Entomology and Forestry.—A collection of economic entomology is now is course of formation. It is intended to enable the public to distinguish insects injurious to man from those that work to his advantage, and to illustrate the best means of destroying those which are injurious, or of mitigating the ravages committed by them.

This collection, in its relation to forestry, contains specimens of the various kinds of timber attacked by insects, the insects themselves in various stages of growth, and the appearance of the foliage and bark when attacked. The best known means of destroying the insects are also indicated.

Collection illustrating Fish Culture.—This collection illustrates the artificial breeding of fish, the protection of rivers, methods of capture of fish, &c. All or nearly all the collection belongs to Mr. Buckland (Inspector of Salmon Fisheries). It is on loan to the Museum.

The Educational Collections.—These collections comprise:—1. A library of books bearing on education, in which education in science is largely represented, and 2. A collection of school furniture and fittings, philosophical instruments, apparatus for scientific and other instruction, specimens and diagrams of natural history, including mineralogy and geology, and other educational appliances, such as drawing materials, &c.

The origin of the library and collections is due to an educational exhibition formed by the Society of Arts, and held in St. Martin's-hall in the summer of 1854. When this exhibition closed, many of the contents, English and foreign, were placed by the exhibitors at the disposal of the Society, and a strong desire was expressed that it should become a permanent institution. The collection thus formed was offered to and accepted by the Government.

The chief manufacturers of educational appliances and publishers of school books have largely contributed, and numerous gifts have been received from foreign Governments, especially at the close of the exhibitions of 1862 and 1871. In consequence of the great demand for educational works on scientific subjects, the vote for purchases has of late years been largely expended in strengthening the library and collections in this direction.

Special collections of apparatus for teaching the various branches of science have lately been formed. Duplicate sets of these are circulated in the country.

The total number of books and pamphlets in the library exceeds 30,000.

A reading-room, ill-adapted and much too small for the purpose as it has been stated in evidence, is attached to the library. It is open during the same hours as the Museum, and is chiefly frequented by students, teachers, clergymen, school managers, and others who wish to consult special books, or to become acquainted with the best educational works on the various subjects.

The Patent Museum.—In connection with the South Kensington Museum, but under the control of the Commissioners of Patents, there is also a Patent Museum, consisting of a collection of patented and other inventions, ill-accommodated in a building which is much too small for the proper display of the objects. The collection belongs partly to the Commissioners of Patents, partly to the Commissioners for the Exhibition of 1851, and partly to private persons; it contains many most interesting specimens, especially a series illustrating the history of the steam engine from its earliest days.

After the above description, the Commissioners proceed to discuss the proposed additions to the Scientific Collections of the South Kensington Museum. They commence by pointing out the "contrast afforded by the British Museum Collections, dealing with biology, geology, and mineralogy; the Jermyn-street Collections, dealing with geology (scientific and economic), mineralogy, mining, and metallurgy; the Kew Collections, dealing with botany, on the one hand; and, on the other hand, the collections in the scientific department in the South Kensington Museum (including the Patent Museum), where alone has any attempt been made to collect together, in a museum, objects illustrating the experimental sciences."

They regret that there is at present no national collection of the instruments used in the investigation of mechanical, chemical, or physical laws; although such collections are of great importance to persons interested in the experimental sciences, especially to teachers. They add an expression of opinion, "that the recent progress in these sciences, and the daily increasing demand for knowledge concerning them make it desirable that the national collections should be increased in this direction."

Although the question hardly comes under their cognisance, they refer to the "Museum of Mechanical Inventions," advocated by the Committee on the Patent Office Library and Museum. In the plan put forward by that Committee they agree, and likewise in the suggested application to such purposes of the large surplus that has accrued from the surplus of patent fees paid by inventors (amounting, at the end of 1871, to £923,741 8s. 11d.). The Commissioners say:—

"We consider that this fund, which is derived in great part from the applications of scientific principles to various uses in the arts and industries of the country, would be very properly spent in bettering some of the conditions on which invention and discovery depend; and we are of opinion that, among the uses to which such a fund could be most advantageously applied, the establishment of such a museum of scientific apparatus as that which we contemplate, would rank among the most important; and we are convinced that such a museum would have a material influence upon the spread of scientific instruction throughout the country, and would, therefore, largely foster invention and discovery.

"We accordingly recommend the formation of a collection of physical and mechanical instruments; and we submit for consideration whether it may not be expedient that this collection, the collection of the Patent Museum, and of the scientific and educational department of the South Kensington Museum, should be united and placed under the authority of a Minister of State.

"Whether this union be effected or not, we are of opinion that it is desirable that the scientific collections now placed at South Kensington should be subjected to a critical revision, with a view to restricting them to such objects as are of national interest or utility."

(VI.) Other Scientific Collections.

The only public scientific museums and botanic gardens, besides those already referred to, which receive direct aid from the Government, are the Edinburgh and Dublin Museums, and the Botanic Gardens of those cities. The Edinburgh Museum consists of a scientific and also of an industrial collection. The natural history collection, formed by the University of Edinburgh, was some years ago handed over to the Government, and was lodged in the same building with the industrial museum, adjoining the university, and placed under the general charge of the Professor of Natural History and the Director of the Industrial Museum.

With regard to the Edinburgh Museum, the Commissioners consider that as a Commission on the Education Department has already reported, there is no need for any further expression of opinion. They merely notice that the arrangement recommended by the Special Commissioners and adopted by the Government is the appointment of a fully qualified Naturalist, under the administrative control of the Director of the Museum.

The Royal Dublin Society act as trustees of the Museum of Natural History (including mineralogy and geology), of the Botanic Gardens and Botanical Museum, Glasnevin, and of the Library, and are responsible for their administration. These establishments are wholly supported by public funds, provided for annually in the estimates of the Science and Art Department. The Agricultural Museum is supported by the Royal Dublin Society out of its own funds.

The institution in St. Stephen's-green, formerly known as the Museum of Irish Industry, has ceased to exist under that name; and the School of Science applied to Mining and the Arts, which was attached to it, has been converted into a Royal College of Science. All the collections of the Industrial Museum (with the exception of the Portlock collections of Irish flora and fauna, which have been transferred to the Royal Dublin Society) are still retained, and with the collections of the Geological Survey, are exhibited in tho building in St. Stephen's-green. The collections comprise objects illustrative of building materials, mining, metallurgy, and fuel; of ceramic and glass manufactures; and of vegetable and chemical products. These collections are in charge of the Curator of the Museum. The Director of the Geological Survey of Ireland has charge of the palæontological and rock collections; the former has been made by the Geological Survey; the latter purchased, out of the funds of the museum, to illustrate lectures and for the use of the officers of the survey.

The report next proceeds to consider in general terms the numerous local museums supported from independent sources in various parts of the kingdom. Most, if not all

of these include natural history collections, often associated with other objects, especially with specimens illustrative of archæology and ethnology, and sometimes of the industrial arts. Some of them are under the government of municipal bodies; some are maintained by the inhabitants of the locality, and are managed by committees or governors elected by the contributors; while others are connected with scientific societies or naturalists' clubs. They are of very various merit. The Commissioners refer with special commendation to the Manchester Natural History and Geological Societies as specimens of valuable institutions of this class. Such as these, however, are rare; and even in the ease of many of the larger and more important museums, many specimens are often required for the completion of their series. The museums of less important towns are generally very incomplete. They too often consist of specimens unconnected witb each other, the gifts of travellers possessing little or no knowledge of natural history. When they are the results of the labours of some local naturalist, or of some provincial society, they are of exceptional, and sometimes of great, value; but such collections are unfrequent.

The Commissioners consider such museums as useful for cultivating a taste for natural history studies, but they urge that if they are to be of any real value they must include collections, typical and local, of geology, botany, and zoology. They add that museums of this character might be used advantageously for purposes of class instruction, and for demonstrations by competent scientific persons.

After a reference to their second report, in which they recommended that greater facilities be given to obtain grants for buildings and for museum fittings, the Commissioners remark that in many towns of considerable population, there are no museums, or only such as are worthless for purposes of even popular instruction. Yet some of these towns are well fitted by situation to become centres of scientific instruction to considerable groups of population. "If a science school, provided with laboratories and a typical museum, existed in such a centre, it would exercise a most important influence on the scientific education of the district. The museum would also be eminently attractive and humanising as a place of popular resort."

The Commissioners, therefore, consider that "the establishment of such museums where they do not exist, as well as their maintenance and improvement where they have already been formed, should be promoted by aid from the State."

Such might either take the form of money, or of contributions of specimens coming into the possession of the Government which may not be required by the British Museum or other public collections.

With regard to this question, great variety of opinion was expressed by the witnesses examined, but the Commissioners came to the opinion, on a careful examination of the whole question, that the organisation of any systematic distribution of specimens would present considerable difficulties.

They considered that the authorities of tho British Museum should be empowered to dispose, by gift, in favour of the local museums, of any specimens which may be ascertained to be duplicates, and which can be dealt with by the present staff, but they do not think that the task of supplying all the wants of provincial museums could possibly be imposed on the present officers of the British Museum. However they express a conviction that, "without some method of collection and distribution, or some efficient supervision, provincial museums will probably generally continue to be, as most of them now are, very inadequately supplied with specimens, imperfectly arranged, and insufficient to prove in any way a source either to popular attraction, or of more complete instruction."

Looking at all these points, they finally recommend with regard to provincial museums:—

1. That, in connexion with the Science and Art Section of the Education Department, qualified naturalists be appointed to direct the collection of specimens in order to supply whatever deficiencies exist in the more important provincial museums; and also, in order to organise typical museums, to be sent by the Department of Science and Art into the provinces to such science schools as may be reported to be likely to make them sufficient in struments of scientific instruction.

2. That a system of inspection of provincial museums be organised with a view of reporting on their condition, and on the extent to which they are usefully employed, and whether the conditions of the loan or grant from the Department of Science and Art have been fulfilled.

(*To be continued.*)

TELEGRAPHING THE BUDGET.

The following, from *Iron*, gives a good instance of the present development of the telegraphic system:—

The Chancellor of the Exchequer's budget-sheet was transmitted to the provinces chiefly by means of the Wheatstone system.

During the night no fewer than half a million of words, or 250 columns equalling those of the *Times*, were transmitted over the wires from the Central Telegraph Station between 6 p.m. and 2 a.m. Seeing, too, that a large quantity of this news had to be delivered to two or more newspapers in the same town, it is estimated that certainly not fewer than a million of words were so delivered throughout the United Kingdom during the period in question; so that the combined provincial newspapers of Friday morning may be said to have contained 500 columns of telegraphed matter relating to the proceedings in Parliament on Thursday night. The transmission of this mass of news was effected chiefly by the Wheatstone instrument, of which as many as 25 were called into use on the occasion. This instrument doubles, and in some cases even triples, the carrying capacity of a wire; so that if a proportionate number of comparatively unskilled operators be employed in preparing the messages beforehand, they can be worked through the telegraphic thrashing machine called the "Wheatstone Transmitter," at a speed varying from 120 to 60 words a minute. The preparation consists in punching holes on a strip of paper to represent the dot, the dash, and the space of the Morse alphabet; and this crochet-like tape represents at the sending end of the wire what the ink marks do at the distant end. It is estimated that ten miles of perforated tape were consumed in the operations of Thursday night; that seven and a half millions of separate holes, or perforations, had to be made; and five and a-half millions of distinct symbols recorded all over the country in transmitting the half million of words already referred to.

From the House of Commons were worked six of the fastest recording instruments in use by the Post-office, and seated before them at the Central Station were an equal number of the most experienced operators of the staff. Some nimbly passed along the printed slip as it was unwound from the instrument with one hand, and wrote down its contents with the other, while others ignored the record altogether, and translated the clicking sounds of the armature into the living words of the Chancellor of the Exchequer. But not all, nor, perhaps even the greater portion, of the Parliamentary n of Thursday was received at the Central Station on these instruments. Large batches streamed in all the evening from the offices of the news associations and the different newspapers; and at eight o'clock the pressure was at its height. The south-west gallery in the new Post-office was crowded with instruments devoted solely to the transmission of news, and a hundred pairs of hands or more were busily employed either in preparing the perforated slip, or in regulating its motion through the transmitter.

Ten wires were devoted to the service of Great Britain, and eleven to Ireland. These special wires were ex-

clusively worked on the Wheatstone principle, and for this purpose as many as twenty-five perforating machines were brought into use. Some of these were worked by hand only, and chattered away briskly as they received a succession of blows from the right or left hand of the small boys in attendance. Others had the pneumatic system applied to them; and although only played upon with a piano-like touch by the operator, they produced three separate slips or tapes with as great ease as the others produced one. The crotchet-looking tape pervaded every corner of the gallery, and was apt to wind itself fantastically round your legs if you stepped out of the beaten track for a moment to investigate more closely the somewhat striking scene.

The House adjourned at 12·15 am., and by one o'clock the whole of the news had been disposed of except to Ireland—where, of course, the working is much slower owing to the cable—and to one or two unimportant places in England. The staff of the Central Telegraph Station after eight p.m., consisted of 260 persons, and of these 150 were specially employed in connection with the transmission of news. Prior to eight o'clock as many, probably, as 500 persons were on duty, the bulk of whom were young ladies. At eight o'clock the young ladies entirely disappeared, and their places were taken by the male clerks, of whom the night staff is wholly composed. The change was effected without any perceptible influence on the work, and the busy scene continued up till midnight.

CORRESPONDENCE.

PATENT-OFFICE MUSEUM.

Sir,—Whatever explanations and excuses can be brought by successive administrations to explain the present shameful condition of the Patent-office Museum, the public cannot resist the conviction that something more than want of space has caused that valuable collection to reach its present abnormal state.

The proximity and magnificence of South Kensington Museum, devoted exclusively to art, is as cogent an argument in favour of a home in some degree suitable for her elder brother and more active colleague, as could well be advanced.

While, on turning to similar collections in America and other nations we see that "they have their reward," in possessing museums of magnificent dimensions and immense value from their completeness and arrangement, almost guaranteeing continuous mental activity on the part of the public.

Nor have these results been attained by extraordinary means. On the contrary, the secret lies in being guided by, instead of attempting to guide, and stop natural development.

One fact is certain, that the present stoppage of development in this country will be as clearly and indelibly registered and as perplexing as any break in succession of animal life in geological formations has been.

A still more lamentable result of the present *régime* is exemplified in the case of the "Watt Collection." This valuable assemblage of models, thought out and made by James Watt, has never yet seen daylight, and remain in Birmingham as he left them. Why? Mr. Boulton Watt will not hand them over except on the modest condition that space be provided for their reception—a condition beyond the elastic powers of this national institution for now many years.

Turning from this and other similar dreary results of past management to examine a few indications of the present, the prospect is not much brighter.

It was with unfeigned regret I read a notice of an appointment of Curator to the Patent-office Museum, in so far as it proved that this branch is still looked upon as existing more for the officials than the officials for it. There may be doubt as to whether this appointment should be filled by an engineer or a gentleman of education. If by the former, I have no doubt many able men will be found candidates; if by the latter (the qualifications of the present nominee), a gross injustice has been done to gentlemen of many years standing in the department, adding to a general, a special education for this peculiarly technical department.

No one can fail observing that in thus acting, the Commissioners, by removing all reasonable hope, reduce the efficiency of their staff from that of an intelligent organisation to a heartless officialism;—with no other object than the hastening of a much-needed reform,—I am, &c., C. E.

Westminster, 18th April, 1874.

GENERAL NOTES.

Alexandra Palace.—It is intended to exhibit at the Alexandra Palace a series of models of the characteristic dwellings of different countries of the world, occupied by groups of figures representing their inhabitants in the actual clothing of the country, and surrounded by the furniture, domestic utensils, &c., in common use, so as to form illustrations of the manners, customs, &c., of the places represented. In furtherance of this object Dr. Dresser has constructed full-sized models of a modern Moorish and a modern Egyptian house. The first represents the dwelling of a middle-class, or rather superior, man in Morocco, and is an exact copy of a modern Moorish villa. The interior of the Egyptian villa is copied from an example in Cairo.

Anthropological and Archæological Congress.—An Anthropological and Archæological Congress of all nations is announced to open at Stockholm on the 7th of August. During the sitting of the Congress excursions will be made to the dolmens and burial places of the surrounding district. A small subscription, about ten shillings, confers the right of being present at the meetings, and members will be allowed to travel on the Swedish railways at half fares. Further particulars may be obtained of the Secretary of the Congress, Mr. Hildebrand, of Stockholm, or at the Museum of Natural History, Brussels.

NOTICES.

THE LIBRARY.

The following works have been presented to the Library:—

The Technical History of Commerce, by John Yeats, LL.D. Presented by the Author.

The Natural History of the Raw Materials of Commerce, by John Yeats, LL.D. Presented by the Author.

The Growth and Vicissitudes of Commerce from B.C. 1500 to A.D. 1789, by John Yeats, LL.D. Presented by the Author.

A Manual of Record and Existing Commerce from 1789 to 1872, by John Yeats, LL.D. Presented by the Author.

Memoirs of the Literary and Philosophical Society of Manchester. 3rd series. Vol. 4. Presented by the Society.

Proceedings of the Literary and Philosophical Society of Manchester. Vols. 8 to 10. Presented by the Society.

Report of the Commissioners of Education (Washington, U.S.) for the year 1872.

The Addresses and Journal of Proceedings of the National Education Association, 1871 (St. Louis) and 1872 (Boston, Massachusetts).

The Circular of Information of the Bureau of Education, Washington.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque, Post-office order, or Cheque Bank cheque, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

The following arrangements for Wednesday evenings have been made:—

MAY 6.—"On Timber Houses." By FRANK E. THICKE, Esq.

MAY 13.—"On the Importance of a Special Organisation for the Diffusion of Sanitary Knowledge." By Major-General SYNGE.

May 20th.—"On Simplicity as the Essential Element of Safety and Efficiency in the Working of Railways." By CAPTAIN H. W. TYLER.

The specimens lent by Mr. H. Doulton to illustrate the paper by Mr. Sparkes, on Lambeth Pottery, will remain in view for members and their friends till Monday next, the 4th inst.

INDIAN SECTION.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

MAY 1. (this evening).—"On the Ruins of Cambodia, and the Antiquities of Indo-China." By H. G. KENNEDY, Esq.

CHEMICAL SECTION.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

MAY 8.—"On Sugar Refining, with special reference to Finzel's Sugar Crystals." By Dr. GRIFFIN. On this evening DR. LETHEBY, M.B., M.A., &c., will preside.

MAY 22.—"On the Manufacture of Chlorine." By W. WELDON, Esq., F.C.S.

CANTOR LECTURES.

The third course will be by Professor BARFF, M.A., "On Carbon and Certain Compounds of Carbon treated principally in reference to Heating and Illuminating Purposes."

The object of these lectures is to explain the scientific principles involved in all heating and illuminating processes, and to apply those principles to practical purposes. The absorbent properties of carbon will be briefly noticed.

LECTURE IV.—MAY 4.

Liquid compounds containing carbon and hydrogen, and fuel.

LECTURE V.—MAY 11.

Coal gas, its composition and purification, and its illuminating properties.

LECTURE VI.—MAY 18.

Heat of combustion; how heat is communicated, and how quantity of heat is determined.

LECTURE VII.—MAY 25.

Consideration of furnaces, stoves, lamps, &c., in which the principles stated in the former lectures will be applied.

All the above Meetings and Lectures are open to Members, each of whom has the privilege of introducing two friends.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

MON. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Professor Barff, M.A., "On Carbon and Certain Compounds of Carbon treated principally in reference to Heating and Illuminating Purposes." (Lecture IV.)
Farmers' Club, Salisbury-square, E.C., 5½ p.m. Mr. Henry Clark, "On Land Laws and Landlords."
Royal Institution, Albemarle-street, W., 2 p.m. General Monthly Meeting.
Society of Engineers, 6, Westminster-chambers, 7½. Mr. N. J. Suckling, "On Modern Systems of Generating Steam."
Royal United Service Institution, Whitehall-yard, 8½ p.m. 1. Captain W. S. Croudace, "On Croudace's Stellar Azimuth Compass, and Ordnance Night Light-Vane or Collimator." 2. Mr. A. Folkard, "On Improvements in Apparatus for Lowering, Hoisting, Engaging, and Freeing Ships' Boats."
Entomological, 12, Bedford-row, W.C., 7 p.m.
British Architects, 9, Conduit-street, W., 8 p.m. Annual Meeting.
Medical, 11, Chandos-street, W., 8 p.m.
Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m. Rev. A. I. McCaul, "On Biblical Interpretation in connection with Science."
London Institution, Finsbury-circus, E.C., 4 p.m. Prof. Bentley, "Elementary Botany" (Lecture VI. and last.)

TUES. ...Royal Institution, Albemarle-street, W., 3 p.m. Professor Rutherford, "On the Nervous System."
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. 1. Continued Discussion "On the Fixed Signals of Railways;" and, time permitting, 2. Mr. Joseph M'C. Meadows, "On Peat Fuel Machinery."
Pathological, 53, Berners-street, Oxford-street, W., 8 p.m.
Biblical Archæology, 9, Conduit-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m.
Sculptors of England, 7, Gower-street, W.C., 7 p.m.

WED....SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Frank E. Thicke, "On Timber Houses."
Microscopical, King's College, W.C., 8 p.m. Mr. H. J. Slack, "On certain Silica Films Artificially Produced."

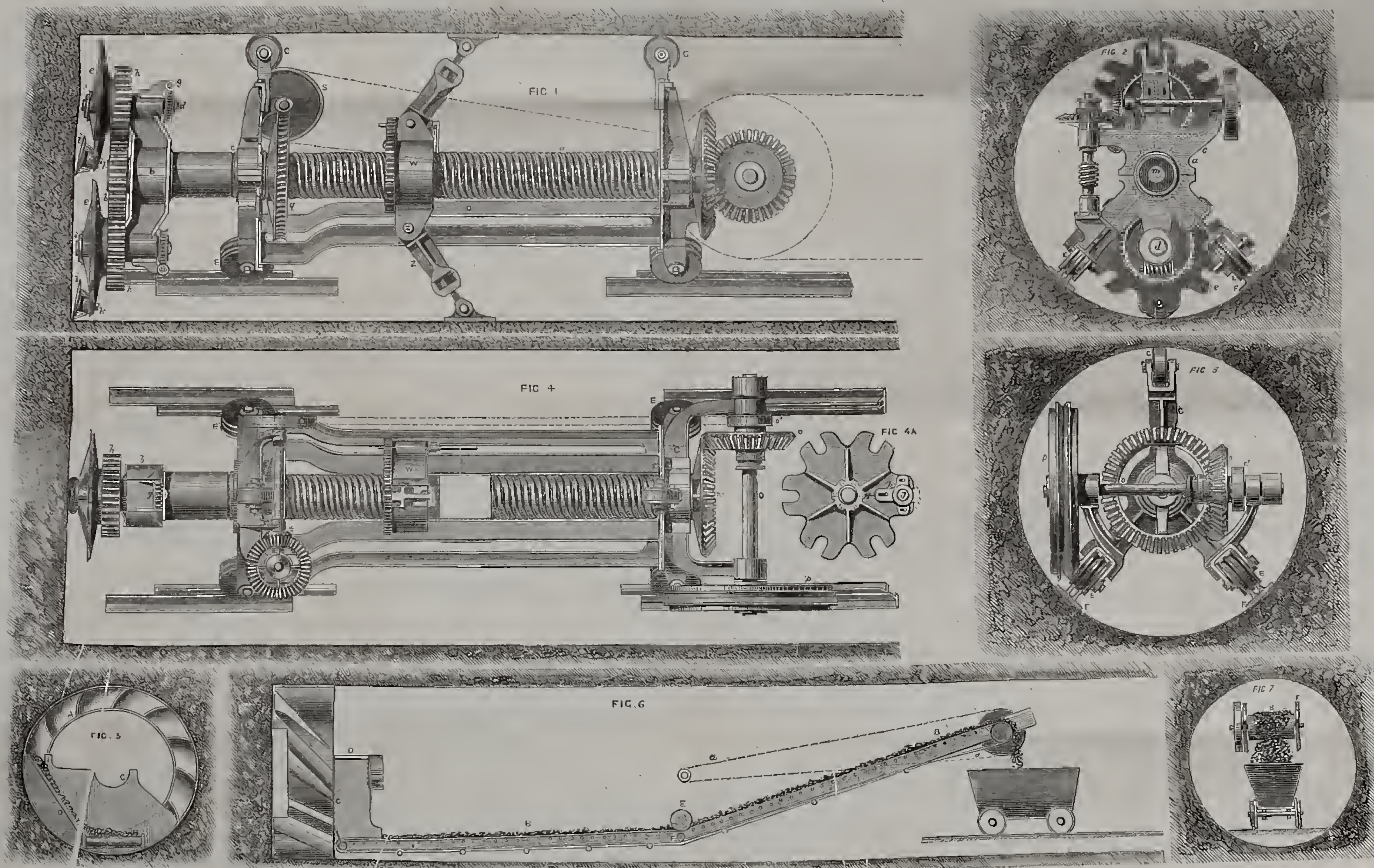
THUR....Royal, Burlington House, W., 8½ p.m.
Antiquaries, Somerset House, W.C., 8½ p.m.
Linnæan, Burlington House, W., 8 p.m. 1. Dr. Willemoes Suhm, "Atlantic Crustacea from the *Challenger* Expedition." 2. Rev. T. R. R. Stebbing, "On a New Atlantic Sphœromid, &c." 3. Mr. A. G. Butler, "Descriptions of five new species of *Gouglcptes*."
Chemical, Burlington House, W., 8 p.m. 1. Dr. Gladstone and Mr. A. Tribe, "On the Constitution of Urea, by Dr. Tourmaise. Researches on the Action of the Copper Zinc Couple on Organic Bodies. Part VII. On the Chlorides of Ethylene and Ethyleclene." 2. Mr. A. Liversidge, "On a Mineral from New Caledonia."
Society for the Encouragement of Fine Arts, 9, Conduit-street, W. 8 p.m. Mr. Brindley Richards, "National Music of Wales."
Royal Institution, Albemarle-street, W., 3 p.m. Mr. W. N. Hartley, "On the Atmosphere and its Relations to Life."
Royal Society Club, Willis's Rooms, St. James's, S.W. 6 p.m.

FRI.......SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Chemical Section.) Dr. Griffin, "On Sugar Refining, with Special Reference to Finzel's Sugar Crystals."
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Mr. Sedley Taylor, "An Historical Enigma in the trial of Galileo before the Inquisition."
Astronomical, Somerset House, W.C., 8 p.m.
Quekett Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.
Literary and Artistic, 7, Gower-street, W.C., 7 p.m.
New Shakspere Society, University College, W.C., 8 p.m. Rev. F. G. Fleay, "On the Authorship of 'Timon of Athens' and 'Pericles.'"

SAT......Royal Institution, Albemarle-street, W., 3 p.m. Mr. R. A. Proctor, "On the Planetary System."
Royal Botanic, Inner Circle, Regent's-park, N.W. 3¾ p.m.

[The Editor will be glad to receive notices of papers for insertion in the above list.]

BRUNTON'S TUNNELLING MACHINE.



JOURNAL OF THE SOCIETY OF ARTS.

No. 1,120. VOL. XXII.

FRIDAY, MAY 8, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ECONOMICAL USE OF FUEL.

A meeting of this Committee was held at the Testing Houses, Western Annexe, International Exhibition, on Saturday, 2nd instant. Present—Major-General F. Eardley-Wilmot, R.A., F.R.S. (in the chair); Dr. Mann, Rev. A. Rigg, and Capt. Scott, R.N., with Mr. Le Neve Foster, Secretary, and Mr. S. W. Davies.

PUBLIC MUSEUMS AND GALLERIES.

On the recommendation of the Committee, the Council have fixed Wednesday, May 20, for a General Meeting on this subject. To it will be invited the Mayors of Corporations, Chairmen of Art and Science Schools, and others interested in the question. The object of the meeting will be to name a Deputation to wait upon the Prime Minister, and urge upon him the importance of bringing all National Museums and Galleries under the authority of a Minister of the Crown, with direct responsibility to Parliament; and also of causing all such Museums to be made conducive to the advancement of Education and Technical Instruction. The chair will be taken by the Right Hon. Lord HAMPTON, at 12 o'clock.

AFRICAN SECTION.

In the report of the meeting of this Section on April 28, which appeared in last week's *Journal*, it was stated that the chair had been taken by Vice-Admiral Erasmus Ommanney, C.B., F.R.S., whereas Mr. Hyde Clarke really occupied the chair on this occasion, and his name ought to have appeared in the published report.

INTERNATIONAL EXHIBITION OF 1874.

The Council have resolved to offer the Society's Gold and Silver Medals in connection with the International Exhibition of 1874.

A gold and a silver medal is offered in each class, and these medals will be given for any object exhibited which, in the opinion of the Council, shows paramount or very great excellence, whether in respect of the final result, the machinery, method of production, or novelty.

PROCEEDINGS OF THE SOCIETY.

DEPUTATION ON FACILITATING THE PURCHASE OF CONSOLS IN SMALL SUMS THROUGH THE POST-OFFICE.

On Tuesday last, a deputation, consisting of the following gentlemen, waited upon the Chancellor of the Exchequer in Downing-street:—Major-General F. Eardley-Wilmot, R.A., F.R.S., Mr. George C. T. Bartley, Mr. Hyde Clarke, C. J. Freake, Mr. Seymour Teulon, Mr. W. M. Wilkinson, with Mr. P. Le Neve Foster, and Mr. H. T. Wood.

Major-General F. Eardley-Wilmot, Chairman of the Council, in introducing the deputation, said Mr. Bartley had prepared a paper, which had already been forwarded, and he would explain it further on that occasion. He would only remind the Chancellor of the Exchequer how important it was to induce provident habits amongst the poorer classes, and so encourage them to feel that they had a stake in the country.

Mr. G. C. T. Bartley said the subject was not a new one, it had been before the world many years, but unfortunately it had not been carried out. In his relations with Lord Derby in connection with the Provident Knowledge Society, he took occasion some months ago to bring this matter before his Lordship, and his Lordship stated that he thought something might be done, suggesting at the same time that a scheme should be framed to carry out the object. He (Mr. Bartley) had accordingly prepared a scheme, which he ventured now to bring forward. He did not say it was the only scheme, or the right one; but he thought it was one that might be worked, and the experiment would tend to show whether any change was necessary or not. His idea was to facilitate the purchase of consols in small sums through the Post-office. He proposed in the first place to open what he called an "English Fund Department," where the English funds could be bought, at the central Post-office and the chief district offices of London, and at large post-offices of the provinces, but at the present, not in small districts. For the purpose of paying the dividends, he proposed to divide £100 into 60 parts of £1 13s. 4d. nominal value, which would give interest at the rate of 1s. a year, or 6d. a half-year. The arrangement for selling would be by a person going to the office and filling up a form; and once a week, or oftener as the case might be, each local department should send to the central office a statement forward, showing the amount required; that would be handed over to the government broker, who would buy that sum. He would then send a statement back to the local department, showing the price at which the sums were bought, which would be the market price. This, he thought, was an essential thing, otherwise there would be a sort of sentimental grievance felt. He proposed that the purchaser should have a stock certificate, which would not bear his name, but his name would be on the counterfoil; so that the loss of the document would not necessarily involve the loss of his savings. With regard to paying dividends, he proposed that they should be paid six months after the purchase in each case; thus there would not be a heavy strain each half year upon the Post-office; and in this way a person might accumulate small sums and purchase a permanent annuity coming in every month. Of course it would be essential that it should be self-supporting. He thought it would be recognised at once, that the arrangements for buying and selling should be so managed that there should be nothing to pay for it out of the Imperial taxation. By a system of small stamps, of 2d. or 3d. each, according to the transactions, calculating that £100,000

a year would be sold, which he thought was a small estimate, would quite recompense the cost of the whole transaction. Then as the dividends would be paid half-yearly, he thought it would be very little trouble, inasmuch as it must be remembered that each local fund department would merely have the paying of its own depositors. There would be no ledgering, as in the Post-office, and the whole account of stock would stand in the name of the Post-office in the Bank of England books. So that if £100,000 were held in this way by the public, the whole interest would be paid in a lump sum to the Post-office, and they would divide it out in the ordinary way. He thought a great deal of good would be done by the experiment, which, if successful, could be extended to any length desirable, and if not, it could be given up without serious harm to the country. He thought what General Wilmot had said was obvious as to the advantage of giving all classes a stake in the country. He did not suggest that this scheme should take the place, in any way, of that which existed, or that it should be antagonistic to the Post-office. He thought the Post-office Savings Banks should be a means of feeding this, and was quite convinced that the greater the number of facilities for saving and self-improvement which existed, the greater would be the number who took advantage of them. The number of friendly societies which existed showed that there was a very large spirit of saving which required to be brought into these channels.

The Chancellor of the Exchequer inquired whether Mr. Bartley thought a man could be said to have more of a stake in the country if he held Consols than if he held any other kind of property?

Mr. Bartley said he thought there was a sentimental idea that people could not purchase consols as he proposed, and it was very difficult to teach them how to do it. Besides that, very few brokers would care to be inundated with applications to buy £2 or £3 worth of Consols, and the machinery for distributing the dividends would not meet that case. A very great point was the matter of interest. At present there was an idea that the Post-office Savings Banks only giving $2\frac{1}{2}$ per cent., richer persons who invested in the funds got more, viz., something over 3 per cent. That would be a substantial advantage, which it was desirable the public should obtain. Inasmuch as at the present time the Post-office Savings Banks did not allow people to hold more than a certain sum, money would flow in, and persons would become holders of the funds. He thought it would tend to increase the price of the funds, which meant an increase of facility with which the country could borrow money at any moment.

The Chancellor of the Exchequer asked whether that facility would not be taken advantage of by persons considerably above the class in whom Mr. Bartley was interested.

Mr. Bartley said it would cost too much to buy £100 of Consols in the way he proposed, because it would be loading the transaction greatly, whereas a few pence upon each small transaction would not be regarded.

Mr. Hyde Clarke said he looked upon the matter as one of great importance, and of a practical character. The principle was familiar from what had taken place in France from a very early period, where it had produced very great political and financial advantages. It cultivated the habit of saving to a degree which was recognised in the enormous subscriptions of what he might call the weaker classes of the French to the various loans, and had been of material assistance in raising the provisions for the war indemnity. He thought they should see whether they could not adopt the same system here. He had occasion to come in contact with a great many small investors, who had facilities for investments in foreign bonds, which they had not in consols. A person in the country looked upon it as a trouble to go up to a broker, or even to carry out the transaction through a local bank. If such a scheme as was proposed were carried out, it would tend very materially to increase the habit of saving in the community, which was a matter of great importance, if they looked to the example of France and Holland, and would likewise add to the strength of the empire at large, It mattered little, no doubt, whether a man had a stake in Consols, in one sense, or in any other form of public investment. But these things were matter of sentiment to a certain extent, and it was always desirable to have the sentiment of the community bound up with the welfare of the country.

The Chancellor of the Exchequer—I think we must all feel it is a matter of very great national importance to encourage in every possible way the provident habits of the people; to encourage them to save, and to invest their savings for their own benefit. According to one expression which has been used two or three times to-day, and which is a very common one, it is important to make them feel that they have a stake in the country. As I said before, you can hardly say that a man really has a greater stake in the country because he has his money in Consols than he would have if he had it in shares in companies that were of a public character, or had it in land, or in many other classes of securities, or even in the savings banks, which are more or less in the hands of the Government. Every man who has property is interested in the maintenance of order in the general welfare of the country. I dare say it may have its advantages, that a certain number of the poorer classes should become investors in Consols. But I confess I do not at present see that the case is so strong as to outweigh some of the drawbacks which I see to the proposal. The scheme that Mr. Bartley has drawn up is an ingenious one, which seems to be workable, and undoubtedly deserves great commendation; but I think it would have the disadvantage at the present moment of rather overloading our Post-office department, which has a great deal of work not originally belonging to it now assigned to it in connection with the Money Order-office, the Savings Bank, and other matters; in the management of the great department of the telegraphs; and upon which I have a sort of rival scheme to Mr. Bartley's, and want to throw a little additional work in connection with friendly societies. Therefore, I think, before we can positively say we would like to charge it with anything new, we ought to consider what it is proposed to throw upon it, and what it is capable of performing. I should like to consider very carefully how far this scheme would be workable with the existing machinery, how far the machinery would require strengthening or reorganising, in order to enable the Post-office fairly and properly to do its own work and undertake this additional burden. The fact is, the Post-office has of late years undertaken so much and done it so well, that an idea is growing in the country that it is capable of undertaking any amount of work. Therefore, I am afraid we must take care we do not overload it and break it down. All I can say is, that we will look upon this matter with care, and by no means with disfavour, but we must consider it carefully as regards both what the Post-office is capable of doing with reference to this scheme, and also its bearing upon other kinds of saving. I cannot help thinking it would come into competition with the Post-office Savings Banks to a considerable extent. I cannot help thinking, also, it might come into competition with the friendly societies to some considerable extent; and, therefore it must be seen how it can be brought into harmony before we could undertake it. At the same time, it is no doubt an ingenious plan, one which reflects great credit upon Mr. Bartley, and deserves very careful consideration.

The following is the detailed draft scheme, drawn up by Mr. George C. T. Bartley :—

1. It is desirable to give facilities for persons in every class of life to become holders of stock in the English Funds. At the present time it is difficult for many to do this, and without the intervention of a broker it is impossible. The industrial classes do not understand the technical points required for purchasing in the ordinary way, and it is a matter of great difficulty to teach them. Besides this, very few brokers would care to transact business on so small a scale in any great quantity, and the minimum commission charged, viz., 1s., is a high fee for very small dealings.

2. With a view to enable any person to purchase Consols in small sums, and to receive the dividends half-yearly without fear of being imposed upon, and yet in a perfectly simple way, the following scheme is suggested.

3. The General Post-office in London, the District Post-offices in London, the General Post-offices in Edinburgh, Dublin, Liverpool, Manchester, Birmingham, Bristol, Hull, Glasgow, Belfast, and others which may be from time to time decided upon, to form a department, to be called the "English Fund Department," the General Post-office in London to be called also the "Central English Fund Department."

4. This English Fund Department at first, and until the work became extended, to be carried on chiefly in the evening by the staff now employed in the Post-office Savings Banks.

5. The work of the English Fund Department to be as follows :—

(*a*) The sale of English Funds to the public in sums as explained in Section 6.

(*b*) The re-purchase of such sums from the public.

(*c*) The transfer of the ownerships of such sums from one individual to another.

(*d*) The payment of the dividends half-yearly.

Regulations for the Sale of English Funds.

6. For the convenience of the dividend the £100 3 per Cent. Stock to be divided into 60 parts, that is, parts of the nominal value of £1 13s. 4d. each. These would each represent a dividend of 1s. a year or 6d. a half-year. This sum of £1 13s. 4d. stock to be the minimum amount purchasable, and a certificate (No. 1) to be issued for it. Certificate No. 2 to represent five such sums in one, that is, £8 6s. 8d. stock. Certificate No. 3 represent ten such sums in one, that is £16 13s. 4d. stock. These would bear interest at the rate respectively of 5s. and 10s. a year, or 2s. 6d. and 5s. a half-year.

7. A person wishing to purchase stock to leave at any one of the English Fund Departments (Section 3) a form of application duly filled up.

8. The manager of each English Fund Department to be required to send a statement [once] a week, say, on Wednesday, to the Central Department in London, stating the number of stock certificates required to be purchased.

9. The Central Department would total up the gross amount required each week from the various items sent in, and instruct their broker to purchase that amount of stock in the market in the ordinary way. This stock would be bought in the name and for the account of the English Fund Department, General Post-office, and the dividends would be paid in gross, to that department, without deducting income-tax.

10. The Central Department would each [Thursday] directly after the stock was purchased, inform each local English Fund Department of the price at which the stock had been purchased, including the commission, and would state the selling price to the public. This would be the nearest whole pence amount above the absolute cost.

11. On the purchaser presenting himself to complete his purchase, he would have to pay the balance between the deposit he had paid and the market price of the stock (Section 10) together with 3d. for the commission stamp. He would be required to sign the counterfoil retained by the English Fund Department, and he would be presented with the stock certificate.

12. This stock certificate would consequently be the owner's title to the stock, and he would have to produce it for his dividends, but as he would be the registered owner of it, the loss of the document would not necessarily involve absolute loss of his savings. The English Fund Department would have to hold itself free from all responsibility if this document be lost or presented by the wrong person, but it would be difficult for anyone to get the dividends or sell the certificate, as he would have to sign a receipt on the counterfoil of the stock certificate at the back, in the presence of the English Fund Department officers, as explained in Sections 21 and 24. As however the owner's name, address, and signature would not be on the face of the certificate, but only on the counterfoil retained by the English Fund Department, there would be little fear of fraud.

13. A special affidavit, signed in the presence of a clergyman or a justice of the peace, might be required of a person losing his certificate before a fresh one could be issued. A stamp of 1s. might be required to be placed on this.

14. Should the holder of stock at one English Fund Department require to have it transferred to another English Fund Department, he could do so by presenting himself with his certificate. The manager would satisfy himself with his identity, requiring him to fill up a form. This form the manager would then transmit to the Central Department, who would note it and forward it to the new English Fund Department.

15. For the convenience of the English Fund Department, and to reduce the labour of paying dividends, it might be arranged to issue a No. 2 or No. 3 certificate (Section 6) on application without charge. It might also be arranged to transfer, at the option of the holder, say even 15 certificates or £25 stock, standing in one name, direct on to the books of the Bank of England.

The Re-purchase of such Small Sums from the Public.

16. The mode of carrying on this business would be very similar to that of the sale above described. A person holding any number of certificates which he wished to sell to the English Fund Department would have to present himself at the English Fund Department with his certificates.

17. The manager, on being satisfied of his identity, would take the notice and the certificates attached and return a receipt.

18. The manager would retain the stock certificates and forward [once] a week on the same day as the purchases were made (Section 8) a notice to the Central Office, stating the amount required to be sold.

19. The Central Department would proceed to sell this amount of stock, in the open market, in the same way in which it was purchased, as above described (Section 9).

20. The Central Department would every [Thursday], directly after the stock had been sold, inform each local English Fund Department of the price at which the stock had been sold, including the commission, and would state the buying price for the public. This would be the nearest whole pence amount below the absolute cost.

21. On the seller presenting himself, with his receipt, to complete the sale, the amount would be handed to him on his signing a receipt, on which a fourpenny commission stamp would have to be attached.

22. The sale would have to be noted on the counterfoil, and the receipt sent to the Central Department.

The Transfer of the Ownership of such Sums of English Funds from One Owner to Another.

23. Any person wishing to sell or transfer his certificate to any individual other than to the English Fund Department, would proceed as follows:—The registered owner of the certificate, and the person to whom it was to be transferred, would have to present themselves at the English Fund Department. The manager having satisfied himself that the producer of the certificate was the registered owner in the usual way, would require him to fill up the form.

24. The purchaser or person to whom the certificate was to be transferred, would then sign the counterfoil, and the seller would sign the back of the certificate, on a 2d. stamp.

The Payment of the Dividends Half-Yearly.

25. The payments of the dividends would be half-yearly, and would be made at that English Fund Department where the stock was purchased, or to where it had been transferred (Section 14). The dividend on each certificate would be due the first Monday in the next month, six calendar months after the purchase was completed. Thus a certificate purchased in February would have the first dividend due on or after the first Monday in September, and subsequently in March and September. If taken out in April the dividends would be due in November and May.

26. The Central Department would keep an account of the gross purchases and sales made by each Local English Fund Department each month. On the last day of each month the Central Department would send each Local English Fund Department the amount necessary to pay the dividends of the following month.

27. The Local Department would make a monthly list from the counterfoils, and on each person presenting himself, with his certificate, he would be asked his name, and if the manager had any reason to doubt the honesty of the person, he might require his address and signature, and compare it with the counterfoil. Persons unable to attend might send a written order for the dividends, with their certificates.

28. As each certificate was paid it might be desirable to print or emboss the date on the face of it, so as to prevent any attempt at a second demand on account of the same certificate for the same dividend. The name on the Section 27 would, at the same time, be noted as paid, with the date of payment.

29. Once a year each Local English Fund Department would transmit a statement of paid and unpaid dividends to the Central Department, and remit whatever balances might remain in hand.

Financial Considerations.

30. The scheme thus proposed should, as a matter of course, be so arranged as to pay its own cost. It is believed that the commission and other stamps would amply do this.

31. *First as regards the expenses to the country.*

Let it be supposed that the sales per annum were £100,000 of stock, which would involve 60,000 transactions. The paper and printing might be paid for certainly by allowing a penny for each transaction, that is, 60,000 pence, or £250. The cost of clerical labour in issuing the certificates as above explained might be estimated at 1¼d. each, and as it is proposed to utilise the present staff of the Post-office in the evening for this work, many would be found willing to undertake it at this price. This would represent £312 10s. for the £100,000 stock. For an outlay therefore of £562 10s. the stock would be issued.

32. The cost of paying the dividend remains. For the first year only one half-yearly dividend would have to be paid, that is, 60,000 payments. These payments would be simple, would only involve a clerk's looking at the certificate, ticking the list as paid, and stamping the certificate as explained in Sections 27 and 28. No central ledgering, which is so costly, as is required in the Post-office Savings Banks, would be necessary, and it would seem that ½d. a transaction would be sufficient estimate for this work. A clerk could pay one a minute, and this would be 2s. an hour, and 6d. for printing and preparing lists, &c. The 60,000 at ½d. each would represent £125; this, added to the above £562 10s. would amount to £687 10s. for the cost of the first year.

33. The cost for the second year would be as follows:—

The payment of the two dividends or 120,000 transactions, at ½d. each, less ten per cent. presumed to be re-sold to the English Fund Department each year, that is, £225.

The cost of transfers, at ½d. each (see Sections 23, 24). Suppose 10 per cent. of the stock changes hands—that is, 6,000 transactions, £12 10s.

The cost of sales at 1d. each (see Sections 16 to 22). Suppose 10 per cent. of the stock is sold—that is, 6,000 transactions, £25.

The cost of duplicate certificates issued for lost ones and other accidental charges, say £25.

This would make the total for the year £287 10s., and it would, roughly speaking, be the annual cost of the second and subsequent years, though, strictly speaking, each year's cost would somewhat diminish.

34. *Secondly, as regards the receipts from the public.*

As regards the purchasing, the loading would be as follows:—

First the penny stamp on the application.

Second, the 3d. commission stamp on the certificate; and, thirdly, the profit on making the selling price to the public whole pence above the exact cost. This would on an average be say ½d., total 4½d. per transaction, or for the 60,000 transactions, £1,125.

35. The next item of receipt would be the interest on interest received. The gross dividends to the English Fund Department would be due twice a year, but the dividends to the holders would be due every six months, beginning the month after the purchase was effected (see Section 25). The dividends on £100,000 stock would be £1,500 every half-year. This would be paid out monthly, chiefly during the first three months after it was received by the English Fund Department, say £500 a month. The least amount of interest which would therefore be earned every half-year by the English Fund Department would be, on £500 for one month and on £500 for two months, which at 3 per cent. would amount to, say £4 for the first year, and £8 a year afterwards.

36. The next item of receipt would be the interest on deposits and on payments for certificates kept in hand till the account day on which the stock was paid for. As £1 deposit would be paid for each purchase—that is, £60,000 in the year—and as each of these deposits would have to be paid on an average three days before the purchase was made, it follows that the interest on deposits would be represented by the interest at 3 per cent. on £60,000 for three days, or £10 per annum. Further, as an average time of eight days would elapse between the purchase of the Consols by the broker and the account day on which he would have to pay for them, during which time the whole of the purchase money would have been paid by the public, it follows that about £90,000 would be in hand for eight days. This at the rate of 3 per cent. per annum equals just £60.

37. The receipts for the second and for each subsequent year might be estimated as follows:—

Sinking the balance of profit on first year, estimating it at somewhat less than 6 per cent., which would be a reasonable estimate, as we suppose 10 per cent. of the stock would be re-sold to the English Fund Department each year; say interest on this £30.

The re-sales by the public of 10 per cent. of the stock, that is, 6,000 transactions, each loaded with a twopenny and fourpenny stamp, that is at 6d. each, would make a total of £150.

Profit on making the selling price to the public whole

pence below cost, say, on an average, ½d. a transaction, or 6,000 transactions, £12 10s.

Stamps on transfer from one person to another, say 10 per cent. or 6,000 transactions at 2d., or £50.

Stamps for issuing duplicates for lost certificates, say 1 per cent., or 600 at 1s. each, £30.

Stamps for change of office, say 5 per cent. at 1d., or 3,000 transactions, that is £12 10s.

Stamps for delays in claiming dividends, &c., say 5 per cent. at 1d., or 3,000 transactions, that is £12 10d.

Interest on instalments, &c., as explained in Section 36, £70.

Interest on interest, as explained in Section 35, £8.

The total receipts would therefore be £374, and, deducting the costs, would leave a net balance for further contingencies of £87 10s.

GENERAL CONCLUSIONS.

38. This scheme could be tried in the few places named, or in some of them, without any staff being created for the purpose.

39. It would afford facility for small investments of savings.

40. As regards the income-tax, which would not be deducted, it must be remembered that the commission fees are high enough to prevent well-to-do persons from buying largely in this way for the purpose of avoiding the income-tax. It would not pay them to do so.

41. This scheme would avoid the difficulty so often felt by many persons with the Post-office Savings Banks, and which prevents not a few from investing in these banks, inasmuch as no one would know anything of a man's savings; anyone could save to any extent in a perfectly safe way, and he would get as large an interest as any one who invests in the funds.

42. From a philanthropic, social, and political point of view, the enabling all classes to become interested in the public funds is most desirable.

INDIAN SECTION.

A meeting of this Section was held on Friday, the 1st inst., HYDE CLARKE, Esq., Member of the Council, in the chair.

The paper read was—

REMARKS ON THE ANTIQUITIES OF SIAM AND CAMBOJA, WITH SOME NOTICE OF THE CONDITION OF THOSE COUNTRIES AT THE PRESENT DAY.

By H. G. Kennedy, Esq.

I am deeply conscious of the insufficiency of my acquaintance with the subject which I have undertaken to bring forward this evening, and I must therefore begin by claiming the indulgence of my auditors for one who can command but little leisure to devote to Oriental inquiries, and who during five years spent in Indo-China had practically none of the needful books at command. Having, however, been honoured with a request from this Society to give them the benefit of such knowledge as I possess respecting two countries with which Englishmen are but little acquainted, I thought it right to comply with the suggestion, and for two reasons.

1. The past history of Indo-China, or rather of Camboja—for it is round that kingdom that the chief interest centres—though capable, as I believe, of considerable elucidation, yet requires for its investigation the co-operative efforts of scholars who may chance to reside in various Eastern countries, as well as of the learned who make Oriental antiquities their special study at home. This will become more apparent when I enter into detail. The hope of awakening others of greater ability and scholarship than I possess to the study of the remarkable and mysterious ruins of Camboja, and of inducing further research into the notices of that great kingdom contained in the anuals of China, and it may well be of other neighbouring nations, is the principal reason which has led me to present myself before you to-night. A further motive is because I think it much to be regretted that the results of Dr. Bastian's travels in Indo-China, which are contained in several very elaborate volumes, have been left untranslated—sealed books to those who are unfamiliar with German.

There is not, so far as I am aware, a single book in the English language which gives anything like a complete account of the Indo-Chinese nations, their manners, antiquities, and their religions. Yet much might be done to fill that gap in our libraries by the translation of Dr. Bastian's valuable works.

Having thus, with all humility, made confession of my own ignorance, and having explained the two objects which I have in view, let me now proceed to my subject. And first of Siam.

Dr. Thorel, one of the members of the recent French Scientific Expedition into Indo-China, remarks, in his notice of the anthropology of the Indo-Chinese races,* that the Cambojans, the Laotians, the Siamese, and probably the Birmans "possess a genuine civilisation . . . . uniformly based on the Chinese civilisation." This conclusion I venture to think is open to considerable question. The Laotians and the Siamese are well known to be branches of the same stock. As to the Cambojans, though they speak a different tongue, yet they now-a-days wear their hair and attire themselves precisely as the Siamese do, and follow, to all appearance, manners and usages exactly the same.

Now with respect to the Siamese, their language is indeed tonic (a point of slight importance if we discover tones to be a fashion imitated from China and of modern growth), and monosyllabic, belonging therefore to the Mongolian family; and continual intermarriage for several centuries with Chinese immigrants has had a most marked effect on the facial configuration of the race. But there are several points on which more information is yet needed, which should lead us to pause before making up our minds that the civilisation of Laos and Siam is a civilisation introduced from China.

The Siamese are simply the most powerful tribe among the Laos; and we know that, advancing from Northern Laos, from what are commonly called the Shan States, they gradually pushed southwards till they founded Ayuthia, in A.D. 1350. "This date is an ascertained fact," to quote the words of the late King; but even he, though he made special search, was unable to carry the origin of his nation to an earlier epoch.

I may add that the date of the Sukothay inscription, which has been translated by Dr. Bastian,† is, according to him, 1193 A.D., and at that time we see the Siamese capital established at Sukothay, a town a long way to the north of Ayuthia. Even without making allowance for the braggart pride of the monarch who caused the history of his reign to be engraved, we can at any rate here see evidence that

* See "Voyage d'Exploration en Indo-China," vol. 11, p. 310.

† J. A. S. Bengal, xxxiv., 1st part, p. 27.

in 1193 A.D., the Sukothay kingdom was only just beginning to make itself felt among the surrounding nations.

As to the organisation and the usages of the Siamese State, all I have time to do on the present occasion is to touch upon some prominent peculiarities, and I shall ask those familiar with the Chinese to tell me whether the practises I refer to have their counterparts in the Celestial Empire. In the first place, we find two kings in Siam—the major king and the subordinate king. Now the Siamese monarchy does not necessarily devolve in the strict line of hereditary descent. The succession is indeed confined to the members of a single family, both in the case of the first king, and in the case of the second king. But whenever a vacancy to the throne occurs, the Senabodi, the supreme council, composed of about six of the principal nobles, meet and decide as to the particular successor, the choice, of course, commonly lying between one of the late monarch's younger brothers and one of his sons. Having thus in secret council settled who is to be the man, they go through the ceremony—how far this is purely formal or a real appeal for approval I know not—of submitting the chosen prince's name to the assembled host of general nobility; and if the selection is approved, the succession is then regarded as settled.

I know that what I describe is correct, because I happened to be in Siam when such an election took place, and I may, in support of my statement, quote the very words used by the present king.* In an autograph letter written after his accession, and since published by Mrs. Leonowens, he says:—"I have the pleasure to mention that our Government in council has elected me to assume the reins of government, notwithstanding my juvenility."

The second king seems to take no very active part in the administration of the State. The fact is, he is the king-elect—the *rex designatus*. He is chosen, crowned, and enthroned simultaneously with the investiture of the major king; he lives in a separate palace, and has regal honours paid to him. Should the major king die, the second king will at once take his place; and thus a war of succession—so common in Eastern countries—is avoided. This I believe to be the origin of the institution. If the second king decease first, no fresh second king is appointed till the throne of the major king becomes empty too, and then both vacancies are filled. This fact confirms my view as to the meaning of the custom. The second king only exists to fill the gap at once should the supreme king suddenly die; but it would not be consistent with respect to the supreme monarch, or just to his own children, to re-appoint a second king if the latter chance to have come first to his end. Such a step would be a deep injury to the heir-apparent. This tallies with what actually happened when the late second king died during the lifetime of the major king. No successor was chosen till the major king had died too. When in Camboja I asked the sovereign of that country whether there was or ought to be a second king there, and he told me that if his people asked to have one appointed, it would be contrary to usage not to assent to their demands.

Now, I am not aware—I rather ask scholars to tell me—whether this institution of a major king and a subordinate king has existed also in ancient Indian monarchies; but I find the following remarks in Dr. Goldstücker's "Sanscrit Dictionary" (page 281), which seem to carry us back to antiquity for the origin of this dual sovereignty. Dr. Goldstücker says:—

"It is worthy of note that a custom is met with in the epic poems, the origin of which cannot with certainty be traced to the injunctions of the Aitareya Brahmana, viz., a king's having a son or relative of his inaugurated as 'junior king' (Yuvaraja). For although Sayana's commentary speaks of a father, brother, &c., who eulogise the king before the priest sprinkles him with the sacred liquid, and although the presence of the father at the ceremony might countenance the inference that the Vaidik text implies also the inauguration of the Yuvaraja, it must be observed that the text of the Brahmana does not contain the quoted words, but in their stead 'king makers,' which may or may not comprise the paternal relationship. . . . . The object of the inauguration of the prince as Yuvaraja is to secure him the right of succession, and besides the advantages supposed to arise from the religious ceremony—a share in the government, and perhaps all the advantages of a reigning king. For when Dasaratha intends to make his son Rama a Yuvaraja he addresses him in these words:—'Rama, I am old. . . I have paid my debt to the gods, the Rishis, my deceased ancestors, the Brahmanas, and my own self; nothing remains for me to be done save inaugurating thee,' &c."

Other instances of installations of Yuvarajas are mentioned, one being a simultaneous installation of a king and of his son as Yuvaraja.

Now with regard to the the term Yuvaraja, I must observe that I have never heard it used in Siam to designate the second king; but the title does exist, though in the changed forms Uparat and Umarat, and is the official name of one of the highest officers in the kingdom, who has supreme charge over the criminal law. The son of the major king is called Chao Fa, "the prince of heaven."

In ancient Camboja, on the other hand, there is reason to believe, not only that the second king was one of their institutions, but that the very term Yuvaraja was applied to him. Thus one of their legends* gives an account of their national origin, and says that "Long ago one of their kings, a great and wise monarch, having unanimous complaints made by his people against his own son, who was Obbaraj," that is, second king, &c. And so late as 1809 the chronicles tell us that two younger sons of a deceased Cambojan ruler, their eldest brother being then on the throne, received from the King of Siam, their Suzerain, the titles of Obbojureach and Obbarach.† I take these last particulars from M. Garnier's book, but I arrived at my own conclusions on the subject, independently of him. I think he has made some mistakes in quoting the titles Obbojureach and Obbarach, which he translates as "second king" and "third king." Obbarach should be second king; but at any rate his note fully confirms what I say, for he remarks that the Obbarach is analogous to the Yuvaraja or Crown Prince in India; and he mentions what I was not aware of—a Uparaja as known to the Birmans.

When the late major king of Siam died in 1868, both thrones became vacant, the eldest son of the late second king was chosen to be second king, and the eldest among the sons born to the late major king after his accession was elected major king. The new supreme monarch was at that time under twenty years of age. However, the customary coronation ceremonies were gone through, and during the major king's minority the control of public affairs was left

* "English Governess in Siam." Leonowens.

* Garnier, vol. 1, p. 100.

† Garnier, vol. 1, p. 146.

very much in the hands of the Prime Minister and the Senabodi.

Now, to pass some short period, at any rate, in the priesthood after the attainment of the twentieth year is, I believe, one of the duties rigidly required of those Buddhists who desire to attain greater perfection in the next stage of their existence. In accordance with this rule, we therefore find a very remarkable event taking place in Siam in October last year. The young king laid his robes of State aside, descended from his throne, put the diadem off his brows, and re-joined the priesthood for the space of a fortnight or thereabouts. I say re-joined, because during his father's lifetime, when he was about sixteen years of age, he was for a short term attached to a temple as a disciple of the priests. On the 16th of November he resumed the reins of power, and was actually re-crowned. I shall not trouble you here with more than a very brief notice of these coronation ceremonies. The rites and solemnities which take place at a Siamese State festival, whether it be a coronation, a purification, a hair-cutting, or what not, are in nearly every case Brahminical. There is a temple of Brahmin priests at Bangkok, and the institution is maintained by the State in order that these Brahmins may direct and superintend the ceremonials. Now, this coronation is a purely Brahminical rite. The king, clad in a thin white costume, takes his seat beneath the canopy of a carefully-constructed golden dais, and rills of clear water trickle down upon him through the perforated ceiling above. These purificatory solemnities completed, the five insignia of royalty are next presented in due form; at a later stage in the proceedings seven sectioned spiral vases of glass, gold, silver, and plaintain leaf are set up in front of the throne, and then the nobles within and without the hall simultaneously pass the lighted taper round, "dedicating the throne according to royal custom." Five days afterwards the king completes a procession round the city, making his exit by a particular gate of his palace, going round the palace walls, turning always to the right, and re-entering by the same gate.

It is somewhat startling thus to find a ceremonial enacted at the present day which is nothing more than the ancient Abisheka rite, as ordained by the Brahmins in writings possessing an antiquity which I do not pretend to determine. As the king in Siam was crowned yesterday, so very probably were Indian sovereigns consecrated 3,000 years ago.

One point remains to be noticed before I leave this question. The Abisheka coronation rites, in a form more or less complete, would appear to be adopted, not by the kings of Siam only, but by the tributary princes in the Laos States. Thus I find it stated by M. De Carne that the Governor of Ubon, an outlying Laos province subject to the Siamese, in the early part of 1867, obtained the permission of the Court at Bangkok to assume the title of King. Accordingly the transformation from governor to king was effected by the Abisheka ceremony. The fine robes were laid aside, and the sovereign seated himself on a kind of dais, where lustral water was poured over him. Other details follow.

When we consider the hardly-disguised policy which the French are pursuing in Indo-China—how they seek to detach the Laos States and Siamese Camboja from the jurisdiction of Bangkok, and to bring them into their own control—it is hard to understand why the Siamese authorities were so short-sighted as to concede a royal title, and therefore increased independence, to one of their tributaries, who has been hitherto very strictly submissive to their rule. Royal the title must have been, otherwise we should not thus have the Abisheka rite. But this is by the way.

I venture to close these remarks with the following inquiries. What is known of the coronation rites practised in China, in Birma, among the Malay Rajahs, and by the Cochin-Chinese? I might perhaps go further, and ask whether in Persia there are traces in the coronation ceremonies of the ancient Indian rites; whether, again, any solemnities at all akin take place in the installation of a Grand Llama in Thibet?

What we already know concerning the early history of the Lao-Siamese race I have already briefly described. It remains for us to inquire whether the original source whence these Shan tribes spread southwards can be traced to some still earlier point, before their own records took shape and their social consolidation began.

Perhaps the only valuable result attained by Brown's comparison of Indo-Chinese languages, published in the 6th vol. of the *Journal of the Asiatic Society* (part 2, pp. 14-31), was the discovery that 95 per cent. of the words used by the Khamtee tribes are Siamese. Now, Mr. Cooper, in his "Mishmee Hills," has lately given us some account of these Khamtees. They are a race inhabiting in part the upper waters of the Brahmaputra, just on the borders of our own frontier stations; but their stronghold is the Irriwaddy, in the extreme north of Birma. Nominally they are Buddhists; they use the Birmese written character; they are divided into innumerable clans, and each clan is recognised by the pattern of the waist-cloths worn by the men—an obvious relic, and, to my mind, a clear explanation of the elaborate body-tattooing still practised by the "black-bellied" Laos. The description of their dress corresponds exactly with that of the Siamese, but they seem to wear their hair tied up in a knot, and in this respect they differ from the modern inhabitants of Siam. Another singular point of divergence is that (accord- to Mr. Cooper) the Khamtees drink cows' milk freely, whereas the Siamese regard it with abhorrence—a strange fact, for which I have never been able to account. Other curious particulars of Khamtee customs are related in Mr. Cooper's book; and it certainly seems to me as if we had in this wild tribe—one of those dwelling on the border land between Birma and Thibet—a branch of the Lao-Siamese race, which, if not actually the original stock, will at any rate show us what manner of men the Shan tribes were before they founded cities and established for themselves independent states.

Mr. Cooper is now our political agent at Bhamo, in the north of Birma, and it is to be wished that he would supply us with some photographs of the Khamtee men and women. Are there any tones in their speech? Have they musical instincts, and ears attuned to harmony of sound, like the Laos and the Siamese? What are their laws, especially with respect to slavery? Is it among them a mark of gentility and good breeding to be able, when squatting before a superior, to rest with the inner side of the forearm turned outwards, by twisting the bone in the socket of the elbow point? Does a mother, when a child has been born, scorch herself for some four or five

days, vapour-bath fashion, over a stove or brazier of glowing fire?

The Khamtees must have split from the main body of the Laos at a very recent period indeed, otherwise the languages would not have been so closely similar; but the Khamtees are savages and Buddhists, hence the Laos must very lately—possibly long subsequent to their conversion to Buddhism—have been savages too. Now we have seen that these Laos or Siamese did not get so far south as Ayuthia till 1350, whereas the Fou-nan—which Wade and others have taken to be Siam—is a civilised Indo-Chinese nation, described or referred to by the Chinese historians many centuries before the year A.D. 1300. These considerations make it clear that Fou-nan, at any rate, cannot be Siam.

Reverting once more to Dr. Thorel's statement that the Cambojans, the Laotians, the Siamese, and probably the Birmans "possess a genuine civilisation uniformly based on Chinese civilisation," I venture to think that I have put together some particulars which indicate both where the Laos and Siamese came from, and that their civilisation is of very recent growth. Whatever arts, knowledge, and civilisation they got, they certainly do not seem to have got from China. And though they may have been converted to Buddhism by missionaries from India, my own suspicion is that such usages, manners, and customs as they did not develope from the institutions in their own clans, they adopted ready-made from the old temple-building Cambojans, whose empire they bit by bit subdued. Whether those temple-builders are the ancestors of the modern Cambojans, and if so, whether after all they are not merely a branch of the same Laos stock which ripened far earlier and withered in consequence while the younger shoots on the trunk were still green, are points which as yet we are not in a position to determine.

As to their dramas and plays, these the Siamese seem to have been taught by the Malays. They have a code of laws, tolerably complete, and very elaborate in its details, but where these laws were got I believe has not yet been ascertained, though not from the Chinese; of this I feel certain.

Their village system, so far as ever I have heard, is unlike anything in China.

The Laos and Siamese are musical, the Chinese are not; their political system is different, too; the right hand is more honourable than the left; exactly the opposite view is taken in China.

Here again is a curious Siamese usage which needs further investigation, but which I shall certainly be surprised to find paralleled in China. Whenever a Siamese is created a noble, an official notification is added to the title, stating precisely the number of acres of land (or fields as they term it) which he is to be allowed to possess. When we come to the six or eight great chiefs who really assist the king in the business of governing, we find that the last words of their titles are "fields not taken into account"—that is, no limit is set to the extent of the territory which these high functionaries may hold. Practically I do not believe that the nobility in Siam are restricted now-a-days in the area of their landed possessions; but the custom was originally introduced to prevent any single nobleman from becoming dangerously powerful, for land with them means slaves, followers, retainers, and dependents. Every man was therefore to hold a certain quantity of land suited to his rank, which amount was settled by the king for him when the title was bestowed. The reason why the few great chieftains were honoured with a special exemption from the restriction seems to have been because they are the great executive officers of the State, and, being charged with all but absolute control over some one great department or territorial division, to limit the number of fields they may hold would in no way lessen the power which their office gives them, while it would imply that the king's confidence in their good faith was not as complete as it might be.

This usage has been hitherto misunderstood by Europeans who have occasionally been honoured by the King of Siam with a Siamese title of nobility. Thus Mrs. Leonowens*, describing her own experience on such an occasion, says that the King placed in her hand "a small silk bag containing a title of nobility, and the number and description of the roods of land pertaining to it." "My estate," she says, "was in the district of Nokburi and Prabat, and I found that to reach it I must perform a tedious overland journey." I am glad she never set out; she would certainly not have arrived, for no estate really exists. The words used do not convey a grant of land, but merely forbid that particular noble from acquiring more acres than the number specified in the patent. I should like, however, to ask whether this usage can be traced among any other nations.

With respect to Camboja it is, of course, a very simple matter to determine both the actual limits of the modern kingdom, and the precise provinces which have at various periods during the last 300 years fallen wholly under Siamese rule; but to settle with any approach to accuracy the area over which the ancient Kambojan Empire once dominated is a much more difficult task. It is said by M. Garnier† that a part of Birma, between the Irrawadi and the Salween, is still called Kamboza (such was the information furnished to him), and this was perhaps an integral portion once of the ancient empire. Possibly some gentleman who knows Birma may be able to tell us something about this assertion. It would be desirable to know not merely the exact locality of this Birmese Camboza, but the account given by the Birmese themselves of the origin of the name. Perhaps the same name is again met with independently as a geographical term in India, that is, if Mr. Colebroke be correct in his orthography, when he tells us (Miscellaneous Essays, vol. i., p. 405) that the Nerbudda river, which he styles the Nermada, disembogues into the sea in the Gulf of Camboga, which we usually call it the Gulf of Cambay.

It must here be remarked that the Sanscrit name Kamboga does not really represent the way in which the Siamese write the name for the Indo-Chinese kingdom. The latter in the Siamese language is written and pronounced Kamfohucha, which term is much more closely reproduced in Kampoot, our name for the port of the country, and gamboge, our name for its best known product, than in Cambodia, the modern method of writing down the name.

The Cambojas are frequently mentioned in ancient Indian literature,‡ for example, in the

* "English Governess," page 123.
† Vol. 1, p. 125.
‡ See Garnier, vol. 1, p. 106.

Ramayana, the Mahabharata, and the Puranas, they are spoken of along with the Sakas, the Yavanas, the Pahlavas, and other barbarian or outcast tribes. I do not, of course, pretend to identify the Indo-Chinese kingdom with the country referred to by the Indian poets; on the contrary, I incline to the belief that the name is merely a title assumed or borrowed by the Cambojan rulers at some remote period in their history, from a fondness for the adoption of grand Indian terms and forms of speech. The Ganges poured its waters onward till it mingled with the Mekong, and the influences of Indian language and literature on the nomenclature of Indo-China is visible everywhere at the present day. Thus the proper name for Bangkok is Krung theph phra maha nakhon siri ayuthia, everyone of which words, except perhaps the first, I believe to be Sanscrit; but theva wara maha nagore siri ayuthaja, the angelic, best, great, capital, illustrious and inexpugnable, is a phrase which explains itself; and I believe that in every instance where borrowed names have been introduced an interpretation lurks somewhere near at hand. I ask, then, can any scholar assign a meaning to the word Kamboja? The common name of the country among the inhabitants is Khmer, or in Siamese Khamen, but Kampot is the name of their only port, and "Kampoucha" they explain, in a legend quoted by Garnier,* to have been given to the ancient capital when it was founded, and to signify "born out of the waters." Such an interpretation appears to me to be frivolous, but it points to the recognition of the antiquity of the name, which I believe that I have also met with in one of the ancient inscriptions. The country has besides this been known to the Thibetans as Kan-phou-tchi for at any rate centuries back.

Among the Chinese historians in early times, the Cambojan Empire was styled Founan,† a term which we are informed occurs for the last time in the annals of the Thang dynasty,‡ and for the first time about 1109, B.C., in a fragment from the Chinese chronicles, the original of which has not yet been discovered.

The Annamese§ refer to the country as Pho-nam apparently an identical title,|| but afterwards they apply the term Chan-lap. This same name occurs in the annals of the Chinese Emperor Lung-King (1565-71). The King of Siam made war against Chan-lap, dethroned its king, and appropriated his territory. There can be no doubt that Camboja is meant, though there is a discrepancy of about 10 years between the Chinese and Siamese dates, (Bowring, 1, 76). At a later period the country is again mentioned by the Chinese historians, as Tchin-la,¶ and appears to have been divided about 707 A.D., into two kingdoms, Tchin-la *de terre* and Tchin-la *de l'eau*.

It would be perhaps unsafe, with our present scanty knowledge, to conclude that Chan-lap of the Annamese, and Tchin-la of the Chinese, are the same term, but there is at any rate considerable similarity in the names.

In a memorandum by Mr. Wade on the past relations between Siam and China, published in Bowring's "Siam,"* we find it stated that in the chronicle of the Lin dynasty (A.D., 584-622) Fu-nam is also called Chih-tu, (Chik du or Chik tu), red earth; while in another Chinese record of a few years later, the term Polosha is used, which, owing to the eccentricity of Chinese foreign pronunciation, may posibly contain the elements of the name Kamboja.

In a paper which Mr. Thomson read before the North China Branch of the Royal Asiatic Society, in January 1872,† it is stated that in the Teen-hia-kwo-le-ping-swo (about 140 B.C. Tchin-la has also the name of Kan-po-chee, and that it originally belonged to Fou-nan). This last remark, if it be correct, proves at any rate two things, viz., that Kamboja was indeed the ancient name of the country, and secondly, that Fou-nan was not Siam, as has been supposed, but the ancient kingdom of which the modern Camboja formed a part.

I have not space here to collate all the evidence which exists in support of the identity between Fou-nan and Tchin-la; but, assuming that point to be established, we may go on to deduce that Siam was a distinct nation, from the remark made by the Chinese traveller to Camboja, whose narrative M. Remusat translated in 1829, and who was in Indo-China in 1295, A.D. He tells his readers that the wars recently carried on against the Siamese had greatly depopulated Tchin-la. That is, the Siamese are referred to by him as an independent and hostile race.

The modern Cambojans, on the other hand, describe their ancient monarchy under the term Couc-Thloc; and M. Garnier remarks‡ that they recognise two sorts of ancient Cambojans; one of noble race, fairer than those of modern times, the other, on the contrary, blacker, but both pierced their ears. In another place§ he says that the modern Cambojans call the Kouy—a savage tribe—the Khmer dôm, or ancient Cambojans.

These particulars may seem tediously minute, but I have given them on the chance that the information may be of use in enabling others resident in China, Ceylon, or elsewhere, to identify allusions to Camboja, and perhaps bring further historical notices of that country to light. Its importance will become the more apparent when we reflect that the scholarly memorandum by Mr. Wade, to which I have already referred, is based on the notion that Fou-nan is identical with Siam, a country which at the early date referred to had hardly an existence. I believe that Bastian, S. Julien, and Lassen have adopted the same erroneous identification. I think, however, there is good reason for considering Fou-nan to be not Siam, but Camboja, and consequently, it is much to be wished that Mr. Wade, who, when he wrote his memorandum was of course not in a position to know anything of the Cambojan ruins, should re-investigate the subject under the light of the fresh information which Garnier, Bastian, and others have been able to put together.

As to the ruins themselves, there are upwards of 20 distinct groups, which have already been

* Vol. 1, p. 100.
† Garnier, vol. 1, 110.
‡ Pien-y-tier, k 97, fo. 17.
§ Garnier, vol. 1, p. 113.
|| Garnier, vol. 1, p. 129.
¶ Garnier, p. 128.

* Vol. I. p. 69.
† See *Journal*, No. 7, new series, p. 201.
§ Vol. I., p. 110.
|| Vol. I., p. 98.

examined by Europeans with more or less care. The principal remains are the ruins of the great temple, known as Ongcor or Nakhon Wat, and the ruins of the ancient capital, three miles further to the north; but there are other relics of great importance, some within a radiance of 50 miles from the ancient capital, some more distant, at Korat, in Laos, or in the southern provinces of Camboja. These are not temples merely, and simple pagodas, but vast banked-up causeways, running high and dry above the autumn inundations, and doubtless uniting city to city in times long gone by. There are huge square reservoirs, faced with brick or stone, and constructed for the use of a population that must plainly have been a dense one. These reservoirs are found not merely in the temples and the cities, but at frequent intervals alongside what were anciently the main highways. The rivers were crossed with handsomely balustraded bridges, built on archways and constructed of stone, and the whole character of the ruins, from their grandeur, from the extended area on which they occur, as well as from their number and variety, bears silent, but unmistakable witness to the existence of a very great, powerful, and populous empire, which has past from history, and left, so far as is yet known, not one single written chronicle of its own behind. The materials of which the monuments are built comprise a ferruginous sort of stone, common in many parts of that country; granite, and, less frequently, bricks. In the temple of Ongcor Wat alone M. Mouhot took the trouble to count the pillars, and found them to number more than 1,532; they are monoliths, and were dragged from the quarries in rough blocks, and carved after they had been placed in position. (The accompanying photograph taken from an unfinished edifice at Phra Nakhon Wat establishes this assertion.) Whether any masonic marks are to be found on the columns or other sculptures I do not know. Such marks are discovered, I believe, by the explorers in Palestine, but in Camboja nobody yet seems to have inquired into this point. The small holes to be seen in the exposed faces of the huge blocks of stone were of use, as I presume, in the mechanical appliances adopted for conveying the blocks from the quarries, and for hoisting them into their ultimate position. An indication of one of the methods employed for this purpose is afforded by the photograph of a bas-relief, which shows us a mighty stone being heaved up by the united efforts of two torturers in the realms below, for the pounding of some poor wretch whom we see awaiting his doom in a sort of mortar.

The quarries from which the stones for Ongcor Wat and the other temples around it were procured lie about 30 miles from the ancient capital, at the foot of a low range of jungle-clad hills; and there, not only may the marks of the masons' chisels, and the touch of many a vanished hand still be discovered, but blocks half severed from the parent rock are to be seen too, just as they were left when the labourers were suddenly interrupted long centuries ago. This at least is what the Frenchmen tell us, and I see no reason to doubt their statement. This range of hills where the quarries are to be found, is connected by an ancient causeway with the old capital, and, while various ruins of minor importance are scattered along the route, the temple or palace of Melea, which is one of the principal remains, and perhaps the latest, lies a mile or two further to the east. We might expect, therefore, that in old time there was a numerous population in that locality. Hence it is interesting to note—and this is a point which has, I believe, hitherto escaped remark—that the group of hills referred to is still known as the Khao Rishi, or the hills of the Rishis; and on those hill sides, perhaps, in an age of fervid Buddhism, many a Rishi meditated in his hermit cell on the unrealities of human life, on the merits of his Great Master, and on the duties of self-abnegation. Native testimony corroborates this view, and kindled in me, at any rate, when I halted at the foot of those hills, an eager, but impossible wish to push my researches further. There, so they report, on the hill tops, and buried in the silence of the forest, are statues of Buddha and other relics of the past. But there would be great difficulty in verifying such statements, because the natives, who alone would guide us to the spots, stand in awe of demons, whom they allege to inhabit the mountain sides.

There are a good many groups of these Cambojan ruins, which, though known to exist in localities much more accessible than those to which I have just referred, have, unfortunately, not yet been examined by Europeans. For example, two days north of Preakan, in Camboja proper, are some remains styled Caker; near Phimai, in the province of Korat, are some stone temples, which have been photographed by a Siamese artist; and again at Souren, in Laos, remains are to be found which the natives allege to be of great importance. I stumbled upon some myself on the lonely bank of an unfrequented river, but the jungle was so dense, and my time so short, that I cannot at all tell whether they were of great extent or the reverse. Further careful exploration is much to be desired, more particularly as inscriptions frequently turn up, and these, if collected and examined, might throw a flood of light on the history of the race.

From the very incomplete examination which I made of the ancient capital, and of the ruins in its vicinity, I gathered the general impression that though, as years roll on, the destruction of these antiquities is being swiftly and surely accomplished, it was not the hand of time that dealt the first and fatal blow. I rather seemed to see the traces of some sudden and complete overthrow, of the capture of the city by an invading army, and of the subsequent ravages of an unsparing conqueror and his host. In one temple, for example, which I visited, the stone-vaulted doorways had been bricked half-way up, as though for purposes of hasty defence, and everywhere, though there are no marks of cannon shot, yet we find idols with arms and noses knocked off, and cornices which apparently have been mutilated by the hands of men, or split perhaps by the heat of the flames when the bamboo huts clustered round them were set on fire. Let us now see whether M. Garnier can throw any light for us upon this question. At p. 139 of his account, he says:—

"Phra Rama Thibodi (the King of Siam), after having seized Angcor, established three of his sons, one after another, as sovereigns there. Their domination seems to have lasted from 1352 to 1358, and during that period the Siamese led more than 90,000 Cambojans into captivity. On the death

of Phra Rama Thiboli, which happened in 1369, Camboja recovered her independence. Some years later the Siamese king, Phra Boromaraja, laid seige again to Angcor. At the close of a seige which lasted for seven months the city was taken, the King of Camboja was killed, and his son fled to the Annamese (1373). Boromaraja set his son upon the throne at Angcor under the name of Phra Chao Ento Reachea, but the latter was assassinated the very next year by emissaries from the Prince Royal of Camboja, who, with the aid of the Annamese (now as we find intervening for the first time in the affairs of Camboja) returned to reign at Angcor. In 1384, the King of Camboja, taking advantage of the circumstance that the King of Siam, Phra Rama Suen, was engaged in a war against Chiengmai, carried the war in his turn into Siam, pillaged the cities of Chonbury and Chantabouri, and carried off 6,000 captives. But Phra Rama Suen inflicted a terrible revenge. Next year he took Angcor (1385) but left no more than 5,000 inhabitants there behind him. The King of Camboja fled, and his son was taken prisoner. A Siamese general named Chainerong was left with 5,000 men to guard the country. The King of Camboja seems to have called in the assistance of Annamese a second time to restore him to his throne. In 1388 the King of Camboja abandoned his capital, too exposed to Siamese invasions, and fixed his residence at Basan or Boribun, and after that at Penom Penh."

M. Garnier has not supplied us with his authorities for this very important statement, but we can confirm his account by comparing it with the particulars of Siamese history given by Sir John Bowring and Bishop Pallegoix, which the late King of Siam acknowledged to be in the main correct. I shall refer again to the question of the dates at which the Cambojan temples were erected a little further on; but now let me say a word or two as to the inscriptions which are to be found among them. I cannot do justice to this subject to-night. I had hoped to have been able to go much more into detail, but my leisure lately has been very limited indeed. I must defer a fuller account to some future occasion. There are, at any rate, three styles of writing adopted. I do not say that the languages differ; I suspect they will be found to be in all cases identical; but the characters, though fundamentally the same, and, as more competent men than I am have assured me, modifications of the Dewanagiri alphabet, yet manifestly differ in their configuration, and belong, as I presume, therefore to different epochs. Three successive modifications in the style of writing surely prove this at least, that the establishment and the overthrow of the ancient Cambojan empire must have been separated by a long period of years. A further point to be noticed is that if we compare an inscription engraved in what is regarded as the most ancient style of Cambojan character, with a long inscription found in Ongcor Wat, and describing some offerings made there at so late a period as A.D. 1701—long subsequent to the overthrow of the ancient empire—we recognise at once the similarity between the two styles of character.

When I was at Penompein, the chief priest of the Cambojan Buddhists examined such copies of the ancient inscriptions as I had collected from Nakhon Wat, and also supplied me with two others of a more ancient character from some other temples. He furnished me with his own interpretations, both of the Ongcor Wat inscriptions which I had obtained, and of those other ones also which he had supplied to me. He gave, in addition, the alphabet employed at Ongcor Wat, according to his interpretation. But either because I imperfectly understood his renderings, or because they are not really accurate, I have not accomplished a complete solution of these inscriptions. The Frenchmen hitherto have been equally unsuccessful, and I may add that others who have submitted some of the inscriptions to men of learning among the Cambojans and the Siamese have obtained renderings which always differ the one from the other. I have, however, succeeded so far as to decipher three of the shortest inscriptions, and even this small result is not without importance, for it fixes several of the old Cambojan alphabetical characters with certainty. It also proves that they, like the Siamese and modern Cambojans, used the word Phra as a term for anything royal or sacred. Phra, Mr. Alabaster explains, to be shortened from the Sanscrit Wara, meaning excellent or best.

We also see such terms as mitragupta, siri, and chaija, all which I take to be Sanscrit, used as by the Siamese and Cambojans to-day in their titles for noblemen and princes.

It seems to me, too—though I have not gone nearly far enough to feel at all sure—as if the old Cambojans moulded their Indian words as the Siamese and Cambojans do now, as if they were of kindred stock, not as if they got their religion and their religious vocabulary and phraseology through the medium of the Malays from Java or elsewhere.

What I mean is that the expressions look like Laos Sanscrit, not like Malay Sanscrit. Perhaps I should call it Pali rather than Sanscrit, but there my limited knowledge fails me, and I must look to others for information. However, there is this peculiarity to be noticed, which is probably one of the secrets of the failure hitherto of all attempts at interpretation. These men of monosyllabic speech cut down their long Pali or Sanscrit terms to the shortest possible dimensions. Thus Indra becomes In, a disciple of a priest (Samanera) becomes Nen, and the name for a camel is not ushtra but ut; akshara (letters) becomes akson. But when these words are written down, in many cases their derivation is shown by a number of mute terminals, with an accent superscribed, denoting that that portion of the word is left without articulation. Now when we examine these inscriptions, it becomes necessary to inquire whether the engraver expended the time and labour requisite to write down the unpronounced part of the word which he had to engrave, or would he simply cut the letters of the shortened form, the word as pronounced, and not the word as written? According to my latest information, the French Government has lately despatched an officer to bring home correct rubbings of all the Cambojan inscriptions which he may be able to obtain. This is very welcome news; and when that task has been accomplished we may perhaps hope that what must after all be a very easy problem, compared with the successes achieved by cuneiform scholars, will not have long to wait for a full elucidation. It is to be wished that an opportunity may be taken at the same time of thoroughly collecting from the lips of the Cambojan chief priest, to whom I have already referred, and who had been making a special study of the subject, all the information which he may be able to give both as to these inscriptions and as to the past history of Camboja. But the fact is that this cannot be done except by

some one pretty familiar with Siamese, for that is the language spoken at the court of Camboja, and is really as essential to a traveller in Indo-China as French to a tourist in Europe.

When we turn to examine the chronology of Camboja, so far as our present knowledge supplies it, we find ourselves landed in realms of much uncertainty. M. Garnier quotes from what I believe to be *De Mancanedo's account, telling us that about the year A.D. 1570, Ongcor was visited by the Portuguese and the Spaniards, and found at that time to be completely abandoned, and I do not at all dispute the correctness of this statement. Now, as we have just seen, it was about A.D. 1385 that Ongcor was finally destroyed by the Siamese. The Chinese official whose narrative has been translated by Remusat, visited Camboja in A.D. 1295, and though he gives a full account of what he saw there, he never mentions Ongcor Wat at all. Hence we might conclude that this, the greatest of the temples, was built between A.D. 1300 and 1380; but when we turn to the temple at Penom Bachey, which there are good reasons for regarding as an edifice erected later than Ongcor Wat, we find from an inscription there that it was consecrated A.D. 945. Now this inscription is in ancient character, one however that can still be read, whereas the inscriptions at Ongcor Wat cannot be read; and thus we find ourselves thrown back according to this reckoning to some date previous to A.D. 945 for the erection of the famous temple. The year given in the Penom Bachey inscription is alleged to be 1488 of the sacred era. I believe in the correctness of the Chinese traveller's date, and I believe in the authenticity of the Portuguese statements, which are well corroborated by the previously-quoted accounts from the Siamese annals of the destruction of Ongcor in 1385. I therefore see at present no way out of the difficulty, except either to regard the Penom Bachey dates as wrongly rendered, or else to conclude that after all B.C. 543 was not the year in which Samana Khodom died.

This is a subject admitting further investigation. I cannot do more than thus touch upon it here.

Garnier says that Fou-nan is mentioned by the Chinese "Annalist" in 1109 A.D., but that the fragment containing the statement has not yet been found in the original. The first mention of the kingdom that seems thoroughly trustworthy occurs at about 275 A.D., in the Pien-y-tien, at which period a king, called by the Chinese Fanse-man, occupied the Cambojan throne.

The Chinese traveller to whom I have several times referred visited Camboja in 1295 A.D. Remusat translated his narrative in 1829, at which period little or nothing respecting these ruins was known in Europe.

And here, first calling attention to the caution which Remusat uttered long ago, that a Chinese traveller would note as strange only those things which differed from the practices of China, let me supply some evidence to show that the Tchin-la which he has described was indeed the old Cambojan empire. He tells us that the country of Tchin-la is also called Ki-mici; surely Khmer pronounced à la Chinese. He speaks of reaching the city of Kan-pang-thsui, which is probably Kampong Sawai, the capital of a Cambojan province. He tells us that one of their kings was afflicted with leprosy, which not only accords with the local tradition, but is confirmed by the famous statue known as that of the leprous king. In describing the causeway and bridge which led over the moat into the principal gate of the capital, he says:—

"On each side of the bridge there are 54 stone statues, representing divinities, very large, like statues of generals, and their countenances are threatening. * * * The fifty-four statutes all hold a serpent in their hand, as if to prevent passers by from approaching."

Compare this with Garnier's account, where the latter tells us—

"On each side of that causeway (that is the one leading up to the capital) are found fifty-four giants, seated and facing outwards; upon their knees and in their arms they support a serpent sculptured in stone."

Other identities might be brought forward, but enough has, I believe, been said to show that Tchin-la is indeed Camboja, and Tchin-la can on other evidence be proved to have been also Fou-nan. Who then were these temple builders? Were they in their generations the green and vigorous foliage of the same Cambojan tree, which we still see, with its sap almost dried up, shorn of its most glorious branches, shivered by the thunderbolts of war, and resting now on the props of Siamese protection, now kept from falling by the iron bands with which France has girdled it around? Or were they men of some wholly different race, whose name and lineage have been utterly blotted out? Much may be done to settle this question when the inscriptions shall have been fully deciphered. But there are other quarters in which we may seek for information. Thus it would appear that in 1407 A.D., there was at Pekin a sort of translation college, instituted for official purposes, that Chinese might be trained to act as interpreters when embassies or letters from surrounding nations arrived. I believe that this college continued to exist till very recent times. Colonel Yule, in his edition of Marco Polo,* speaks of Birmese and Siamese as having been among the foreign languages thus studied at Pekin. It seems likely that Cambojan should have been studied there at that early date rather than Siamese, for Camboja at that time was by far the better known nation of the two; and Mr. Thomson, whose photographs have done so much to bring Camboja to our knowledge, informs me that a language known to the Chinese as Papih, and spoken in Indo-China, seemed to him to bear a strong resemblance in its character to those used in the ancient Cambojan writing. His opinion was founded on a vocabulary of the Papih language by a Chinese grammarian, which was shown to him in Shanghai. This, then, is a subject on which I urge those acquainted with China to supply us with further information.

It seems difficult to conceive that men naturally so indolent and easy-going as the modern Cambojans—and the Siamese are no better—could ever have made these gigantic, solid causeways, these stone bridges, enfaced tanks, and megalithic temples. They do, indeed, get the common people to render forced labour, calling them up

* Vol. I., p. 142.

* Vol. I., pp. 27 28.

for service by turns for three months at a time in every year. But what sort of labour is it which they thus obtain? The perfunctory, skill-less work of unwilling slaves. The Siamese and Cambojan potentates would find it impossible to get such public works erected by compulsory labour in the present day, and their listless temper naturally makes them averse to any such undertakings. What they are fond of is playing, smoking, story-telling, gambling, and sleeping. They are even too lazy and careless to scold their slaves if their houses are dirty, or their property allowed to decay. Are these the men ever to have set to with one accord, and for years to have kept all their people cutting, hoisting, dragging, and fitting enormous blocks of stone. Now-a-days Chinese artificers can be hired; and it is one thing to build with bricks, and another to rear up structures made, roofs and all, out of monstrous blocks of quarried stone. But then if it was some other—now extinct—race who made these works, how comes it that they, with their superior energy, were swept away by the Laos and Siamese, timid tribes who really have no fight in them at all? This is a question which I feel quite unable to solve. Of course, civil war, famine, pestilence or severe inundations might give great advantages to an invading foe, but besides this my belief is that before guns were introduced elephants were got to do most of the fighting in Indo-China, and as it is from Laos that the limitless supplies of elephants are obtained, it is probable that the Cambojans in this respect may have been greatly out-matched. The ramparts of Ongcor are lofty and strong, and its moat is broad and deep, but if once the invaders stopped the sea-coast, I do not know where salt was to be obtained. For even now it is in great demand there, and has to be purchased from the neighbourhood of Saigon.

The Chinese traveller's account is full of curious details, but it leaves us still uncertain whether the people he visited were Brahmins or Buddhists, belonging to the stock still dwelling in those countries or to some different race. He says in one place :—

"When a man dies they put him in a desert place, and leave the birds of prey to devour him. When the corpse has been entirely eaten up, this is considered a piece of good luck."

This looks like an age of fervid Buddhism. Contrast this statement with the following passage from the *Bangkok Recorder* in May, 1866 :—

"The corpse was first to be offered to the vultures, the body was taken from the coffin, and the birds were allowed to descend and tear it as they liked. The mourners waited till the vultures had stripped the bones, and these were then gathered together, placed on a funeral pile, and burned."

The Chinaman tells us that the night was divided into four watches; so it is there still. That to shave the head was a sign of mourning; so it is there still. They wrote in black books with a white pencil; and so they do still. On the other hand, he gives us a list of their numerals, differing certainly from those which Garnier supplies, but which show, if correct, that the ancient Cambojans counted up to five on one hand, so to speak, and then, passing to the other hand, counted $5 + 1$; $5 + 2$, &c. The modern Siamese numerals from 1 to 10 resemble the Chinese. Another curious thing is that the ancient Cambojans are described by their Chinese visitor as practising the *couvade*, a custom found among many scattered tribes in all the four quarters of the globe, but which Mr. Tylor declares is unknown as an Aryan Hindu usage, existing only among the ruder populations whose fate it has been to be amalgamated with and shaped by the stronger races, or driven from their fruitful lands to take refuge in mountains and deserts. Perhaps, after all, what this Chinese traveller really found in Camboja was a mixed population and a mixture of creeds. A subject, conquered community, ruled by a dominant alien race; families of couvade-practising slaves, captured and tamed so to speak, from the surrounding mountain tribes; Brahmins versed in astronomy from India, and Buddhists from Ceylon and Nepaul. Traders also of many nationalities and various creeds. Thus it may be that this stranger, unable to distinguish between indigenous customs and the habits of foreign residents, has often described as the words and practices of the Cambojan nation those which in reality belonged to men wholly separate in faith, languages, and descent.

Professor Ferguson, in his valuable work on "Tree and Serpent Worship," p. 48, has stated that "it seems certain that the great temple at Nakhon Wat was wholly dedicated to serpent worship." He adds that "there is no image in the sanctuary there," and he regards this Cambojan temple as "the most remarkable development of pure serpent worship anywhere to be found." I must take this opportunity of emphatically dissenting from any such view. Nakhon Wat is no more a temple for serpent worship than are any of the Buddhist temples in Indo-China. Seven-headed serpents were used in temple ornamentation then, and they are so used now. Nakhon Wat may perhaps have been originally a Brahmin temple, though I doubt even this, but it was either Brahmin or Buddhist. The question is too long a one to discuss in detail now, but I may remark that there is an image in the sanctuary, an image which I take to be Buddha, and which modern pilgrims certainly adore as such. Bastian says, "in each of the four larger sides (of the central tower) opening out in gates stands a large figure of Buddha."* He also states that these four figures are cut in stone. Now Mr. Thomson dissents from this view; he believes from the look of these four figures, which are coloured black—if I remember right—that they are a plaster patch-up of modern date, and quite unworthy of the grand temple in which they have been set up. It was, of course, impossible to actually test the materials of objects so revered, and the chambers which enshrined them were very dimly lit; but I agree with Mr. Thomson's view. This, however, proves nothing. The original image was perhaps of solid gold; perhaps the so-called emerald idol now in the royal temple at Bangkok. Whatever it may have been, the invaders took very good care to carry it off, and this wretched plaster figure had to be set up in its stead. Neither ought any weight to be attached to the presence of those numerous female figures all over the outside of the temple. They are still common in Buddhist shrines of

* R. G. S. 1865, p. 78.

modern date, painted, that is on the walls inside, not carved in stone, a process too laborious for Cambojan or Siamese at the present day; and in the Thibetan engraving which I have here we see them again associated with what is undeniably a figure of Buddha. Many other objections, did space admit, might be urged against Mr. Ferguson's views, but I feel that I have already trespassed upon your patience too long, and must therefore hasten to bring my subject to a close.

Before I sit down, let me express a hope that my remarks this evening, though unleavened with scholarship, and though hastily put together during intervals snatched from other occupations, may yet have excited some interest in the subjects which I have so imperfectly discussed.

Time and trouble are needed to clear up the mysteries which hang around this strange Cambojan people. Bastian has accomplished much, but his researches are not accessible to the body of English readers. The French, too, are doing something to further the investigation, but in England, unfortunately, no serious effort seems yet to have been made to enlarge our acquaintance with Indo-China, and it is to this object I wish to invite the attention, both of those who seek an interesting field for travel, and of those who make Asiatic researches their special study, either in the East or at home.

DISCUSSION.

The Chairman said the paper of Mr. Kennedy was of importance in a double respect, in its political and commercial relations, and in the information it gave with regard to a remote part of civilisation. The monuments of Camboja are as little known to us as the country itself is, and they are, moreover, of a very remarkable character, and their origin must be due to a powerful race. On this subject it was desirable to supplement the information in the paper. The people are of various types, but their languages are connected, and may be grouped as Indo-Chinese, including the Cambojan, the Siamese, the Mon or Peguan, and the Karen, but there are many others. In some respects these languages have a relationship to the Chinese, but we cannot content ourselves by putting them in that class. In all these countries we find the remains of an advanced state of culture, ancient and mighty cities, great monuments, and cultivated languages. On investigating the relations of the languages, his observations led him to the discovery that they were connected with those of other populations, which have also enjoyed a corresponding degree of culture, which have founded great empires, which have recorded annals and carved inscriptions, and in which countries likewise are found deserted cities, ruined temples, fortresses, and palaces. The names of these regions are much more familiar to us than those of Indo-China, because they include the Inca empire of Peru, that of the Aztecs in Yucatan, and the Maya monuments of Yucatan. The Spanish annalists and modern writers have made these known, but have not extended the field of research, nor have they solved the mystery of the foundation of dynasties and of cities, which had preceded those even of the Incas and of the Aztecs. The connection between the Peruvian and Mexican civilisation was suspected from the monuments, but was not proved, as the relations of these languages with each other are not so close as with the Indo-Chinese groups, which will now throw important light on the affinities of the American kindred. It will be observed that this result, while it gives us the origin of the American culture, does not help us to that of the Indo-Chinese, of whom Mr. Kennedy had now treated. Setting aside the Chinese, which does not account for the facts to be dealt with, we should naturally look further east. We get no satisfaction in Aryan or in Semitic, in the Assyrian, or Persian cuneiform, or even in the more ancient Egyptian. There is, however, an earlier cuneiform, which has been recently deciphered, and its grammar displayed by the labour of Mr. Oppert, Mons. F. Lenormant, and the Rev. A. H. Sayce. It is called the Sumerian, or Akkadian, and its civilisation preceded and gave the example to that of Assyria and Persia, as made known to us by so many monuments. The name of Akkad, in Genesis, will be remembered as that of one of the earliest cities recorded, and the title of king of Akkad and Sumer for centuries remained one of the proudest designations of the monarchs of those regions. Many of the characters are still unread, and those which are understood have been deciphered by the aid of what, a few years ago, were the equally mysterious languages of the other classes of inscriptions. To these the Egyptian hieroglyphics gave the key by means of a few short bilingual inscriptions. Thus the knowledge of four great languages, which had perished, and which the relations of Greek and Roman authors failed to transmit, was obtained by means of the ingenious labours of Young and Champollion. Thus a germ of knowledge brings forth a rich harvest of fruit, for Young little knew while he was labouring to decipher the Rosetta stone that his work was to enable us to read the libraries of the monarchs of Babylon and of Nineveh. In science no useful labour is lost, however long it may take to fructify, and its returns may be great and perennial. Among the strange but for some time useless relics of the royal libraries were the bilingual dictionaries of the Akkadians. Having got to Akkad, to Nineveh, and Babylon, we are in regions which have the characteristics of the monarchies of the western world. Here again this rare old language of Akkad came to the rescue, for his (the Chairman's) comparisons showed not only connections with the Indo-Chinese, but with the American. There are many divergencies of course, but for these we have not for the moment to account, and we have no thorough identity, but the points of contact are positive. There is this, too, to be observed, that the affinities are not with the newer empires, but with those that were older, and with tribes dispossessed and driven into the mountains ages ago. Thus not only are the men of Pegu near relatives, but still closer are the Karen languages of the upper regions of Siam; the Aymara is nearer than the Inca or Quichua, and the Maya of Yucatan nearer than the Aztec. In Peru, the ruins on Lake Titicaca, in the country of the Aymaras, are regarded as older and of a higher class than those of the Incas. It would thus be seen that the illustrations presented by Mr. Kennedy belong to a much wider subject than that of Camboja alone, and may materially assist in promoting our knowledge. As may well be conceived, with regard to migrations and the foundations of empire which took place thousands of years ago, great mutations and diversities have arisen, and we can only explain single facts by the comparison of the whole. While some eminent scholars had found in Akkadian grammatical elements like those in the Finnic family, his observations showed others similar to American, Indo-Chinese, the Georgian of the Caucasus, and, in all appearance to Etruscan, Lydian, and Phrygian; and it appeared by no means beyond compass that the Akkadian may solve the mystery of Etruscan, and extend the influence of the researches of Young and his fellow-labourers. To his mind it was also by no means improbable that the Maya inscriptions of Yucatan will be deciphered, and if his views were right, these will be found to be connected in system with those of Henneh, another city of Scripture, and the sculptures of which are our last puzzle, and which scholars contended with him as to their title to be inscriptions, and of which the language is unknown, as the characters are undeciphered. Having

shown that Indo-China shared in the most ancient civilisation, and transmitted it to Peru and Mexico, the question is by what route. The new facts now first brought by me before the public, give a support to the view propounded by Van Humboldt and others, that there was a migration across the Pacific. Upon this head Mr. Park Harrison had brought forward many remarkable ethnological facts. If, then, a wave of population was transmitted from Babylon to India, beyond the Ganges, and thence by the islands of Australasia to Easter Island and so to the shore of the Pacific, to plant the arts of Babylon on the slopes of the Cordillera in Peru and in Mexico, we very naturally seek to know whether in Babylon itself, and in Memphis, it may be said in Jerusalem also, there was a knowledge of this route and whether it extended. Before this later confirmation had reached him, it appeared certain that such must be the case, and attention had been called by him to the fact that in what was called the doctrine of the four worlds, the Greek geographers of the school of Pergamos had received* from their Chaldean forefathers knowledge of Australia, and of North and South America, which they had dimly transmitted to the Romans, and which survived during the dark ages to attract the censures of the church, and lingered to the days of Columbus.†

Mr. Parke Harrison said, in reference to the point alluded to by the Chairman, of communication with America in ancient times, there were a number of singular analogies to be found amongst the various races, which even Mr. Tylor could not suggest arose from spontaneous impulse, and which therefore showed that at a very early period there had been communication across the Pacific. Time would not admit of going into many of these cases, but one very singular one was the enlargement of the lobe of the ear, which had been referred to by Mr. Kennedy; he had paid some attention to it, and would briefly trace its extent. In the southern part of India and Ceylon, and again in the north, this custom prevailed, which had been alluded to by ancient authors, as that of making windows in the ears, the ears of children being pierced when very young, and the aperture gradually enlarged by inserting leaves and other materials, until at last it would receive a metal disc of two or three inches in diameter. When the disc was removed, the ears hung down on the shoulders or chest, as was seen in the images of Buddha. Col. Hamilton and others who visited Birma 150 years ago, described the kings, priests, and nobles as having their ears enlarged in this singular manner, and the same was found in the Solomon Islands, the Fiji Islands, and even Easter Island, probably the most isolated island in the world, being about 2,000 miles from any other island, or from the coast of Peru. When the Spaniards conquered the latter country they found a similar custom prevalent principally amongst the nobles, though imitated to a certain extent by the common people. It was curious to find such a singular custom prevalent in such widely separated countries, and as he had mentioned at Bradford last year, other customs were also found associated with it. In Easter Island, in particular, were found large stone monuments, beautifully cut, square, and put together without any mortar or cement, as was mentioned by Capt. Cooke. Another point which had struck him rather forcibly was that the people who practised this custom of enlarging their ears differed in facial development from the small-nosed, high cheek-boned Malays and Polynesians amongst whom they were found, having aquiline features, and in general a Caucasian cast of countenance.

The Hon. Mr. Clay (late United States Minister in Peru) said that notwithstanding all his efforts he had not been able to discover any book or any monumental inscription which tended to show that the Incas had any written language at all. All communications seemed to have been made by means of a string with knots upon it, called a *kipus*, though how these messages—which were sometimes sent long distances by courier—were interpreted had always remained a mystery. His time had been principally occupied with commercial matters, and it was very remarkable that although the use of guano was evidently known to the ancient Incas, and used under their rule for the cultivation of the fields, it was not until 1842 that the Peruvian Government awoke to the value of this material. Near Lima he had seen the remains of an ancient aqueduct, which passed over the Andes at a height of 12,000 feet, having been constructed for the purpose of bringing water to Lima; but not only this, but all other ruins in that country were made of sunburnt bricks, and there was not an inscription on any of them. In another locality, in the interior, he had been shown a canal twenty feet deep and as wide as the room, which extended as far as the eye could reach, cut out of the solid chalk, and intended originally for irrigation, but it had long fallen into disuse. It showed, however, that the former inhabitants must have had considerable knowledge of engineering. In another place he had seen large monuments formed of immense blocks of stone, perfectly polished, and so nicely fitted to each other that you could not insert even the point of a knife between them. No one could now tell the origin or use of these structures, and there was no stone of any kind in the neighbourhood. He had collected a great many pieces of ancient pottery but none bore any inscription, though on one was found a St. Andrew's Cross and on another a figure of an Egyptian ibis.

After a few words from **Sir Daniel Lange** and **Mr. J. G. Caswell**,

Mr. Thompson remarked, in reference to the practice of elongating the lobe of the ear, referred to by Mr. Harrison, that he had remarked this peculiarity in almost all the sculptures and antiquities of Camboja, and it seemed therefore to have been practised by the ancient Cambojans; and this would be seen on the photographs he had taken, though there was in some of them a little indistinctness, owing to the dim light in some of the corridors, necessitating an exposure in some cases of half an hour. He believed some light might be thrown on the ancient buildings of Camboja by a study of the antiquities of Java, there being many points of resemblance between the two. It appeared from Javan history, and also from allusions in Chinese literature, that in ancient times the Javanese and Cambojans were frequently at war; and another fact worthy of notice was that the Javanese were the only people, apart from the dwellers on the Malay peninsula, who built temples and cities of stone at all worthy to be compared with the temples of Camboja. This was a subject well worthy the attention of scholars, who were able to compare the languages of the two peoples. With regard to the ancient wars between the Cambojans and Javanese, it was worthy of note that in Camboja were often found settlements of people not only speaking the Malayan

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* See the "Timæus" of Plato.

† The following notes may be useful for reference and illustrations:—

	Akkad.	Other Numerals.
2	*bi*	*pa*, Mon.; *pa*, Aymara.
3	*essa*	*Sam*, Siamese; *Kimsa*, Aymara.
4	*sa, sana*	*si*, Siamese; *pusi*, Aymara.
5	*para*	*patson*, Mon; *piska*, Aymara.
6	*as*	*sau*, Aumen; *sojta*, Aymara.
Red	*gusci*	*pako*, Aymara; *hpakit*, Mon.
2	*kas*	*pa*, Aymara; *pa*, Mon.
Man	*Kara*	*Kkari*, Aymara.
Mother }	*tuku*	*layka*, Aymara.
Mouth }	*ka*	*lakka*, Aymara; *tahko*, Karen.
Hand	*sugab*	*kubac*, May; *su*, Thoung-thu.
Fire	*ne*	*nina*, Aymara.
Water }	*a*	*yaku*, Quichur; *ha*, Maya.
River }	*aria*	*hahuiri*, Aymara.
River	*ado*	*atoya*, Mexican.
Fish	*kha, khan*	*challua*, Aymara; *kay*, Maya; *ka*, Mon.
Not	*ma, na*	*ama, mana*, Aymara.

language, but whose chiefs claimed Malayan and even Arab descent.

The Chairman, in closing the discussion, remarked in reference to the canal in Peru, spoken of by Mr. Clay, that Mr. Fox Talbot, in one of his earliest interpretations of Assyrian text, gave a decree of Sumarabi, King of Sumer and Akkad, in which he proclaimed the opening of a great canal which was to confer vast benefits on the people. Akkad, it would be remembered, was one of the most ancient cities in the world, being mentioned in Genesis. He was sorry the commercial aspect of the question had not been taken up, because, though the antiquarian researches of Mr. Kennedy were of great interest, his main object was to call attention to its commercial importance, for he was sure Sir Daniel Lange would agree with him, that it was capable of sending much more produce through the Suez Canal than yet made its way to either English or French ports. Even Siam he was unable to find in the "British Postal Guide," so that apparently there was no postal communication with that country. He deemed it a matter of great importance that the relations with these Indo-Chinese countries should be closely watched, for the French operations there did not tend to develop commerce to anything like a satisfactory extent; and he therefore trusted that Mr. Kennedy would be encouraged to bring the subject before the Indian Section again in the ensuing session. In closing the present series of meetings, he thought they might fairly congratulate themselves on what had been done. For instance, a great effect had been produced on the public mind by Sir Bartle Frere's announcement of the policy of the Government at the opening meeting, and now, at the close of the session, the appointment of Mr. Andrew Cassells to a seat at the Council of India was equally matter for congratulation. Mr. Cassells was an active member of the India Committee, and had rendered valuable assistance to the section on many occasions. He trusted his appointment might be looked upon as a new pledge given by the Government of their desire to co-operate with the policy which had been supported by commercial men in London and Manchester, and to give an industrial development to the Indian Empire. Referring to the Congress of French Orientalists to be held in London in September next, he hoped it would be well attended, and that it would lead to the carrying out of a scheme which he (the chairman) had previously proposed, viz., the establishment of an Oriental association in England, which should hold a yearly meeting, either in some large commercial centre, such as Manchester or Liverpool, or else in one of the university towns, where Oriental learning is cultivated. He trusted this matter would not be left in the hands of the French, for much as they and the Germans had done to encourage the study of Eastern learning, Englishmen also had contributed a far greater share to the same end, both in theory and practice. He concluded by moving a cordial vote of thanks to Mr. Kennedy for his able paper.

Mr. Kennedy, in acknowledging the compliment, regretted that there had been so little discussion on the real subject of the evening; but this, perhaps, illustrated the fact he had already referred to, that no one seemed to have familiarised himself thoroughly with Indo-Chinese questions. He hoped to have an opportunity of recurring to the subject on a future occasion, more especially as there were many points of interest and importance which he had been obliged to omit. Thus he had been, with one exception, altogether silent as to the conduct of the French in Indo-China, but they had lately concluded a treaty with the King of Birma, who was our ally, and almost under our protection; in fact, he was astonished at the apathy of the English Government upon the subject. They had also concluded a treaty with the Sultan of Tonquin, and were actually in possession of the whole of South Cochin China. In fact, the line of policy they were now pursuing seemed to leave no doubt at all that they intended to make themselves masters of Indo-China, if possible, and so get an entrance to Southern China. No doubt the idea which led them to the Sangkoi in the first instance was that it was navigable; it was an enormous river, and they thought that if they could establish steam communication upon it, they would be able to engross a large proportion of the Chinese trade. If, however, they had taken the trouble to make inquiries at Bangkok, they would have found that there were so many cataracts and currents that this was utterly impossible. They had now made a new treaty with Tonquin, and were establishing themselves there with the same object. In connection with this subject arose the question of an overland route to China, which Captain Spry and several other gentlemen had interested themselves in; and though it was not generally known, he believed a great many of the obstacles which had been raised arose from jealousy on the part of the merchants at Calcutta, who feared that the success of such a project would interfere with their own importance. In the meantime, however, the French were trying all they knew to obtain an overland route of their own. One other point he thought it right to mention, and that was this, that in every book published by the French having reference to Camboja, they represented, which was not the case, that the provinces under the Siamese protection were cruelly treated, and that great discontent prevailed. He did not believe there was any evidence whatever to support such an assertion, but no doubt the object was to make out a pretext for interference, in order that the French might get possession of the country for themselves.

Sir Daniel Lange protested against political subjects being introduced into such a discussion, and thought it very undesirable to publish observations which the French, who were remarkably sensitive, would be very likely to take offence at.

The Chairman said no doubt Sir Daniel Lange's cosmopolitan sympathies as chief manager of the Suez Canal had been aroused on behalf of his French friends, but he could not hold that Mr. Kennedy was out of order in the remarks he had made, nor was it possible in discussing such questions to draw a strict line between commercial and political action. On other occasions similar allusions had been made with regard to other nations, and sometimes even the home authorities had come in for rather severe criticism. When, however, all were agreed as to the benefits derived from an extension of commerce by the world at large, he trusted no one would feel offended at the most perfect freedom being used in discussion.

TWENTY-FIRST ORDINARY MEETING.

Wednesday, May 6th, 1874; Lord Brabazon in the chair.

The following candidates were proposed for election as members of the Society:—

Barklie, Robert, 35, Hopeton-street, Belfast.
Brown, J. Campbell, School of Medicine, Royal Infirmary, Liverpool.
Calvert, J. H., Subden, Whalley, Lancashire.
Corner, J., Whitby.
De Schreiner, Baron, Imperial Austrian Consulate, 29, St. Swithin's-lane, E.C.
Dresser, C. L., 30, Park-row, Leeds.
Eassie, Peter Boyd, High Orchard, Gloucester.
Evans, George Washington, LL.D., Reading, Berks.
Farr, E., 101, George-street, Altrincham.
Griffith, William, Beachborough-house, Portobello, near Edinburgh.
Hughes, Frederick Robert, Borrowstownness, N.B.
Hughes, John, Ivy-house, Hendon, N.W.

The following candidates were balloted for and duly elected members of the Society:—

Astbury, W. S. W., 48, King-street, Manchester.
Carulla, Facundo J. R., F.C.S., 28, Broomfield-crescent, Sheffield.
Chrispin, William, 39, King-street, Huddersfield.
Cullin, Edward, Lahore, Punjab, India.
Currey, Elliott S., 21, Duke-street, Westminster, S.W.
Durham, Henry, City of London School, Milk-street, E.C.
Field, Frederick, F.R.S., Hither-green-lodge, Lewisham, S.E.
Glass, William, F.C.S., 10, Ashmead-road, St. John's, S.E.
Hampson, Robert, 205, St. John's-street-road, E.C.
Hucks, William, Gilbey's Distillery, Camden-town, N.W.
Janvrin, A., 61, Pall-mall, S.W.
Nicholson, John, Carlton-house, Richmond-road, Putney, S.W.
Wilson, William V., 7, Cottage-grove, Bow, E.

The Paper read was:—

ON TIMBER HOUSES.

By Frank E. Thicke.

Probably no private dwelling house has ever attracted more of the public interest than the timber house which Mr. Fulford Vicary, of North Tawton, Devonshire, imported from Norway about two years ago, and erected on his estate. It was a novelty in building construction, and was said to have cost less than half the money of an ordinary brick and stone building. The now celebrated article descriptive of this house, which appeared in the *Times* of Christmas-day, 1872, and which doubtless many here present have read, seemed to solve the problem of "how a house can be built quickly and cheaply, with the advantage of the proprietor being able to occupy it as soon as it is completed." Altogether the idea of a house being of handsome appearance, being cleaner and equally durable, needing less repair, and costing so little, was so plausible and so fascinating, that it is not at all surprising that a great degree of excitement was caused not only among the speculative building community, but also among noblemen, gentlemen, and landed proprietors. Still less astonishing was it that Herr Thrap-Meyer, the fortunate, or rather unfortunate, architect at Christiania, was inundated with letters and instructions for plans and estimates for all sorts of buildings, including mansions, schools, churches, and labourers' cottages. For my own part, I thought the matter was worth investigating and sufficiently interesting, so I resolved upon a journey to Norway and Sweden, for the purpose of gaining information with regard to the erection of these houses, to inquire into their mode of construction, to test what had been stated as to their durability and cleanliness, and to study their economy.

Accordingly, in April last year, I visited the principal cities in Scandinavia, Stockholm, Gothenberg, and Christiania, and inspected the various large builders' workshops and their machinery, made many inquiries as to the different modes of construction of houses, the cost of timber, the price of labour, &c. By the kindness and courtesy of various architects, engineers, timber merchants, and contractors, I was enabled to bring away with me such plans, photographs, estimates, and information as would put me in the position of grasping the details of the whole question, but when I reached England and had gone into the matter, I felt that a second visit to Norway and Sweden was desirable. An opportunity for again crossing the North Sea did not occur till the beginning of last January, when I once more visited Gothenberg and Christiania; but this time I took with me drawings which I had prepared for various villas, cottages, &c., for the purpose of procuring estimates from the different building firms in those cities.

The result of my two visits may be summed up in a few words, as I endeavoured briefly to point out in my letters to the *Times* in February last. I can bear testimony to the handsome appearance, the cleanliness, the equable temperature, and the durability of these timber houses; but I am not able to state that they can be built at the same reduction of cost as stated to be the case with the house in Devonshire, although I found that they can be built for considerably less money than we have been accustomed to pay in this country for the same class of house. First of all, I found that Mr. Vicary was singularly fortunate in choosing the time he did for giving the order for his house, for immediately afterwards the price of timber rose immensely; and, moreover, his house was built principally by a man who it is well known in Christiania lost money by the transaction. It was clearly shown to me also that the price of timber was steadily rising to such a height that at least 30 per cent. must be added to the cost in estimating for these houses. Notwithstanding this, my experience shows me that they can be built cheaper by 30 or 40 per cent. than an ordinary house of brick or stone. This is what I intended to convey in my letter to the *Times* of the 12th of February last, although it has been supposed that my object was to state that Norwegian or Swedish houses could not be built any cheaper than our English ones. I will endeavour now to go as fully as I can into the details of the informotion which I have gained from the study of this interesting subject.

Timber as a material for the construction of houses, of course, dates from the very earliest history of house architecture, and it is not at all surprising that even now, notwithstanding brick and stone are more generally used, there should be many admirers in this country of timber erections. What more beautiful specimens of ancient domestic half-timbered architecture could be selected than the following mansions:—Ince Hall, near Wigan; Moreton Hall, Cheshire; Smalesbury Old Hall, Lancashire; Hall i' the Woods, Bolton; Pitchford Hall, Shropshire; Park Hall, Oswestry; and The Oaks, West Bromwich?

It will not, perhaps, be out of place here, before I proceed to describe the different modes of construction, to remark upon a subject which has occupied a good deal of attention in the building trade. I allude to the prevailing notion that the supply of timber is becoming exhausted. Till within the last few years, young forests have been ready for hewing in Scandinavia when the old ones were demolished, but the prevailing tendency now-a-days is unfortunately towards premature felling, in order to keep pace with the increasing

demand for exportation; but still I do not think there is any great reason for anxiety and alarm, for even if this improvident disforestation is allowed to continue, we can but resort to the American markets for our supply of timber. And, besides, there are many other countries rich in this valuable commodity, from which it can be obtained. In the Islands of Japan, for instance, I am informed there are vast resources of most valuable timber, including oak, elm, pine, beech, &c. Parts of India also are said to be rich in ancient woods, but they are chiefly applicable for ornamental work. The West Indies, Spain, and Germany are all markets which ought to supply us with the extra quantity we are yearly consuming over and above our own produce, and surely, with all these last-named countries more or less near at hand, the anticipated exhaustion of timber must be a mistake.

I will now try to explain the different modes of construction of the walls of the Norwegian and Swedish houses.

As you will perceive, I have shown on my diagrams four methods of building horizontally and three methods vertically. No. 1 represents a wall of logs about 5 in. thick grooved and tongued together. No. 2 is made of similar logs, but birdsmouth-notched into one another. No. 3 represents a plank wall, the planks being grooved and tongued together; this is the most usually adopted style; and No. 4 is also a plank wall, the planks being notched into one another as in No. 2 log wall. These are all placed horizontally one on the other, lapping into one another at the angles in the same manner as placing one's fingers at right-angles one hand with the other. No, 5 drawing shows a vertical wall of logs, the logs being notched into one another as before, and standing upon a sill into which it is grooved and tongued; it is also bound down by a cap in the same manner. No. 6 is similar, but the logs are grooved and tongued together instead of being notched. No. 7 shows the logs placed end on end one against the other, without notching or tongueing and grooving, but they are grooved and tongued at top and bottom into the cap and cill. In all cases, of course, the cill rests on a foundation of brick or stone. At the side are the different modes of construction of the outer and inner shells. I think these diagrams sufficiently explain themselves, so I will not take up any more of your time by describing them than is necessary. The long one represents the section through the front wall of the cottage. There is the cill on the brick foundation with the weather-boarding and plinth. There is the vertical plank, with the horizontal boards fixed to it, with a joint as shown. There is the cill for the window, under which is another piece of weather-boarding. There is also the head of the window, with the small projecting fillet, which is made an ornamental feature in the elevation to protect the joints of the woodwork from the action of the weather. This is repeated wherever deemed necessary. The eaves in all cases overhang considerably, thereby in a great measure preventing driving rain or snow penetrating the walls. These, if properly treated, add very greatly to the picturesqueness of the houses, as everyone knows who has seen Swiss chalets and some of the pretty villas in many of the German watering places.

I regret that I have not received in time for this evening some plans and information in conection with the erection of timber houses that I expected, but I will try my best to describe the way in which they are built.

It appears there are six different methods of constructing them:—1st, the hewn log; 2nd, log-on-end; 3rd, frame; 4th, plank or balloon; 5th, board, plank, or flat; and 6th, plank. Hewn log; this mode of construction consists of logs hewn square and laid horizontally one on the other with dovetailed quoins or angles.

The log-on-end method is not very often used; it consists of a sill and cap, the posts being cut to the required height and let into the sill below, and bound down by the cap being spiked on them; the joists are then plastered and covered by saplings secured to the cap and sill.

What is known as the frame house was, some years ago, the only way known to the Americans of building wooden houses. The frames are put together, and being ready are hoisted into position and strengthened by ties and angle pieces. The spaces and quarterings used to be filled in with brick nogging, but this is not always done now; more often the outside is covered with what is called clap-boarding, otherwise feather-edged, or lath plastered and cemented, or rough cast. Sometimes instead of this feather-edged boarding, flush horizontal boards are fixed throughout with bevelled joints.

Plank or Balloon.—This method of wooden house building is superior to others in point of strength and cheapness; it is very compact, very simple, and of handsome appearance. It consists of planks nailed to a cap and sill, the joists of the planks being covered with slips or fillets, three inches wide. Frequently the better plan is to use hemlock, two inches thick, and sheet the outside with inch dressed or wrought boards secured horizontally, the joints being run with white lead, and when the whole is painted, it is sanded over, and the joists ruled in imitation of sandstone.

Board Plank or Flat.—This mode of building, as its name implies, is simply laying 6-inch planks on the top of one another, the alternate sides projecting or lapping over so as to dispense with the necessity of lathing. This style possesses one great advantage, namely, the extreme ease with which it can be built. Any two persons can, with the slightest mechanical skill, put it together; all they have to do is to be careful that the angles are kept square, and to mark where the openings of doors and windows come. It is naturally very strong, as every three courses of planks are secured firmly together with nails, and of course it makes the house very warm. It possesses, however, two disadvantages, namely, its expense, and its tendency, if any sap remains in the wood, to dry rot setting in, in which case there is no remedy.

Plank on Edge.—This style is seldom adopted, as it is decidedly inferior to the planks on balloon form. It is constructed by placing 2-inch tongued or grooved hemlock, or pine wood, edge on edge over each other horizontally, each course being spiked and dovetailed together.

Shingles are very much used in America for roofs, and also tiles made of tin, chiefly for public buildings and churches. Many houses of a smaller class are built, so I am informed, without a nail in

them, as all the flooring, &c., is tongued and grooved, and wooden pegs used. A correspondent in Ottawa writes to me :—

"It is a very common thing to see a man moving from one side of the lake to the other; he pulls down his frame house, makes a raft of the walls and flooring, on which he places his staircase, doors, windows, furniture, and effects, including very often his cow and pig tied by the legs. Once I even saw a man shoot the Shiler rapids with his raft house and family, but it was in the fall of the year, when the rapids were not very strong."

He goes on further to say :—

"Firemen in this country say that a wooden building on fire is more easily put out than a brick one. Of their comfort —warm in winter and cool in summer—there is but one universal opinion, namely, that they are perfect, which cannot be said to be the case in a brick or stone erection. Pitch pine and yellow pine are principally used for internal joinery, especially door panels, white pine for mouldings, and red pine for panelling and framing."

I may state that the framework before described is appropriately trussed and filled in with upright quarterings, similar to English stud partitions, with a covering of weatherboards, and the internal work is lath and plastered. When it is required to take extra precautions against draughts and dampness, rough lath and plaster is put behind the weather boarding.

There can be no doubt, and I could quote many authorities to confirm what I say, that wooden house building is preferred to all others in America. All their architects affirm that they are in every way more comfortable, drier and warmer, and incontestably cheaper than any other mode of building; and I maintain that if such be the case there can be no reason why moderate-sized houses, cottage ornées, and other rural buildings not involving a very large outlay, should not be erected in like manner in this country.

It would be idle for any one to suppose that I anticipate a revolution in the building trade of England, or that I am advocating the building of ancestral homes, large buildings, cathedrals, &c., in timber, but I do say that I have never yet heard any argument advanced which tends to alter my opinion with regard to the expediency and desirability of following the example of our cousins the Americans, and our neighbours the Scandinavians, in building pavilions, temporary hospitals, railway stations, houses, villas, and smaller houses, of timber, when economy and comfort have to be studied. As a professional paper lately remarked :—

"It is quite evident that, so far as the structural principle goes, no degree of complication or artistic effect can be said to interfere with the essential idea of a wooden house, or to prevent its being carried into execution."

If timber house building were adopted more generally in England, of course it is not to be expected that the Norwegian and Swedish, or American system would be adopted. We are far more likely to go back to the days of Queen Elizabeth, at which period timber house building in our country may be said to have virtually ceased. In those days brick nogging and concrete work was put between ornamental framing of timber. Neither can we suppose that we are all at once to allow our internal lath and plaster to give place altogether to the boarding and panelling of the Swedes. The journal to which I have alluded, *The Architect*, in a recent article on timber houses, asks six very practical and pertinent questions. 1st. Why should not a small country house be built of timber? 2nd. Would it be more economical? 3rd. Would it be more comfortable? 4th. Would it be equally durable? 5th. What would be its cost of repair? And lastly, need it be within reasonable limits less dignified?

To the 1st, "Why should not a country house be built of timber?" I am only able to say, that having given the subject a great deal of consideration, and looked at it from all points of view, in addition to travelling twice through Norway and Sweden, and having seen and inspected those actually in existence, there does not seem to me to be any reason whatever why they should not be built.

Question No. 2, "Would it be more economical?" Of this I believe the bitterest opponent to their introduction to this country will admit there is no doubt whatever, as I think I shall conclusively show presently by my statistics and estimates.

No. 3, "Would it be more comfortable?" This is a very important question, and to a certain extent a difficult one for me to answer. Not that I have any doubt whatever in my own mind as to the answer that would be given by all who have inhabited these houses, but that I naturally feel that it is not easy to make people readily comprehend a statement which they believe to be more or less only an interested opinion. If I thought I could make them thoroughly believe what I know to be a fact, I would tell them my own unbiassed opinion, which, of course, they would take for what it was worth, that they are far more comfortable than ordinary English dwelling-houses; but in this connection I can put before you the experiences of Herr Thrap-Meyer, than whom perhaps a greater authority does not exist on this subject; he writes to me—"They are undoubtedly more healthy to live in, easier to heat and keep at an even temperature, and more comfortable because they are drier, and less susceptible to dust and dirt. If my countrymen could this very day choose between brick and wooden houses, I am perfectly certain the majority would be in favour of the latter." Every person I came across in both Sweden and Norway I asked this question, and they one and all answered it in the same way. At a professional dinner which was given in my honour at Christiania, at which were present all the leading architects and engineers of the city, I elicited but the same opinion.

No. 4, "Would they be equally durable?" As to this question, as Herr Thrap-Meyer himself says, "The only answer is, we have many wooden houses here in our capital, Christiania, which have been erected since 1624, and are now, after a lapse of 250 years, in a thorough state of repair, and have not even been redressed with outer boards." Is not this a conclusive answer to sceptics? "In a damp climate such as England timber houses ought to be more lasting than those of brick or stone, for the latter draws the dampness to itself and communicates it to the wood in a very destructive manner."

Question No. 5, "Cost of repairs." Somehow or another it appears to be imagined that these houses will always be in a state requiring repairs and patching. Why this should be so I cannot

quite comprehend. Of course there is a larger surface to paint than in a brick or stone-fronted house, but beyond that the whole of the testimony I elicited in Norway went to show that the repairs required would not be in excess of ordinary houses, chiefly owing to the peculiar construction.

With regard to the last question, "Need they be less dignified?" I think you will agree with me, when you have inspected the drawings and photographs which lie on the table, that they are capable of being made as handsome and as stately, and very often as majestic as any erection of brick or stone. Whether they are made so or not rests with the skill of the architect, for wood being a material so susceptible of ornamentation, he is able to manipulate it as he pleases.

Perhaps there is no class of men who have to put up with what has been termed the "incomprehensible perversity" of the English house-building community, and the petty annoyances of a fickle and untractable people, than the often wrongly-abused and unappreciated architects. There seems to be amongst all classes a sad want of knowledge of the relative position and duties of an architect and contractor, and were it not well known to us as a body that this ignorance does exist, we should very often feel angry with the world at large and discontented with our lot. It would surprise you, for instance, as it surprised me, when I learnt from Herr Thrap-Meyer that bushels of letters arrived for him by every English mail for many months after the appearance of the article in the *Times*, asking not only for information, but for plans, elevations, photographs, estimates, and even contracts, the postage of many of which letters was not even prepaid. Herr Thrap-Meyer, in his simple but shrewd way, looked upon these enthusiasts as being a crowd of lunatics escaped from an asylum. He responded, however, to a selected few, and with unnecessary generosity obtained plans and estimates, which he dispatched to his correspondents, who in nine cases out of ten returned the documents, keeping the plans, and declining to pay the unfortunate architect for the time and trouble they had cost him. This of course could not last long, so at last he returned a stereotyped reply to the remaining correspondents, that he could not and would not do any more business without receiving his proper fees. I might perhaps have scarcely credited that things were quite so bad as represented had I not myself been treated almost in a similar manner. Correspondents are continually addressing themselves to me, but I confess, although it gives me great pleasure in the majority of cases to answer them, I do find it irksome and difficult to reply to some of the frivolous and absurd questions that are put. And I am glad now to have been enabled to publicly state all that I know and think about the erection of timber houses, so that I can show I am not advocating a fallacious idea, and not stating facts that will not bear investigation.

With regard to two principal objections that have been raised, namely, the non-preservation of the timber, and what is considered the greatest drawback of all—fire—I feel bound to say a few words.

As to the preservation of timber I am not acquainted, practically, with the different processes for its preservation that have been invented, but I know that many have been tried, and mostly failed.

I believe the process of creosoting has been in use for nearly thirty years, and I am told effectually resists the attack of insects, but I think there has never yet been known a perfect mode for effectually preserving wood.

So far as fire is concerned—and this is the first objection that has always been raised when a discussion has arisen—I cannot of course deny that when once a timber erection has caught fire there is less hope of saving it than if it had been built of brick or stone, but that these houses are more liable to fire I emphatically deny, for there is nothing in their construction to make them so. All outer and inner walls are of solid logs or planks, consequently there is not the same opportunity of the flames travelling, as is the case in our ordinary hollow lath and plaster partitions. Again referring to Herr Thrap-Meyer, he says, "Danger of fire has never been in this country a subject for deliberation, or given as a reason why wooden houses should not be built. And I apprehend that in these days, when the system for the prevention of fire is so perfect, there is less need for fear and alarm on this score. All the insurance offices here include wooden houses in their risks." Various inventions have been patented for the purpose of rendering timber incombustible, but none have, I think, answered the purpose.

I lately read a report in the newspapers of some experiments recently made by the Reverend Doctor Jones, Principal of Harewood College, Tavistock. It appears he made a large heap of various sized pieces of wood, all of which had been properly prepared and saturated with paraffine. He then set it on fire, and as soon as the paraffine was consumed the fire went out spontaneously, and on examination the wood was found to be scarcely injured. This process, according to the inventor, not only renders timber uninflammable, but makes the softer kind of timber much harder. This portion of my paper I have no doubt will raise a certain amount of discussion, but I fear I can say no more than I have. I feel it is difficult to eradicate a popular and to my mind somewhat absurd prejudice, but I doubt not that there are many who will agree with what the *Times* stated, "that it is possible, if proper precautions are taken in their construction and management, the risk of fire in these houses may be very materially reduced." Before I proceed into the comparative cost and saving of the expense of these houses, I should like to say a few words with reference to a not at all unimportant subject—I mean the introduction of Scandinavian joinery. Many of you will be aware that all kinds of carpenters and joiners' work have been imported from Norway and Sweden for some considerable time past, but the dual advantages they possessed, of cheapness and superiority in manufacture over our own, have been the theme of frequent private discussions and criticism, and a very unsatisfactory result, in so far as the public do not know what or who to believe, has been the consequence. I myself am not at the present moment, though I had hoped to have been, in a position to give you the opportunity of judging for yourselves by exhibiting some specimens, but I may perhaps be allowed to give my opinion (and I have not the least hesitation in

doing so), that the joinery can be obtained very much cheaper, and in most cases a great deal better. As in the English building trade, so in all countries there are black sheep; and I can quite believe—in fact, I know—that large quantities of joinery have been imported to this country and used in our houses, which have been made of bad and unseasoned stuff; it is to be hoped, however, that the public will not be prejudiced against all Norwegian and Swedish joinery, because in one or two cases it has been unfit for use.

After all it could not have been worse than some which is foisted upon us by our suburban speculative builders. It is necessary, as in all cases of buying and selling, to go to the cheapest and best market, and I should advise any intending purchaser of foreign joinery to be careful what firm he selects.

Whilst admitting that very large quantities of bad joinery have been imported to England, on the other hand it cannot be denied that very much larger quantities of most excellent and cheap joinery have been sent over from Sweden. I have the authority of Mr. Henry Currey, the architect of St. Thomas' Hospital, for saying that having now had some few years wherein to test the joinery he caused to be brought over from Stockholm and used in that institution, he finds that it is as good and as sound as when first put together.

On the table are some detail drawings of joinery, with the prices marked, which is now being made for a large house I am building at Berkhampstead, Herts, for Alfred Keyser, Esq.; it is 60 per cent. cheaper than it could have been made in London, and I am quite satisfied that it will be as good as any I could have procured in this country. This will be over here in a week or two, and I should be very glad to show it to any gentleman who would like to inspect it.

Now I have arrived at the very important question of the cost of these timber houses. It is important, I apprehend, because it is their cheapness alone, most people will argue, that is their chief recommendation. Although not wholly of that opinion, I still admit it would influence, and rightly so, many in the middle walk of life who contemplate erecting a house of their own. I do not propose boring you with a lot of figures, or dry-as-dust statistics, but simply place before you some estimates which I have received, whereby you may be enabled to judge between the relative costs of a timber-built house and a house erected of brick and mortar.

Drawings A are the same as the diagrams, and represent a cottage containing living-room 16 ft. 3in. by 11 ft., scullery 10 ft. 6in. by 7 ft. 6in., and two bed-rooms, 11 ft. by 8 ft., and one 10 ft. 6in. by 7 ft. 6in. The estimate for the wood work of this cottage from a firm of Swedish builders, and my own estimate for the foundations, freightage, &c., amounts to £159. I procured an estimate from a London builder for the same cottage, to be built within an area of 15 miles of the metropolis, and it amounted to £220, thus showing a saving of 40 per cent. Of course, if very many are made, a reduction in the cost of building and freightage may be made, and the cost might be further reduced by making it even plainer than it is. A pair would, of course, cost less in proportion than a single one. One similar to this will shortly be exhibited at the International Exhibition.

Drawing B (also enlarged as a diagram) represent a small cottage *ornée*, containing drawing-room 20 ft. by 14 ft., exclusive of bay window 10 ft. by 6 ft., dining-room 14 ft. by 12 ft., kitchen 12 ft. by 10 ft., scullery in basement, the bed-room same size as drawing-room, which might be divided into two if necessary, and two smaller ones. This house, if imported, would cost complete £502. In England a similar one would cost £700.

Drawings C show a dwelling-house of the villa order. It comprises a large outer hall 18 ft. by 7 ft. 6in., the staircase being quite away from it; dining-room 18 ft. by 14 ft., opening out on a terrace, with verandah over and conservatory at side; drawing-room 18 ft. by 15 ft. (exclusive of bay window); breakfast-room, 15 ft. 6in. by 15 ft.; library or smoking-room, 12 ft. by 9 ft.; kitchen, 16 ft. by 12 ft.; serving-room, scullery, and usual offices; five large bed-rooms, bath-room, dressing-room, and housemaid's closet. This villa could be built complete and well fitted up for £1,400, my estimate near London being £1,800.

Drawings D represent another of the villa class. It comprises lobby, inner and outer hall, drawing-room 16 ft. by 13 ft. 6in., dining-room 15 ft. by 13 ft. 6in., library 11 ft. by 7 ft.; close verandah, kitchen, scullery, &c. &c., four good-sized bedrooms and bath-room. The cost if imported would be £1,000. My estimate, if erected within 15 miles of London, £1,300. I have tested the cost in every way possible, and I find there is a saving of at least 30 per cent.

Before concluding my remarks, I think it may be as well if I quote Mr. Vicary's opinion with regard to timber houses, but it must be borne in mind he is a great advocate of the Norwegian stoves, which I am not, for I am sure they will never be popular or even tolerated in England. He says:—

"The comfort of the smaller houses in Norway is very great in comparison with English houses. I have seen houses that did not cost more than £225 and £450, which were really pleasant to live in. For many classes of houses in England they would answer a good purpose. We hardly know our own comfort in moving from an old damp country house to the one I have just built. We used to burn a ton of coal in a week, we now use ½ cwt. of coal per day. I have sixteen stoves in the house. I think that similar houses built in the suburbs of London, with the economy in fuel, would effect a saving of half the cost, with the same house accommodation as at present obtained in villa houses. For instance, if a house lets at £120 per annum, cost £2,000, the same house accommodation could be had say for £1,200, to let at £80, the saving in fuel should be at least £20, and thus reduce the amount to £60 a year in comparison."

I will also read to you what he has stated as his experience since he has lived in his house, in a letter to the *Architect* last January. He says:—

"We find it very comfortable, and have nothing to regret or to grumble at. Of course we do grumble, but we do not grumble on this subject. We find that the even temperature of the interior is a great comfort, and when in other houses at this time of the year are more sensitive to the changes of temperature that occur than I see other persons are. I mean that we can perceive cold draughts of air and the lowering of the fire in the grates more quickly. We generally have an even temperature of about 56° Fahr., and this is maintained with little fuel. In a country house I left I used to send in from nine to thirteen waggon loads of wood for the winter's use of the house, and a ton of coal lasted about the same time as it does in similar houses. In the wooden house our consumption of wood is very much less, and we have burnt

only two tons of coal the last six months. I have placed no check on the consumption of fuel, and my people do not know that I have watched the consumption that has taken place.

"I think it is a point that you might suggest to your readers, that it is a great advantage to attain to an even temperature in the interior of a house, with a small expenditure of fuel, and at the same time to have plenty of fresh air. Your professional readers will probably at once think that the situation is a sheltered and warm one, but, on the contrary, it is more exposed. Any wind blowing from any quarter strikes the house, and from the dining-room windows we can see half the extent of Dartmoor, the nearest point of which is six miles distant. I think this will convey the idea of a high and exposed situation."

In conclusion, I would point out that the continued increase of house rent, as well as of all the necessaries of life, present an ever accumulating difficulty, and many persons would now be residing in their own houses, instead of paying very high rents for very inferior abodes, if the cost of building was not so inordinately great. Here, then, it seems to me is a suggestion for them, which if they adopt they can be confident is a good one, although it may not have been put before them as I for one should have liked. By sending to Norway and Sweden for such a house as they may require, they can be assured that they will obtain one that will be built in half the time of an ordinary house, be ready for occupation immediately, be drier and warmer, and cost very much less money. I have endeavoured to the best of my ability to point out the merits of these timber houses, and although, of course, I could have gone more into the details of their construction, and thus perhaps have gratified the curiosity of many of my professional brethren, I have preferred giving you the result of my experience when in Scandinavia, as to their durability, cleanliness, and comfort. As I said before, my opinion must only be taken for what it is worth, but still, at the same time, if that opinion, humble though it is, is borne out by the statements of abler and more experienced men than myself, as I venture to think it is, I am confident that on reflection those who have so persistently stated that wooden houses are not durable, are not comfortable, are not dry, are not clean, and are as costly as brick and stone houses, will soon come round and alter that opinion when what are shown to them as facts are proved to be so. If I shall have been the instrument whereby this change in their opinion occurs, I shall not have read this paper on "timber houses" in vain.

DISCUSSION.

Mr. Sparkes said he could support what Mr. Thicke had stated with respect to the comfort of wooden houses. The objections which he found to these houses was that they were not cleanly. The usual method of building them was to take the green logs, square them on two sides, put them together with moss, and then do no more. They were filled with vermin, and the Norwegians said it was hardly possible to keep the house free from this plague. There was very little objection on the score of the shrinking of the wood, as the courses were laid horizontally, and they all shrank together. There was always sufficient room left in the frames of the doors and windows to allow of the settlement. With respect to durability, he had seen a church himself which had been built in 1280 or 1290, but only as a temporary church while the stone one was being constructed. The latter took twenty or thirty years to build, and had ever since been under repair, while the temporary wooden one required no repairs. Not only was the wood of the houses durable, but there was great power in the pine wood of resisting damp even when it was carved with the finest patterns. There were several churches built of vertical planks, a plan which was called "staff" building. Each staff was carved elaborately. The carving was as fresh at this date as when it was first executed. As to the cheapness of these houses, he had had a little experience of it. He had an estimate from the places he had visited that a house could be built for £40. The freight of bringing it over here, and the wages of two men to put it together when here, would be as much again, so that for £80 a house could be built. He had done his best to induce the Board of Works to permit one such house to be built, but, although it was to have been built at the end of a long garden, where there were no contiguous houses which could be burned down if it had caught fire, they would not allow it. It was a great mistake to think that wooden houses were not inflammable. No one could live in a Norwegian town many days without feeling that he was on the edge of a volcano. Every inhabitant was trained to act in the fire brigade; but he had seen in country places, where the houses had been burnt, that the walls were so thick that while the roof and floors had been destroyed the walls remained. These were the solid timber walls. The objection to the German stoves he did not think just. He could speak to their convenience in his own house, and to their economy in fuel. He would like to see them more extensively used.

Mr. Fitzgerald inquired of Mr. Thicke whether the manual labour employed in building a Norwegian house was equal to that in an ordinary brick house of the same size in London, because where labour was high-priced, the wooden house would be more suitable if the labour was less.

Mr. Thicke said the labour was very much less in wooden-house building.

Mr. R. Rawlinson, C.B., said he had come that evening to hear history read backwards, for the paper they had listened to took them into a period of two centuries ago. He would not have ventured to speak on this question if he had not been through Sweden and Norway. He had been far inland there to the forests where the timber was grown, and he had seen the style of house in the different villages and on the roads. What Mr. Sparkes had said with regard to the vermin was quite true, but whether they were necessary to that style of house he was not ready to say. In the two principal towns of Sweden, Gothenberg and Stockholm, houses were not built of wood, but of brick or stone, the same as in Copenhagen. In the plans which were hung on the walls now before the audience, he did not see any of the peculiar characteristics of the Swedish and Norwegian houses, one of which was the ladder outside of almost every house. When he first saw this, he asked what it was for, and was told it was to aid the people in extinguishing fire. That timber houses would be liable to fire where stoves are used, and in a climate where a high temperature was got up inside, and every crack and crevice stopped up to shut out the cold, was only to be expected. That square log houses might be gutted by fire, and the log walls be left as in brick houses, he could quite understand. They must not imagine that Sweden was a cold country by any means. He never suffered so much from heat himself as when he was in the Arctic Circle. The heat during the summer was most intense. As to the economy of erecting wooden houses, no doubt there would be some in a country where wood was plentiful. Trees there of 120 years old could be bought for 5s. each. They were cut on the margins of the rivers, and thence they were sleighed down by reindeer and lodged on the ice. When the ice broke up they floated down, but an immense number of them were destroyed on the passage. It might be easily imagined that in such a country timbe

houses were economical in construction; but even if they were built cheaply here and found to answer, should there be any demand for them, the prices that had been quoted would not stand six months. They would rise, and the building of wooden houses would soon be stopped by price alone. As to brick and stone houses being uncomfortable, that of course depended entirely on the mode of their construction. He was sure he was speaking to persons who would bear him out in saying that houses as built in England were generally comfortable. Many were uncomfortable they knew, but he believed that if his audience went to Sweden and Norway and attempted to winter there they could find many wooden houses there were uncomfortable as well. Whether they should have open fires or stoves, as in Norway and Sweden, depended on taste and constitution. Many English constitutions would not stand what had to be borne in Sweden and Norway in winter. Windows were double-framed; the outer frame was taken out in summer and put in in winter, and so intense was the cold that the space between the two frames was packed in with cotton wool, and every means was taken to shut out the frosty air. The stove then became a necessity, for if there were open flues and chimneys the down draught would be of such a character that the fire and smoke would be blown into the room.

Mr. Hale thought wooden houses would do very well in isolated spots, but it was a little questionable whether houses in streets should be built of wood. In the latter case there would be great danger of fire.

Mr. C. Cooke observed that when he was at New Washington, Hampshire, in America, he had seen a large wooden house; and he had also seen similar ones in Cheshire last year; and in Essex, near Chelmsford, there was a wooden church.

Mr. J. Milton was sure that wood might be rendered uninflammable. As to vermin, they might be destroyed by fumigation with sulphur.

Mr. Macomber said there was one point on which they all agreed with the author of the paper, which was that wood would burn. Stone would not alone of itself, nor would brick or iron. If they could find a method by which wood could be rendered uninflammable, the point would be ceded at once that the advantages of wood were superior. The building on Mount Washington which had been mentioned was a very solid one. He was acquainted with it himself, and he could say it was very solid indeed, for it was built of rocks, there being no wood in the vicinity for five miles. The important thing to consider was how to render wood uninflammable. A friend of his had a process which he had tested for very many years, and he was now building some miniature houses, which would be shown to the public within a few weeks, or months at the outside, and which would settle the question whether wood could be rendered uninflammable in a cheap form. The wood had to be treated, however, while it was green.

Sir Walter Stirling had lived in very comfortable houses in Norway and Sweden, but certainly they were exposed to that awful plague of insects which had been mentioned, and which had rendered them intolerable to live in in many respects. But Mr. Thicke's scheme was a most interesting one, although he could not help thinking that in this country the construction of wooden houses must be considered to be utterly impracticable, whether they looked at Cheshire or at Essex, on the borders of which last country he himself lived. He had been in the habit of building cottages on his own estate, and would have been pleased beyond anything to adopt the picturesque character for them which a structure of wood presented. In Shropshire, there was a house belonging to the Earl of Haddington, which anyone would desire to occupy. A similar one was attempted by Lord Ellesmere at his seat near Manchester, but it was of the most extravagant and costly character. A person indulging his fancy in the construction of wooden houses in this country would find it very expensive. The number of travellers who went to Norway and Sweden, and Switzerland, would never think of imitating the dwellings of those countries in building for themselves, as some of the princes of Germany had done after they had been in Switzerland in delightful villa residences in the summer. The abundance of wood in Norway and Sweden rendered building of wooden houses practicable there, while it could not be carried out here. The fir and pine in those countries were different to fir and pine in England, being very hard. As a grower of hops he knew that the hop poles would last four or five years creosoted, which was an admirable method of giving endurance to wood, and he thought the plan should be tried of preserving wood and building houses of it.

After a few words from **Mr. W. Bevan** and **Mr. Wake**,

Mr. Rawlinson said the only scope for this class of building was in country places, which were not under municipal regulations which prevented the building of wooden houses.

The Chairman, in moving a vote of thanks to Mr. Thicke, said that whatever might be the individual views of the meeting upon the paper, they must all agree that in ventilating the subject he had done a great deal of good. In making two journeys to Norway in connection with the subject he had shown immense energy, and in the ability with which he had overcome all the details and difficulties of the question he had shown it was a work of love with him. It was, no doubt, an earnest of future success. There appeared to be a good deal of diversity of opinion on the point whether it was advisable to build wooden houses in this country, but the real question lay in a nutshell—could they be introduced economically? If men were rich enough, they would live in houses of stone or brick, but if they were not, then they must build the best houses they could for less money. The whole matter turned on this. Mr. Thicke had said that if they were living in Norway or Sweden they could get houses built 40 per cent. cheaper than they could in England; but he had not sufficiently looked at a view which was taken by one or two speakers that if there was a great demand made for these houses, according to the law of demand and supply the price would rise. That must be solved before any practical steps could be taken. If it could be proved that there was such a supply of wood in Norway, Sweden, and America as would not fail, whatever might be the demand in this country, large masses of people here would avail themselves of this material, for the simple reason that they would be able to get a better and larger house for less money than now; but unless there was really a considerable difference in price between the wooden and the stone house, the builders here or their patrons would not be likely to change their present habits. Mr. Thicke did not himself advocate the employment of wood in building town houses, and as far as he (the Chairman) could see, he was opposed to it. It stood to reason, as they had heard, and as their own common sense would tell them, that if it was possible to build houses in towns of a material that was not so inflammable as wood, those houses would be built; but if there was a large aggregation of houses of wood, and one of them caught fire, they knew from many lamentable instances in Germany, Switzerland, and America, the whole of them must go. When he was in America he never went to bed without feeling that he might be burnt in it. The sound of the fire-bell was enough to alarm any one. Possibly long acquaintance with it made the inhabitants bold; but the first time one heard it, it was so alarming that it was very long before the fright was got over. However, there was a great deal to be said if

the wood could be introduced economically. In country districts, where houses were not close together, no doubt a great number of landed proprietors would be glad to avail themselves of any means of building cheap houses for their farm servants. Many proprietors of small means, who had an earnest desire to do the best they could for their cottagers, would be happy to see a cheap way of doing it. Then, again, men of limited income would gladly adopt the wood for building villas for themselves, pretty, cheap, and commodious. Wooden houses were much more capable of being made ornamental than stone ones. If a person wished to make his stone house at all ornamental, the builder instantly raised the price; but ornamentation in wood would be effected very economically. He had seen a great deal of wooden house ornamentation in Germany, in villas and country residences. One of the speakers had alluded to a Swiss house, probably meaning a building at Potsdam, where the Prussian Royal Family spent their summer. That was a luxurious kind of house; but if it could be shown by Mr. Thicke that that class of house could be obtained from Norway and Sweden at a cheap rate, he thought it might be built in England. One gentleman had said that it was expensive to build wooden houses in this country; but the reader of the paper proposed that they should be built of wood, fashioned in Norway and Sweden, and put together here. Our own wood would be enormously dear. In the present day we cared more for beauty of architecture than our ancestors did; and if Mr. Thicke could prove that he could erect a good and commodious class of cottage or villa of wood at a cheap rate, the present generation would support him. In the Georgian era the British did not care about the outside appearance, but the interior comfort. As civilisation advanced, however, we delighted in beauty, whether it was of shape or colour or outline. It was a pleasure which the educated had—a legitimate pleasure—which he was happy to say was spreading in all classes—the beautifying of their residences. He begged to propose a vote of thanks to Mr. Thicke.

The proposition having been carried,

Mr. Thicke said that no argument or objections he had heard had altered the opinion which he had expressed in his paper. He proposed solid walls, and that all the wood should be manufactured in Norway, brought to England by ship, and then erected. That was where the economy lay. He did not see why a man in the middle class should not build himself a pretty ornate villa, suitable to his wishes, at a small cost. There might be a risk of fire, but he did not think it was so great as some feared. No one could lay hold of a word in his paper proposing the erection of wooden houses in towns. He would not have the hardihood to make such a proposition. In the county there were local boards which would allow wooden houses to be built, for he had taken the trouble to find out. As to the durability of wooden houses, he had quoted cases in which wooden houses and churches had lasted 300 or 400 years. He did not know that he could go into details as regarded fire; it was an open question, on which there was a diversity of opinion; but he still maintained that the flames in a wooden house did not travel as in an ordinary house.

COMMITTEE ON THE MEANS OF PROTECTING THE METROPOLIS AGAINST CONFLAGRATION.

INCENDIARISM FOR INSURANCE MONEY.

Public attention has of late been greatly excited by the dangers of fires from accident, which the committee have chiefly and specially had under consideration. But witnesses on the subject, who have had long experience connected with fire-brigades, have represented to the committee that there is another and larger class of fires than the public are aware of, which ought to be taken into serious account for measures of prevention; namely, the fires arising from design for the sake of insurance money, or for other nefarious purposes, to conceal depredation. Thus Mr. Tozer, the superintendent of the Manchester Fire Brigade, who was for many years the chief clerk of Mr. Braidwood of the London Fire Brigade, which he joined in 1851, and who took charge of the Manchester fire establishment in 1862, states, in a letter to the Society, that in his experience "about 33 per cent. of the fires in London are due to carelessness, 33 per cent. to accident, and about 33 per cent. are wilful, or the causes not ascertained." A great proportion of the fires usually entered as "doubtful," are cases of which experienced officers of the service had no doubt whatever, but of which it was doubtful whether there was technical evidence enough to ensure conviction. There was much important evidence in relation to this class of cases taken before a Committee of the House of Commons on Fire Protection, moved by Mr. McLagan in 1867. But this evidence has hitherto passed without due notice and without legislative action. The action chiefly contemplated by the committee was repression by public prosecution, a part of the large measure of the institution of a public prosecutor which the Home Office has evinced little disposition to undertake. This augments the importance of the preventive action recommended in the inquiries of the Society committee consisting of mechanical and engineering means for the quick extinction of fires. The efficiency of such arrangements as against incendiary fires was particularly displayed at Hamburg on the first introduction of a constant supply of water, and the provision of hydrants everywhere for the watering and cleansing the streets. Smoke was seen by the police issuing from warehouses or premises that were locked up. Doors were at once forced by the police, the jets from the hydrants in the streets were immediately brought to bear before they had time to spread; when the arrangements for spreading them by shavings or combustibles laid in trains were displayed, and the parties who had last left the premises were pursued and apprehended as the perpetrators. In Manchester and Liverpool the fires of every species have been reduced by more than two-thirds by these means. They undoubtedly interpose great difficulties and discouragement to incendiarism. The practice is now most rife in outlying and unprotected districts. "Opportunity makes the thief." In times when trade is slack, it is noted fires of this species are the most frequent. Of late, during trading prosperity they have somewhat abated, at least in the metropolis. With an anticipated period of trading depression it is clearly apprehended that they will again spread, if the water arrangements are allowed to continue in their existing conditions, in the hands of the trading companies without systematised public provisions.

The following testimony taken before the committee may serve to show the species of criminals created by the opportunities which the continuance of these onditions provide:—

Mr. William Swanton examined:—

Q.—In what capacity do you appear before the committee?

A.—I am Superintendent of the London Salvage Corps.

Q.—Can you assign any cause for the increase of fires in London?

A.—No; only that, as we believe, incendiarism is very much on the increase. A great many of the fires are caused, either directly or indirectly, by people who are getting their living out of fires.

Q.—But have you any definite information on that point, or is it merely suspicion?

A.—I could speak of some cases, where we have seen

the same men, in various names, having fires several times, which is almost a conclusive proof that it is so.

Q.—Do those fires occur among a respectable class of people?

A.—No, generally not.

Q.—They are not, as a rule, a respectable class who have fires?

A.—Not as a rule; it is the exception rather than the rule.

Mr. Lewis Becker examined:—

Q.—In what capacity do you appear before this committee?

A.—I am Fire Superintendent of the Western Insurance Company.

Q.—One witness told us that whenever there was a depression in any branch of trade, fires increased in that branch. Is that your experience?

A.—The cotton fires of Liverpool were known to have been caused by the peculations of warehousemen when but little trade was doing; they were on half-time, and the moment the cotton went up the fires went down.

Mr. Percy Matthew Dove examined:—

Q.—You are Manager and Actuary of the Royal Insurance Company?

A.—Yes.

Q.—Can you give the committee some of the causes of the increase of fires of late years?

A.—I think that a great many of them are mysterious, but there are some reasons which might be adduced. I think that there is a community or fraternity of criminals consequent on the impunity with which the crime of arson is committed; that is one very material cause. It affords to the dishonest the easiest escape from pecuniary difficulties, and the readiest method of getting money by fraudulent insurances. The criminal knows that the present provisions of the law are insufficient.

Q.—Are you aware of any cases where premises have been fired with the design of concealing robbery on the part of a servant or warehouseman?

A.—I believe that is a frightful source of fire.

Q.—And a frequent source?

A.—And, I think, a frequent source, although that must be merely conjectured in the present state of things. I believe that a great number of the large fires in Liverpool were occasioned by warehousemen having robbed their master, and when the time came for taking stock, the best method of getting rid of the difficulty was to fire the premises. There was a case of that sort since the fire at Compton House, in Harboard's warehouse, in Liverpool, where a fire took place, and a man was suspected, and a reward was offered by the officers, which set the detectives on the scent; they had this man up, he confessed his crime, and he had 10 years' penal servitude.

Q.—Have your insurance company had any cases of decided incendiarism, where the perpetrators of the crime was convicted?

A.—Yes, we have had cases of that sort. We had a singular case in Liverpool of a person who had a shop at Egremont. He came to insure his property with us for £600; we found that there was only about £200 worth of property, and we declined his insurance. Some time after that he came to us and offered us £300; we looked at it, and as he had a respectable shop in Liverpool (this being on the other side of the Mersey), and he stated that he was going to move a portion of his stock to that shop, we took it, and a short time after that the place was destroyed by fire. We ascertained that he had gone to another office the day before he came to us, and insured for £700; he made his claim for over £1,000. But in the meantime we suspected that it was an incendiary fire, and we took possession of the premises. We found all the means of setting a place on fire; a board with a candle placed in it, paper with resin and matters which would easily ignite. He tried to show that the papers had lain there a considerable time, but on examination it was found that the newspapers were of dates not more than two or three days before the fire, and one was the day of the fire. That man was tried and sentenced to penal servitude; that was a case of actual incendiarism. We have another case now, where a man is committed for trial for arson; he is not yet tried, but it is likely to turn out one of the most interesting cases that we have had, and will certainly come under the head of the fraternity of crime. He has three brothers; one of the brothers has had two fires in one town, the third has had a fire in another town, all of which were insured in other companies, and this fourth brother had an insurance with us. He made a claim for the full amount; he sent, as proof of his claim, two receipts, one for about £600, and the other a little over £100, without any address of the parties; we asked him on what bank the cheque had been drawn; he said that he paid it in gold; we traced the case of the £100, and found that one of his brothers had bought an inferior article, to the amount of about £20, in a town in England, and transmitted it under a feigned name to Birmingham, received it under a feigned name at Birmingham, and then transmitted it under his own name to the party who had the fire. There can be no doubt that he had induced the seller to wrap those goods in parcels, intimating that they were the finest goods, and then the finest goods' claim was made on us; whereas, in the *débris*, there was not a particle which would intimate that the finer article was on the premises. He likewise claimed £600 for certain machines that he used in his trade, and we have very strong evidence to show that they were made for about £6 or £7, though he charged £120 a piece. In the previous case the man and his accomplice have been sentenced to ten years' penal servitude, and in the last case the man is committed for trial, and will be tried in a short time.

Q.—One of the results of incendiarism is an increase in the rate of premiums?

A.—The premiums have been, in some instances, increased very considerably; and even though it is not necessary to suppose that incendiarism is greatly on the increase to show how it effects the premium upon insurances, yet if we were to take the risk on ordinary house property, and took any amount as covering the risk, say nine pence per cent., which would imply one fire out of every 2,666 cases; then if one solitary individual of that number insures for the purpose of burning his house, and carries out his intention, that one act increases the risk for insurance by 100 per cent.; consequently it is very clear that incendiarism has necessitated a large increase of premium; and if incendiarism could be put down, the public would be benefited very considerably in the reduced rate of pemium which must follow.

Mr. Charles White examined:—

Q.—I believe you are an auctioneer and assessor of losses of fire?

A.—I am in partnership with my brother; we are assessors to the County Fire Office, ono of the old and leading offices.

Q.—With what class of persons are fires most frequent?

A.—Small shopkeepers on the verge of bankruptcy; detainers are frequently lodged at the office against payment; foreigners, principally of the Hebrew persuasion, Germans or Poles. Some few years since we had six fires in one night of the latter class of persons; in two instances the office refused to pay; actions were brought, and the companies were successful; this had the effect of decreasing the number of fires of this kind. The stock of these persons consists principally of dummies or imitation goods made of plaster of Paris. Cheesemongers and chandler-shop keepers have tubs of butter; sides of bacon, bladders of lard, cheeses; grocers have boxes of sugar, chests of tea, and reams of paper; tobacconists have cigars in bundles; tailors and linendrapers rolls of cloth made of straw, and parcels filled with saw

dust; publicans, wine-merchants, and perfumers, the bottles filled with coloured water.

Q.—Have you discovered those things yourself in your inquiries ?

A.—Yes.

Q.—Are you practically aware of many suspicious or doutful fires ?

A.—Yes, a great many,

Q.—What percentage of them ?

A.—About fifty per cent.

Q.—Of the whole ?

A.—Yes ; about half of the whole of the fires. I infer that from the exorbitant claims and circumstances connected with them. Detainers are lodged at the office against the money often.

Q.—That is within your own experience in fact ?

A.—Yes; within my own experience.

Q.—How do these fires originate ?

A.—From a small hole in a gas pipe pierced with a needle, done intentionally, and then ignited after shutting up shop; at first it burns very slowly, then it increases as the pipe melts; sometimes the gas is left alight at one burner, and all the other taps are left turned on, so as to cause an explosion. Wax tapers are frequently left to burn for two or three hours to give an opportunity of getting away; combustible materials are sometimes placed at the end, such as naphtha and paraffine; oil of tar is frequently smeared on the floors and articles of furniture. Many fires are discovered under staircases, the doors being left open to give ventilation and draught. Fires are sometimes caused by servants robbing their employers to prevent discovery; and by workmen from spite, more particularly in unfurnished buildings. Some fires are caused by carelessness, and the insured knowing he is in needy circumstances, does not attempt to extinguish the fire, it being to his benefit to let it burn.

Q.—Did you ever know of a policy being burnt ?

A.—Those persons having fires where the origin is suspicious, or making excessive claims, invariably save the policy, thinking that they could not recover from the office without.

Q.—Do you think the companies are sufficiently careful in accepting insurances ?

A.—I think the offices are very careless, more particularly those lately established.

Q.—You say that a large number of the fires you have are suspicious ?

A.—Yes.

Q.—In what respect do you consider them suspicious ?

A.—Suppose I found the flooring covered with tar, and found paper under the counter that should not be there, steeped in naphtha, or that I found fires in two or three places at one time; that is, I think, very suspicious.

Q.—Are all the cases marked "suspicious" in your list of that character ?

A.—Yes.

Q.—Does the suspicion arise in consequence of anything in the claim ?

A.—Yes; the claims, which we do not receive until some time after, are very exorbitant. I have seen six fires at one time in different parts of a building.

Q.—Is there any class of people who are very unfortunate in having frequent fires ?

A.—In Jews from Poland and Germany there are a very great many. Jews are very unfortunate.

Q.—I ask that because I have seen the same thing mentioned in America.

A.—Yes.

Q.—Is there any particular class of tradesmen among which fires occur frequently ?

A.—Yes; chandler-shop keepers, clothiers, grocers, and dealers in unredeemed pledges; the sort of shops Jews frequently keep.

Q.—Are they often people in needy circumstances ?

A.—Yes; directly a fire happens a detainer is often lodged against the money.

Q.—Do you find that fires occur more among the needy and the poor than the well-to-do ?

A.—Yes.

Q.—Is there a class of persons who get their living by making out claims against the insurance offices ?

A.—Yes.

Q.—Do they make exorbitant claims ?

A.—They prejudice the insured against the offices, and they make very exorbitant claims.

Q.—How are they paid ?

A.—Five per cent. on the amount paid by the office, and a bonus; they say, "I will charge five per cent.;" the sufferer might say, "My loss is so many hundreds;" the claim-maker will say, "If I get you £200 more, perhaps you will divide the amount with me;" so they get five per cent. and half the bonus.

Q.—Do some of these persons realise tolerably large incomes ?

A.—I should say that several of them realise from £500 to £1,000 a year. Here is one of their cards:—"Mr. ———, offices ———, licensed appraiser, surveyor, and fifteen years' experience as assessor of losses by fire for every description of property. Speedy settlements arranged with any of the insuranee companies. Hier spricht man Deutsch. Cash advanced to sufferers without interest. Upwards of 1,000 testimonials can be seen for speedy settlements. N.B.—No connection with any person in the trade."

Mr. Luke Doyle examined:—

Q.—In what capacity do you appear before the committeee ?

A.—I am a valuer and adjuster of losses for the insurance companies.

Q.—Are you valuer for any particular company ?

A.—No; I act for the principal companies doing business in Ireland.

Q.—That includes English and Scotch companies, as well as Irish companies, I suppose ?

A.—Yes.

Q.—To what do you attribute this great increase of fires of late years ?

A.—A great many shopkeepers, I think, set fire to their small shops from dishonest motives.

Q.—Are the fires in Dublin principally in shops ?

A.—Yes.

Q.—In connection with dwelling-houses ?

A.—Yes, very often.

Q.—With families living above ?

A.—Yes.

Q.—Have you had any loss of life ?

A.—Yes, a very serious loss of life; in one case the entire premises were destroyed.

Mr. William Hancock examined:—

Q.—I believe you are an assessor of damages for insurance companies ?

A.—Yes.

Q.—You have stated that in your experience incendiarism is frequently the cause of fires ?

A.—I believe so.

Q.—Do you know what proportion that cause would bear to other causes ?

A.—If we take what I call wilful neglect, together with actual deliberate fire raising, I should say that they would bear the proportion of one-half to the whole.

Mr. Henry Daniel examined:—

Q.—In what capacity do you appear before the committee ?

A.—As partner in the firm of Alexander and Daniel, who have been auctioneers and valuers and fire investigators for 35 or 40 years.

Q.—In what town ?

A.—In Bristol. We represent 12 or 15 of the chief offices, including the Sun, the Norwich Union, the Im-

perial, the Royal, the Liverpool, and London, and Globe, the Queen, the Atlas, North British and Mercantile, the London and Lancashire, the Phœnix, and a variety of other well-established offices.

Q.—Have you frequently found fires occur in shops where the shops are below and the dwelling houses above?

A.—Not so frequently as when the shops stand alone.

Q.—So that no person can give warning?

A.—Precisely.

Q.—The destruction would be greater in that case?

A.—Just so. I can say most confidently that a very large proportion of the fires are not accidental in character, and that they are followed by most fraudulent claims. I should say that from 50 to 75 per cent. of the fires are not accidental; not clearly proved to be accidental; they are not straightforward. It is a matter of pleasure to us, knowing that the offices want to pay what is fair and right—it is a matter of relief from the monotony and discomfort of having to be the judges of other men (as the public think), to be able to write a certificate to say, "For the most part this case seems straightforward and clear."

Q.—But you would hardly say, would you, that the majority of cases were suspicious?

A.—In a very large proportion of the cases I should say that they were suspicious; that is to say, they are involved in such mystery that, with all our accumulating experience (for I have had this matter under my own care for 12 or 14 years), and with all the tests that every additional cases gives us, we cannot get at what we want. Every board of directors expects from us something like a satisfactory account of the origin and general characteristics of a fire, and frequently we are obliged to give that up in despair.

Q.—From the causes of fires being unknown and exorbitant claims being made, you think that most of the fires are suspicious?

A.—Most certainly. In the South Wales district, something like six or seven years ago, during the mayoralty of Mr. Michael, he and his brother town councillors were so impressed with the danger to life, as well as the destruction of property from the fires, that, of their own accord, they established a court of inquiry; I suppose without any law to justify them, but with the influence which their position gave them. They called on the superintendent of police to direct his attention to the subject, and finding that the fires occurred mainly from Saturday to Monday, they had before them, on the following Monday or Tuesday, as much evidence as they could gather with regard to the cause of any fire, and that had the effect of reducing the fires in the Swansea district most materially, so that two or three years elapsed without their having ten cases.

Q.—Do you know of any cases of culpable negligence?

A.—One of my recent cases, perhaps; but that was rather a case of intentional fire than anything else, and the ground is delicate, as the case is under investigation at this moment. A great many of the most unsatisfactory cases arise among German and Polish Jews; they have a kind of cunning about them; they get the actual insurer out of the way. One case occurred in South Wales, where a young inexperienced agent had taken an insurance from a German Jew for about £600; and this was a case in which the public at large felt much interested, because it was a pawnbroker's shop. I dare say the committee are aware that if an article is deposited worth 50s., and the party only draws 5s., and the interest is a penny or three halfpence, that is all the insurer can claim, and that is all the depositor can claim. Instead of that fire occurring at night it was proved to have occurred between seven and eight in the morning. The husband was in London at the time, and the fire had evidently been contrived. The passers-by seeing smoke issuing from the place at that time, the people naturally felt anxious about their things, and they used every means in their power for getting the fire under, alarming the inmates and protecting the property. Receiving an early intimation of that fire from the office, I went down into the country, and on my seeing the agent, he said that he thought it was a very suspicious case; and, on taking a bird's-eye glance at the house, I saw that there could never have been £200, instead of £600 worth of property in the place. The insurer sent in a claim for £485, without any detail, and so significant was the note put at the bottom of the claim that it necessarily attracted my attention. He said that £485 would not cover his loss, whereas the insurance was for £600, and of course I wondered why he did not go further. It so happened that the pledges were not wholly consumed, and that the only thing that was consumed, which gave it so thoroughly a suspicious look, was the end of the counter on which the desk stood, and on which the pledge-books were said to stand. The pledge-books being destroyed, I adopted another plan, and I found that scarcely any one parcel was wholly destroyed, so having made those people understand the seriousness of their position, and not disguising that I was very dissatisfied with the character of the fire, they took my own cheque for £26 10s., handed over the policy, and gave me a receipt in full discharge of the claim.

Q.—Is there any other case of the kind that you could mention?

A.—One case came under our notice in South Wales, where a fire had been distinctly put in three places.

Q.—But still the insurance company paid the claim, I suppose?

A.—Yes; but the claim was £1,400, and the man took £150, and then ran away from his creditors directly. I had another case in a midland county some years ago, when there was a fire, having to do with small wood tool handles and brushwood. Two men were in partnership, and one was much shrewder than the other, and the fire being very destructive, there was very little salvage. The claim was very large, which we had no power to resist, because the books had been defectively kept. He got a large sum of money, and then ran away; he quitted that part of the country and he has since been outlawed as a bankrupt; but I think that he eventually surrendered. We have met with cases before now when the same man has had two or three fires in different towns; and taking a large district, we have come in contact with him again, he supposing that he would not come in contact with the same assessor. We had a case of a man in Bristol, whose place was on fire, and some few years afterwards we came across the same man in Wiltshire. There was one case in Somersetshire, where a man had removed a fat pig on Saturday, that was worth £9 or £10, because he had no live stock insured, and took away his wife and children the same night; and the effect was, that a fire was contrived on the Monday night, and the man came back on some pretext a few hours afterwards to see how it was getting on. His claim was a small one; it was only £97; but one of the under-tenants came and accused him of having no regard for the value of their lives, so that he could simply claim the money for the insurance. He claimed £97 and consented to take £5; therefore I left him with £5, rather than take any other steps. I had a very bad case in the county two or three years ago; and that case was so bad that the mayor of the town and the chief of police took upon themselves to lock up the man's shop and put the city seal on, and kept it so until I came down. This man was a German Jew.

Q.—Did he go away?

A.—He sent in a claim of from £250 to £280; his insurance being only £200. I had recourse to a reference, and he referred me to a neighbour, whose award was not in his favour, and then he departed from the arrangement; afterwards I bound him down to abide by the judgment of two men, and he obtained

only £42 15s. I gave him a eheque, and obtained the policy out of his hands. I found soon afterwards that he had left England, the whole thing being transparent, because there was a little aperture between the store-room behind his shop, where he could speak to his eustomers, and a eandlestick had been introduced through that for the purpose of setting fire to the place, and there was the great seat of the fire. He was trying to make us pay for a great many things which had not been eonsumed at all. There was a very bad case in the West of England not long ago, where a man was agent for the office, and had two fires in one year before his first premium had expired, and both of them were traceable to an alleged wilful defect in his gas-pipe. There was eonsiderable delay in taking up the matter by the authorities for fear they should not get a conviction; the man was under examination for eight or ten hours, but the authorities feared that they would not obtain a conviction before a grand jury, which turned out to be correct; but had the thing been taken up by a judicial inquiry under oath, a great deal of evidence would have come out which could not be got up after the parties had had time to consult together.

Q.—Did that man threaten you for a malicious prosecution?

A.—Yes.

Q.—In fact you ran that risk?

A.—Yes.

Q.—I suppose that this is one reason why you, aeting for insurance companies, do not prosecute so frequently.

A.—Just so. I have met with one or two cases where the assessors have had actions brought against them personally. I met with a case in Devonshire, where a district had been notoriously characterised by bad fires for many years past, all the offices having to contribute to the wilful damage sustained; and not only were the claims very excessive, but on one occasion when the office determined to resist the demand made, as they have a right to do in the case of buildings, and took upon themselves to restore the premises, they allowed the restoration to go on until it was very nearly completed, and then by collusion among themselves they burnt it down again. I gave the man to understand in this ease that I should next time have a watchman on the premises day and night; the effect was, that he consented to take a very much smaller sum than he had claimed. Sometimes a very distressing character is given to a fictitious fire, in order to convey to the world outside that there has been a very narrow escape. I remember a remarkable case, in which through one of the workmen becoming partly inebriated, he revealed what we could not otherwise get at. I wanted the authorities to take the matter up, but they had no power to do so. This man whom I have alluded to described how the partition had been taken down, so that the fire in the back part might be connected with the shop; when the fire occurred there was plenty of facility for coming down stairs in the ordinary way, but the trader preferred passing a young assistant through one of the windows on the first storey, in order, it was believed, to impress his fellow-townsmen. We had a very troublesome reference, his claim being nearly double the amount paid.

It may be observed that, in most of these cases, when arrangements are made for the spread of fire it has very much its own way so far as the particular premises are concerned; but that if, as contemplated for the metropolis, the means of extinction were placed within every fifty yards of space, and made available in little more than two minutes of time, instead of twenty, the difficulties of incendiarism would be vastly augmented, and the conditions of temptation wholly changed. The principle of the constant supply was first fully developed by the first General Board of Health, and it then declared confidently that its adoption would reduce the amount of fires by more than two-thirds. That declaration has been fully realised subsequently by the experience of Manchester, Glasgow, and Liverpool. The eost of setting aside the evidenee and reeommendations of that Board in 1852, and of yielding to the influence of the directorates and others of the trading water companies must have been upwards of two thousand subsequent serious fires, and of considerable loss of life, that is to say, two-thirds of that which has subsequently occurred; besides several millions of capital sunk in separate works that might have been saved, and an annual waste of establishment eharges. Two-thirds at the least of the existing fire risks, affecting some twenty millions in annual value of real property in the metropolis, are now demonstrably the cost of continued inattention and delay of proved measures at the door of the legislature.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Seott, C.B., secretary.]

LACE AT THE INTERNATIONAL EXHIBITION.

The collection of lace exhibited in the East Galleries attracts a large number of appreciative spectators. Those who take a lively interest in the lace work of to-day, gaze lovingly on the delicate *point gaze* for which Brussels is daily becoming more and more famous, while others of an antiquarian turn of mind linger fondly over choice examples of *point de Venise*, Spanish point, *point d'Alençon*, and *point d'Argentan*. From the historic point of view the exhibition is peeuliarly interesting—albeit the history of lace commences in comparatively modern times. Doubtless the art of producing geometrical designs by drawing out the threads of a linen fabric was known at a remote period, and developed by degrees into what is known as "cut work," then into Greek lace, and through the various kinds of plaited lace and *guipure* into the true "point" lace. Possibly the earliest, but certainly the most important seat of this manufacture was Venice. Concerning the invention of the beautiful fabric known as *point de Venise* there is a tradition, as trustworthy perhaps as most other traditions. A young Venetian sailor voyaging in the Southern Seas, preserved a beautiful specimen of the coralline known as "mermaid's lace," and on his return gave this trophy to his lady-love. Now this damsel was a maker of lace after the clumsy antique fashion, and was much struck by the more refined beauty of the "patternless" wavy wandering design traced by the hand of Nature herself. Setting to work to imitate the coralline, she very soon succeeded beyond her wildest hopes, and created a fabric the like of which had not been seen, and has not since been excelled.

Point de Venise became celebrated, and the Queen of the Adriatic, at the moment when art and commerce were beginning to forsake her, found herself without a rival in the manufacture of lace. At length the large importations of Venetian point into France attracted the attention of Colbert, who at once set to work to encourage French lace-making in the most practical and business-like manner. Edicts without number had been passed, forbidding the introduction of foreign laee into France, but had of course proved useless—the ladies and gallants who sighed and fought, and made verses and love under the successive reigns of Richelieu and Mazarin scorning to wear the crude material made by native laee-makers. Colbert engaged a certain Madame Gilbert, skilled in Venetian lace-making, as directress, hired a number of assistants, and planted the new industry at Alençon. As might have been expected, as good Venice point was

made at Alençon as at Venice itself. It soon became the fashion to prefer the native lace, and the name of Alençon grew well known in the lace trade. As became a fresh and vigorous cutting from the parent stem, *point d'Alençon* disdained after a while to be a mere imitation *point de Venise*, and diverging by degrees from the original design, assumed a distinct individuality of its own. Like its ancestor, the new lace was made entirely with the needle on a piece of parchment, no pillow or bobbin work or applied flowers entering into its composition. For beauty of material and true elegance of design, the product of Alençon has never been surpassed. The fineness of the work is almost painful to look upon, and necessitated the introduction of horsehair into the border of the flowers to produce the stiffness required by certain —now byegone—fashions. For nearly two hundred years Alençon reigned supreme over the realms of lace. Pillow lace was and is largely manufactured in France, but is a very inferior material to that made with the needle. Alençon, however, was at last doomed to encounter a tremendous rival. Within the last quarter of a century the manufacturers of Brussels have set themselves seriously to work to imitate *point d'Alençon*, and their efforts have been crowned with such success as to threaten the parent industry with extinction. *Point gaze*, absolutely identical in appearance with its French progenitor, can be produced at about two-fifths of the price. For example, the finest Brussels point, made entirely by hand, and therefore by no means a cheap production, may be worth £6 per yard, while Alençon of the same width and workmanship would cost £15. The Brussels point has attained extraordinary perfection in raised flowers with loose petals, and in butterflies, whose wings, being almost detached, add greatly to the beauty and curiosity of the work. No horsehair is used in *point gaze*, an advantage so far as wear and tear is concerned, as it often shrinks in washing, but for all this the same effect is produced as by the Alençon method, that is to say, the same effect at a distance of three feet from the eye; but very close inspection fails not to reveal the greater fineness and more minute finish of Alençon work. Something might—not long since—have also been said as to the superior elegance of the French designs, but this advantage is now hotly contested by the adventurous Belgians, who employ designs without regard to cost.

Although the highest pitch of excellence has only lately been achieved by the Flemish lace-makers, they have produced an enormous quantity of point and pillow lace during the last two centuries. It must always be borne in mind that what is called by the French *point d'Angleterre*, is not English, but Flemish lace, which acquired its *nom de commerce* by being first sent—in troublous times—to England, and then imported or more frequently smuggled into France. The same lace was known in this country as Mechlin. Therefore, whenever the terms *point d'Angleterre* and Mechlin lace are met with in French and English literature they must be taken as convertible generic terms, indicating the finer produce of the great lace-making industries of Flanders.

While the tendency of Venetian, French, and Flemish point was toward more ætherial forms, Spanish lace and the so-called "bone point" assumed a rich and heavy splendour, totally opposite in style and effect to the work of Alençon. These massive kinds of lace more resemble heavy linen embroidery, with the cambric base on which it was worked cut away, than any other kind of lace known. This ponderous style is admirably fitted for coverlets, capes, collars, and altar-cloths, showing to great advantage against a background of velvet, or any rich dark-coloured material. Many superb specimens of Spanish and bone point enrich the present collection, and at once attract observers by their grand and solid effect. There is nothing gauzy or ephemeral about bone point, which consists of rich pieces of work linked together by a light skeleton, having large bold interstices to reveal the background, absolutely necessary to exhibit this grand lace in its full perfection.

In addition to many examples of all kinds of "point," the exhibition contains innumerable specimens of pillow lace, such as Valenciennes, the true Mechlin, and many varieties of English lace. Other laces in the collection are of mixed manufacture, that is to say, the flowers are made on the pillow and then incorporated in a groundwork made by the needle. Of this mixture of "point" and "plat," the *point de Medici*, made by Messrs. Buchholtz, is a very successful example. The laces called *point de Flandre*, *point Duchesse*, and *point de Paris* are really not "point" at all, being made on the pillow. Another inferior kind of lace is that known as *point appliqué*, which is purely and simply a cheap imitation of a superior class of work.

Among the exhibitors, Mr. A. Blackborne, of South Audley-street, takes a prominent position. His collection includes valuable examples of the more remarkable varieties. Among these are some superb *point de Venise* coverlets of the time of Louis Quatorze, early specimens of Alençon (produced shortly after the establishment of that industry), a chalice veil of the same exquisite make of the time of the Empire, and a fine sample of d'Argentan, a lace in some respect akin to that of Alençon, but distinguished by a very bold style of design. Interesting as are these specimens, they are entirely dwarfed by a magnificent "bone point" coverlet, which once belonged to Louis XIV. This magnificent piece of work was made on parchment, with the help, it is said, of a very strong magnifying glass. It is two and a quarter yards square, and is certainly the most important article in the entire collection.

Mrs. Hailstone sends a very interesting case of ancient lace, among which is some curious old Greek *point coupé*, showing the state of design at the transition period previously referred to. An Indian attempt at lace-making with cocoa-nut fibre is worthy of notice, as are also some superb *point de Venise*, and a pair of Mechlin lace ruffles worn by the Young Pretender. Lady Drake contributes a curious flounce of point and guipure, partly worked in gold thread, several fine pieces of Venice point, especially a beautiful cape, once the property of Marie Antoinette, and a charming flounce of English pillow lace of the seventeenth century. In the two cases of lace sent by Mrs. Bölckow are magnificent specimens of Venice and Spanish point, *point d'Argentan*, and English rose point. The gem of Mrs. Bölckow's collection, however, is a superb priest's robe, formerly in the possession of the Archbishop of Padua, and of the kind worn by the bishops at the Œcumenical Council. A piece of Venice lace trimming for a priest's robe, with a figure of St. Michael, is also well worthy of careful inspection. Mrs. Alfred Morrison also sends a St. Michael overcoming Satan, in "bone point," a splendid set of Spanish point trimmings and collar, and altar-cloth in Spanish point, several fine pieces of Venetian rose point, and a quantity of elegant *point d'Alençon*. A flounce of superb *point de Venise* is exhibited by Lady Middleton, and exercises an immense power of attraction over visitors to the department. Mrs. Bateson contributes a charming selection of the lighter descriptions of point, among which are a pair of *point d'Alençon* sleeves, once belonging to Marie Antoinette, some fine pieces of *point d'Angleterre*, *point d'Alençon*, and Valenciennes, an unique set of *point d'Argentan*, and a handkerchief of *point d'Angleterre*, valued at 200 guineas. Lady Middleton sends a superb piece of Venice point, and Lady Walsingham exhibits some *point d'Argentan* of remarkably elegant design and superb execution. Well worthy of attention is an antique Flemish flounce (exhibited by the Countess of Chesterfield), curiously wrought with human figures playing on musical instruments, and it is interesting to compare this with Lady Sheffield's fine specimen of old Valenciennes richly adorned with classical figures.

Lady Poltimore contributes a dress formerly belonging

to Marie Antoinette, whose monogram appears on the work. Mrs. Davidson also sends a relic of the unfortunate queen—a deep flounce of Venice point. In this lady's collection is another noteworthy specimen of Venetian work—a fragment of an altar-cloth of Venice guipure. A choice selection of old lace is exhibited by Mrs. Bischoffsheim, whose curious old *point de Binche*, old Valenciennes, and Venetian laces all merit study.

In addition to fine specimens of their own make, modern makers and dealers in lace bring a rich collec-lection of antique work. Messrs. Hayward exhibit a quaint example of early *lacis*, some fine old Spanish and Venetian point, *point de gênes*, and several pieces of curious old Italian guipure, and some valuable old Flemish. Side by side are several superb specimens of Honiton. Among the modern work exhibited by this house, the central position is very properly occupied by a full-sized lay figure, attired in a mauve silk dress, fully trimmed with *point gaze;* the *garniture* is complete, flounces, rimming, and handkerchief, all in order. A rival figure is sent by Messrs. Howell and James. This dumb lady is attired in purple velvet, adorned with gorgeous Honiton. Messrs. Desmarès, of Brussels, send a magnificent collection of *point gaze*, and also a quantity of the inferior but still very effective *appliqué* work.

A superb selection from the various kinds of laces manufactured by them is sent by Messrs. Buchholtz and Co., who occupy a prominent position among the great lace manufacturers of Belgium, and have distinguished themselves by taking medals at the Exhibitions of London in 1862, Paris 1867, and Vienna 1873. This firm employs nearly ten thousand persons, a large proportion of whom are occupied in making that *point gaze* which appears destined to take the place of *point d'Alençon.* The workers are women and children from the age of seven upwards. A large number of nuns also follow this delicate industry, the "output" of fine lace from the Belgian convents being very large. Messrs. Buchholtz devote their energies to the production of *point gaze*, or "real Brussels," which is all made with the needle on parchment. It may be imagined that—as it would take one person between thirty or forty years, or about an average working lifetime, to make a complete set of *garniture*—this costly lace is made in small pieces divided among a a number of workers. Both flowers and ground are produced by hand. The flowers are done in plain clothing and Brussels stitches, one part of the leaves being executed in close and the other part in more open tissue. By thus nicely gradating the density of the fabric the pattern is brought out into skilful relief, and by skilful arrangement of airy tissues, effects of singular boldness may be produced. The sections of work are now joined together by a skilful hand. Three lace-makers are required to make *point gaze*—the *gazeuse* to make the flowers and the groundwork, simultaneous operations; the *brodeuse* to fix the *cordonnet* for the relief work; and the *fonneuse* to make the stitches for the open work. These workwomen earn from a shilling to half-a-crown a-day, and it takes a squad of three nearly a month to make a yard of *point gaze* two inches in width. The thread is spun at Ghent, and sometimes costs as much as £60 per pound.

A superb example of this choice work, now exhibited by Messrs. Buchholtz, gained the first prize last year at the Vienna Exhibition. It is a complete *garniture*, consisting of a large half-shawl, seven yards of flouncing eighteen inches wide, a berthe lappet, parasol cover, fan, and handkerchief. This *garniture* occupied a dozen skilled lace-makers for three entire years, and cost 40,000 francs. The design and execution of this *garniture* are of extraordinary beauty. Bold groupings of flowers are executed with marvellous delicacy of shading; but perhaps the most remarkable feature of this fine work is the raised or double work shown in the roses. The petals are actually partially detached from the body of the work, and give a startling verisimilitude to the hand-made flower.

In addition to the *point gaze*, or pure and unadulterated Brussels point, Messrs. Buchholtz exhibit fine specimens of "plat" and "point" mixed; also some handsome pieces of pillow lace, such as Valenciennes and Mechlin, and a few choice examples of black Brussels—a beautiful and well-known lace made with silk on the pillow.

The whole of the lace, ancient and modern, has been admirably arranged under the superintendence of Mrs. Bury Palliser, whose "History of Lace" is well known as the standard work on the subject. To add to the attractions of the lace department for persons of a practical as well as artistic turn of mind, several lace-makers are employed in the adjacent quadrant in the active exercise of their pretty handicraft.

The following is the return of admissions for the fourth week, ending April 25:—Season tickets, 1,289; payment, 11,206; total, 12,495.

The process of purification of sewage shown by the Phosphate Sewage Company is now in daily operation from 2 to 5 p.m.

The French galleries (rooms 19 and 20) are now open; the French Annexe and the Indian Court are still in course of arrangement. They will be opened to the public on the earliest day possible.

The Exhibition of Foreign Wines in the vaults of the Royal Albert Hall is open each day from twelve till five o'clock. The admission to the vaults is sixpence extra. Visitors may taste the exhibited wines on payment of the charge fixed by each exhibitor.

It has been determined to have military bands every Thursday and Saturday during the season. On Thursdays the band will play in the Court of the French Annexe; on Saturdays it will play near the Bier Garten in the Western Annexe. The Queensland Annexe will be open to the public on Monday next.

PUBLIC MUSEUMS AND LIBRARIES.

The following returns of the numbers of visitors for April have been received up to the present date:—

	Number of Visitors.
British Museum	(no return)
National Gallery (Trafalgar-square)	82,808
Kew Gardens and Museum	83,310
South Kensington Museum	106,831
Bethnal-green Museum	60,216
Geological Museum, Jermyn-street	4,533
Patent-office Museum	26,980
Edinburgh National Gallery	5,214
Edinburgh Museum of Antiquities	4,373
Edinburgh Museum of Science and Art	16,953
Royal Dublin Society:—	
Natural History Museum	6,434
Botanic Gardens, Glasnevin	27,339
Dublin National Gallery	
Zoological Society, Dublin	9,046
Museum of Irish Society, Dublin	
Tower of London	13,361
Royal Naval College, including Greenwich Painted Hall	36,003

The Birmese Ambassadors, during their visit to England, ordered a complete plant for extensive ironworks. They propose having in Birma two blast-furnaces, six puddling furnaces, mills for rolling merchant bars, rails, hoops, sheets, plates, wire-drawing mills, and in fact every requisite for turning out finished iron of all descriptions. The mills are to be erected about twelve miles from Mandalay, the capital.

COMMISSION ON SCIENTIFIC EDUCATION.

FOURTH REPORT.

(*Concluded from page 572.*)

In the seventh and concluding portion of their report, the Commissioners deal with a question on which there has been a good deal of discussion, that of the possibility of assisting technical instruction by means of lectures to be delivered in the British and other Museums.

(VII.)—PUBLIC LECTURES IN CONNECTION WITH MUSEUMS.

On this point they have received a good deal of evidence, but of a very varying nature. Several of the witnesses who approve of the idea that some scheme of lectures should be adopted, attach widely different meanings to the word. Some consider that purely elementary courses of lectures should be provided, others hold that the lectures should be of an advanced class; others again would like to see both popular and advanced courses given. On the other hand some witnesses considered that lecturing would be quite incompatible with the ordinary duties of the museum officials. As regards the British Museum, the Commissioners are distinctly of opinion that it would not be advisable to institute systematic courses of lectures, while at the same time they look favourably on the occasional demonstrations that have been made by some of the officials in the museum galleries. The reasons for their opinion are various. Thy do not consider that such different occupations as lecturing and curatorial work could well be carried on by the same person, nor do they consider it advisable that a special educational staff should be added to the present staff of the museum. They remark that special collections would be required for purposes of illustration, and as these would have to be kept separate from the large and more valuable collections, there would be no advantage in keeping such selected specimens at the British Museum. The Commission look rather to the educational advantage to be gained by careful araangement, cataloguing, and labelling, rather than to the more direct instruction of lectures.

In the case of provincial museums these objections are not considered to hold with the same force, and the Commissioners are of opinion that it would be of great advantage for the diffusion of scientific knowledge, that arrangements should be made for giving courses of scientific lectures in such provincial museums of natural history as have typical collections of specimens, and are provided with convenient lecture-rooms. These lectures should be explanatory of the contents of the museum, and accessible to all parties on tho payment of a small fee.

In the same way these objections "do not apply to those museums, whether metropolitan or provincial, which contain collections of physical, mechanical, and chemical apparatus; of geometrical models; or of models illustrating the progress of machinery and in manufacturing processes."

In such museums the curator's duties are simple; he is not engaged in original research or study, and he may well employ his time in explaining well-known principles to the public.

On the whole, the conclusions arrived at lead to the following recommendations:—

That courses of lectures be given in connection with the collection of physical and mechanical instruments, the establishment of which we have proposed, the object of these lectures being to illustrate the progress of scientific and mechanical discovery and invention.

That the establishment of lectures on science, accessible to all classes on payment of a small fee, should be promoted by the Government in the great centres of population.

That, in the first instance, with the view of carrying out the preceding recommendation, the system of instruction of this kind, which has already been established by the Government in the metropolis, should be developed by the institution of courses of lectures on the principal branches of experimental and natural science.

That the proposed lectures be of two kinds. First, lectures of an elementary character on the general principles and most important facts of science. Secondly, lectures specially intended for the working classes on the application of science to the arts and industries of the country.

The concluding paragraphs of the report stated that throughout the Commissioners have been guided by two convictions:—

The first, that the diffusion among the people of a general knowledge of science is in itself an object of great importance, and that, in particular, an acquaintance with the manner in which abstract science is brought to bear upon industrial occupations is of the greatest moment to the working classes of this country, not merely as tending directly to increase the skill of the artisan in his handicraft, but as the best means of awakening his intelligence, by forcing him to reflect upon the general laws which are exemplified by the processes with which he is familiar in his daily life.

The second, that no real advancement of knowledge and none of the higher benefits from science as educational discipline are to hoped for from merely general and occasional scientific instruction, whether it be derived from books or from lectures, but that such advancement and benefits will result only from systematic and sustained study.

While, therefore, they deprecate the notion that no scientific institution ought to be supported by the State unless it contributes directly in some way or other to the instruction or entertainment of the general public, they advocate the fullest extension of popular instruction in science, whether by lectures in connection with public museums suited for such purposes, or otherwise.

The following appendixes are added to the report:—

Appendix I.—Statement of the amounts taken for the various museums in the estimates for the financial year 1873-74.

Appendix II.—Documents relating to the Botanical Collections at Kew and at the British Museum.

Appendix III.—Extract from Mr. Lockyer's report on the aid given by the State to Science in France.

INSTRUCTION AND FINE ARTS IN BELGIUM.

The recent discussion on the budget in the Belgian Assembly presents many points of interest connected with education, art and science, and especially in relation to the International Exhibition at South Kensington.

The amount devoted to primary instruction is, in round numbers, £247,200. Under the head of letters and science, including the academies, museums, Royal library, observatory, scientific explorations, encouragement to scientific men, and publications, is upwards of £21,700. Under the head of fine arts, the sums set down in the budget and adopted by tho Assembly are, for purchase of works of living artists and other means of encouraging painting, sculpture, and engraving, £10,400; assistance given by the State in the purchase of works of local museums, £800; the Antwerp and other academies and schools of art, £9,386; the Conservatoires of Brussels and Liège, and the public schools of music, £10,333; the Royal museums of painting and sculpture, and the Royal museums of arms and antiquities, £6,840; to monuments to public men, £1,200; restoration and preservation of public monuments and works of art, £5,468.

In the first vote under the head of beaux arts, quoted above, was included the sum of £4,000 devoted to the first four London International Exhibitions. It was stated that England had, since those exhibitions had commenced, become an excellent market for Belgian works of art, and that last year the sales amounted to more than £9,000, and the orders to £2,800. The Belgian collection this year is not only more brilliant than last year, but more numerous by one hundred works.

Aeeording to *Nature*, the Rev. Henry Moule, after a series of experiments, extending over twenty years, has devised a process of manufacturing an illuminating gas from Kimmeridge clay.

The Russians are about to explore the eourse of the Oxus. An expedition which is being organised with this object is, to ascertain how far the Oxus is navigable, and what is the average depth at various seasons of the year.

THE RESOURCES OF THE ISLAND OF YEZO.

According to the opinions entertained and expressed by Sir Harry Parkes, the Japanese Government do not at present evince a full appreciation of the benefits they might derive from the great natural resources of the Island of Yezo, nor are they fully alive to the manner in which these might be best developed. It appears that Mr. Watson, whilst upon a visit to Hakodate, took the opportunity of making a visit to Sapôro, the chief town of Yezo, and of recording his observations made during that excursion. The road which has recently been completed by the American surveyors, under the direction of General Caporn, leading from Hakodate to Sapôro, consists of two portions of thirty and ninety miles length respectively. The first of these two connects Hakodate with the village of Mori, on an arm of the Pacific Ocean called Volcano Bay, which takes its name from three volcanic mountains overlooking it. From that place the road sweeps round the sea and enters the hills opposite at a distance of some fifteen miles. It then passes over a high hill to the east of the village and plain and river of Ono, and descends on the other side between two small lakes in the woods at the foot of the volcano of Homogataki. Thence it stretches in a straight line through a forest for ten miles further to Mori. Near Hakodate the road is forty-five feet in breadth, but further on its breadth is lessened to thirty feet. It has been admirably constructed throughout, under the direction of Major Warfield, of the American Agricultural Mission. and it does not show a single slip, notwithstanding the rapidity with which it was carried out, and the heavy rains to which it has been exposed. The survey undertaken prior to its commencement was only begun in April, 1872, and since then 120 miles of excellent carriage-road has been opened for traffic. From Mori, a person proceeding to the opposite coast has the alternative of going round the head of the bay—about seventy-five miles—or of crossing the bay in a junk, a distance of about twenty miles. A line of telegraph has been constructed between Hakodate and Mori, and it is being continued round the head of the bay to Skin-Moraran, whence it will be carried on along the road to Sapôro. Skin-Moraran, formerly known as Endermo, lies at the upper end of the inlet of Endermo, which forms an admirable harbour, capable of containing a large fleet of vessels, and the approach to which might be readily fortified, there being an island at the mouth of the inlet. At the upper end of this beautiful harbour, where a village is now springing up, the main part of the road to Sapôro begins.

Sapôro, the chief, though not the most populous town of Yezo, the seat of the general government of the island, dates only from 1871. It covers about a mile square, and is situated on a fine plain, with wooded hills, about two miles from the town, and close to the Toehera, a tributary of the Ishikari, with which latter stream a small canal likewise connects Sapôra, the distance from Sapôra to the Ishikari being about fifteen miles. There are seven feet of water over the bar at the mouth of the Ishikari. The Toehera is navigable to within two miles of Sapôra for river boats of light draught, capable of transporting fifty tons of goods each. Sapôra is connected with the nearest seaport—Utarimai, on the west coast—by a good road of twenty-three miles' length. The former town has been laid out with a view to its future importance, and contains a government house, several Japanese hotels, a number of houses of superior construction for the use of Japanese officers, and still better houses for the American Mission; the streets are broad and well made, and there are a hospital and other edifices of a public nature. Up to the present time the vicinity of Sapôra is scarcely at all cultivated, with the exception of a few vegetable gardens, in which the ordinary European vegetables are very successfully grown, and the only industry which is apparent in the town is the working of timber—two steam mills being in operation. Mr. Wassoon, with his Japanese assistants, are employed in triangulating the island. He trusts that he may be enabled, by the close of 1874, to lay down correctly upon a map its exact outline and main features, the greater portion of the interior having probably never been explored even by natives of Japan. The chief geologist of the Mission, Mr. Lyman, did not speak with much enthusiasm of the mineral productions of Yezo. He had found coal at some few miles distant from the Ishikari river; but the coal field which he seemed to think most suited to turn to practical account is situated near the roadstead of Iwanai, on the western coast, some forty miles south of Utarimai, the port of Sapôro above referred to. Traces of the following productions have been detected in certain localities, namely:—silver and lead (very thin layers), manganese, iron pyrites, iron sand, copper, zinc, rock oil, and gypsum, as well as sulphur in abundance; but it is probably in its timber and its various fisheries that the chief productiveness of Yezo will for some years hence be found to consist.

Its forests contain an enormous quantity of timber of some of the most serviceable varieties, such as oak, pine, birch, plane, beech, walnut, ash, elm, chesnut, &c.; and the products of these forests might be readily conveyed to the ports of Shin-Moraran or Utarimai. The selling price of wood must vary according to the demand, but taking one wood with another, 35 dollars per 1,000 feet of prepared wood might be an average price at Yokohama. According to the estimates which result from inquiries and examinations instituted by General Capron in the forests of Yezo, one average tree may roughly be assnmed to contain from 300 to 500 feet of planking, and one average acre 42,500 feeet, more or less. If then, 1,000 feet of prepared timber may at an average be assumed to be worth 35 dollars, the produce of one acre of wooded land ought to realise nearly 1,500, less the cost of labour in bringing it into a marketable shape and in carrying it to market. If certain calculations can be relied upon, it would appear that by an outlay of 25,000 dollars, there might be produced daily, in the forests of Yezo, a quantity of prepared timber, which, if brought to market, would be worth 1,225 dollars, or allowing for seventy three holidays, or non-working days in the year—that is the customary number in Japan—there might be produced, for the above outlay yearly, timber to the value of 357,700 dols., less the cost of working the machines and of carrying the wood to market, and these figures might be doubled were the same machinery to be worked during twenty hours of each day in place of ten, that is to say, were it worked by a double relay of workmen. It would seem to be a necessary condition for the successful development of the island to throw open to foreign shipping the three ports of Endermo, Iwanai, and Utarimai, as it would thus be possible to avoid the expense and delay consequent on an extra shipment. At Endermo, with all its obvious advantages, there seemed to be but little trade; but this state of things, it may fairly be anticipated, will be altered when the waggons and public conveyances which have been ordered will have begun to ply along the road between Endermo and Sapôro. The reasons for its being desirable to throw open Iwanai and Utarimai respectively, are the vicinity of the former place to the coal-fields, and that of the latter to the Ishikari River and to Sapôro. At Iwanai there were present a considerable amount of native shipping, and at Utarimai Mr. Watson counted upwards of 100 junks. Both these towns are situated on a well-peopled coast. The total value of the exports from Yezo is estimated at 8,000,000 dols. per annum.

In 1872 there were built in the Dominion of Canada vessels amounting to 115,000 tons, of which 90,000 tons belonged to Nova Scotia and New Brunswick.

THE RECEPTION OF THE WESTERN REPRESENTATIVES AT PEKIN.

The correspondence respecting the audience granted to her Majesty's Ministers and the other foreign representatives, at Pekin, by the Emperor of China, is significant of the changes that have been forced upon that hitherto secluded Court, by this admission of equality, which has not, however, been obtained without repeated negotiations and discussions. Although it would be wrong to over-estimate the immediate effects of these concessions, yet we may presume that China has commenced her retreat from the maintenance of that claim to be greater and better than her neighbours, which has proved, more than any other, a cause of hindrance to improvement at home, and, as a consequence, a standing danger to the security of her relations abroad. The representatives of other powers having stood, face to face with the Emperor, for the first time in its history, the empire has thus broken with tradition, not with a very good grace, but still in manner past recall. The order of proceeding, described by Mr. Ward, was as follows:—

The place appointed by the Emperor was the Tzú-Kuang-Ko, or purple pavilion, a large storied building west of the palace. The palace itself, that is to say, the precinct designated by foreigners the "forbidden city," lies about midway between the east and west outer walls Pekin proper. Round this precinct, at a distance of from a quarter to half a mile, runs an *enceinte*, known as the Huang Ch'eng, usually rendered the Imperial City. This is divided into streets, and with the exception of the grounds lying westward of the palace, is generally open to the public. We rendezvoused according to arrangement at the Pei-tang, a Romish cathedral and mission-house, and were thence escorted by a minister of the Yaman, to the north gate of the palace grounds in our chairs. We had come to the Pei-tang through the west of the outer city, large numbers of people being already on the alert to see the foreigners who were to be presented to the Emperor without prostrating themselves. At the Fu-Hua-Men, the gate by which the palace grounds are here entered from the north, we left our chairs, and were received by the grand secretary and all other ministers of the Yamen, the Prince and the Ministers Pao and Shen excepted. We had been told that they would be in attendance all the morning on his Majesty. We proceeded, according to the programme, to the Shih-ying-Kung, or palace of seasonableness, a temple in which, as circumstances require, the Emperor prays for rain, or for cessation of rain. Confectionery, tea, and Chinese wine from the Emperor's buttery were offered us, and after waiting above an hour, we moved on with the ministers to a large tent pitched westward of the purple pavilion.

The Emperor did not arrive at the pavilion as soon as we had been lead to expect. At length, after we had waited in the tent at least an hour and a half, the Japanese Ambassador was summoned to the presence, and, his audience ended, came our turn. In front of the pavilion in which we were received is a great platform of stone, accessible on three sides by flights of steps. We ascended, as it had been arranged after some debate we should, by the steps on the western side, and entering the pavilion, found ourselves at once in a large hall divided by wooden pillars, in the usual northern style, into five sections. We came into this by the second section from the west, filing into the centre section until we were opposite the throne, on which the Emperor was seated at the north end of the hall. We then bowed to the Emperor, advanced a few paces and bowed again, then advanced a few paces further, bowing again, and halted before a long yellow table about half-way up the hall, some ten or twelve paces distant from the throne. The throne was raised above the floor of the dais on which it stood by a couple of steps. The dais itself was separated from the hall by a light rail, broken right and left of the throne by low flights of three stairs each. The Emperor was seated Manchu fashion—that is, cross-legged. Upon his left were the Prince of Kung, his brother, and another Prince, the son of the famous Sangolussen, who repulsed our attacks on the Iaku forts in 1859. To the right of his Majesty stood two other magnates; below, on either sideway, a double rank of high officials, which spread outwards from the throne towards us, until their flanks reached the columns marking the outer line of the centre section in which we were standing. In rear of these were others filling the flank sections east and west up to the walls. Our party having halted, the Minister of Russia read aloud an address in French, and then our letters of credence were placed upon the table. The Emperor made a slight bow of acknowledgment, and the Prince of Kung falling upon both knees at the foot of the throne, his Majesty appeared to speak to him. Accordingly, as soon as his Highness rose, he descended the steps, and informed us that his Majesty declared the letters of credence had been received. Then returning to his place, he again fell upon his knees, and the Emperor having again spoken to him in a low tone, he again descended the steps, and coming up to us informed us that his Majesty trusted that our respective rulers were in good health, and expressed a hope that foreign affairs might all be satisfactorily arranged between foreign ministers and the Trungh Yamen. This closed the audience, which may have lasted more then five minutes. We then withdrew in the usual fashion, and bowing, we were conducted to our chairs by the Ministers of the Yamen.

PRESERVATION OF MEAT.

This subject has again been brought before the Paris Academy of Medicine, in the form of a report by M. Poggiale to the committee of hygiene of the Department of the Seine, on the subject of preserving meats by means of cold alone. The reporter says that some one, whose name is not given, has constructed a chamber, in which a low degree of temperature is obtained by the evaporation of methylitic ether, the apparatus evaporates and condenses the ether, and causes the circulation of chloride of calcium, and by means of tubes cold is distributed to all parts of the building where it is required. The walls are, of course double, and isolating, the air within is constantly agitated by a ventilator, and is maintained at a temperature between 0° and 1° Centigrade.

All kinds of butchers' meat were laid in the chamber, and all the available sorts of poultry and game were hung up within it.

At the end of six, eight, or ten weeks, says M. Poggiale, the viands were withdrawn from the refrigeratory chamber; their appearance had in no way changed, but their weight had diminished, especially in the case of the poultry and game, to the extent of about 12 per cent.; the odour of the meat had in no way altered. These viands were tasted at meetings of the members of the Academy of Sciences, and left nothing to be desired as regards freshness and flavour. M. Poggiale did not hesitate to declare his conviction that we had at last arrived at the means sought so eargerly during the last half century, of insuring the preservation of meat without alteration.

M. Bouley, one of the members of the Academy of Sciences, confirmed the conclusions of M. Poggiale, with some reservation. He said that the butchers' meat was admirably preserved, that it retained all the wholesome qualities of fresh meat, and that it ought to inspire the most delicate palate with confidence, and not cause any of that repugnance which preserved meat often created, especially in the case of women, but he could not help avowing that an epicure could not be mistaken, and would assuredly distinguish

a preserved from a fresh fillet of beef. At the same time the preserved fillet left no recollection of anything in flavour which was not normal and excellent. With respect to the game and poultry, he could not say as much; the flavour was diminished, and the flesh had acquired somewhat of a greasy flavour. However, M. Bouley shared the opinion of M. Poggiale, that the results of the trials were very remarkable, and that if the method in question were carried out, on a large scale, wholesome, nutritive, and savoury meats might be sold at rates lower that usually a quarter, a third, or a half.

BAMBOO AS A TEXTILE MATERIAL.

A Brazilian correspondent of the American *Manufacturers' Review and Industrial Record* gives the following account of the preparation of a fibre for textile purposes from the bamboo :—

"The first part of the process consists in cutting the knots or joints with a circular saw. Then place the proper quantity in a tub or boiler, having a perforated steam pipe at the bottom. Put in cold water and then caustic soda ; the quantity of the latter is governed by the quantity of the bamboo, and must be determined by experiment, some qualities requiring more than others. Steam is then turned on, and the boiling kept up four or five days with the caustic soda. The caustic liquor is then drawn off, and fresh water poured on. Rinse again, put in fresh water, and boil for three or four days. Draw off the water and put in fresh a second time. Repeat these operations as before, until you have got all the soapy or soda nature out of the bamboo. During the boiling procees, it is necessary to have a close-fitting board or lid to the tub, to bear down on the sticks or fibres of the bamboo, the lid weighted down with stones to keep the board down ; iron weights will not do, but a wooden screw might be made, such as are on cider presses, to press down the board to the bamboo. Now comes the second part of the process. While the bamboo is in a wet state it is put into a machine, resembling an English mangling machine, where a heavy roller, weighing 1,800 pounds, runs over it to crush it. After being thoroughly crushed, it is put out to dry thoroughly in the sun. It is next put into a flax breaker card, clothed with No. 14 clothing, or wire pins, driven in lays. After being run through the above breaker, it is run through a flax finishing card, with No. 16 wire clothing; after that it is run through a flax circular card, with thirteen workers and strippers. The workers and strippers are on the top and bottom, or all around the card. The workers and strippers are clothed with No. 18 clothing (flax), and the cylinder card has two doffers. The doffers are clothed with No. 20 for the bottom doffer, and No. 19 for the top doffer. The circular card is provided with an apron, like the feed apron of a cotton lapper, which carries the bamboo from the doffer, as the comb plate takes the fibre from the two doffers.

"After being oiled and soaped in the same manner in which you oil a batch of wool in the picker house, it is run through a first breaker wool card, clothed with coarse woollen card wire. It is then put up in bales ready for scouring and dying, and for mixing with wool, silk, cotton, or any other fibrous substance. It mixes readily with almost anything, and takes colours without difficulty."

The exports of manufactured articles, from the United States, in 1873, were, machinery, 3,120,984 dols.; locomotives 952,655 dols. ; nails and spikes, 356,299 dols. ; steam boilers, 232,546 dols. ; castings, 159,234 dols. ; rails, 104,054 dols. ; stove, 115,792 dols. ; stationary engines, 111,507 dols. ; general iron manufactures, 3,262,170 dols. ; edge tools, 846,452 dols. ; fire-arms, 1,181,869 dols. ; general manufactures of steel, 297,541 dols.

CORRESPONDENCE.

PATENT-OFFICE MUSEUM.

Sir,—Your correspondent "C. E." appears to think he has got the Commissioners of Patents on the horns of a dilemma. Either they should have appointed an engineer to the vacant curatorship of their museum, or they should have given the berth to one of their clerks. Now the mere point whether they appointed a man already in their service or another, seems to me a mere point of departmental discipline which must be left to the chiefs of the office to decide. On public grounds it is probably a gain that this course was not taken. The rule through the Civil Service is to appoint by simple rotation, and as ill-luck will have it, there is never by any chance a round hole which becomes vacant without there being a square man ready to be promptly dropped in. The wider the field of choice for such a post as the one under discussion, the more likely it is that a good man will be chosen.

Equally fallacious, to my notion, is the idea that an engineer should be the man to superintend a mechanical museum. If it was part of a curator's duty to manufacture his models, or to take them to pieces for cleaning, it might be different, but it is not so. Any skilled art that is required, even to the highest, can always be had by paying for it; and it is no more necessary for the curator of the Patent-office Museum to be a good engineer than it is for him to be a good chemist, photographer, architect, or land-surveyor. The man required should absolutely be without a speciality. He should be a good adminstrator, and a clever man of business. He should have a touch of the showman about him, so as to know what the public will like in his museum, that he may direct public attention—and public money—to it. An educated man, and a man with a good general knowledge of practical and technical science he must be, and the one special qualification that would be useful would be a knowledge of the history of invention. It is shrewd practical admistration which has made South Kensington what it is, and produced the contrast noted by "C. E." between the two museums.

If in the Commissioners' service there is such a man as I describe, they committed a grand error of judgment in not appointing him. If, on the other hand, they merely declined to give the post to the first clerk whose turn it might be for promotion, they probably acted wisely. How far in so doing they commend their own office to public estimation is another matter, but they certainly do not seem to rate very highly the gentlemen they have themselves appointed as clerks, when they go outside that office to find a candidate for one of the two important appointments in their gift.—I am, &c.,

U. U.

COCOA MANUFACTURE.

Sir,—The amount of interest which my paper on cocoa, recently read before your Society, has excited in various quarters has been a source of considerable gratification to me.

The different letters on the subject which have appeared do not, however, call for much comment, the points raised having been either fully considered in my paper or since replied to by other of your correspondents. There is, however, one portion of the letter of "H. E." on which I should wish briefly to remark.

The time alloted to my paper compelled me to curtail it by more than one-half of its original length, and I was therefore precluded from entering so fully as I could have wished into any portion of my subject. Hence, probably, arises your correspondent's impression that I ridi-

culed certain methods of preparing cocoa. For me to have done so would have been out of place, as the firm (Dunn and Hewett) of which I am a member manufactures cocoa in all its forms without any exception. It being, therefore, commercially a matter of indifference to me as to the form in which the public prefer their cocoa prepared, I was in a better position to discuss without undue bias the relative advantages of each mode. But what I did ridicule were the absurd pretensions to exceptional purity and excellence claimed for those preparations originally introduced from Holland, whose peculiarity consists in being deprived at great expense of one of the most valuable constituents of the cocoa seed, viz., the cocoa-butter; and which are therefore unattainable by, as well as unsuited for most customers.

What we should aim at in considering the subject of cocoa manufacture, keeping in view the great end of your Society—the practical benefit of mankind—is to determine in what way the utilisation of so valuable a food can be developed in the greatest degree; and in doing so we should guard against being led away by specious arguments in favour, or undue laudation of any particular preparations, whether prompted by motives of trade interest or pseudo-scientific crotchets.

While fully agreeing with "H. E." that different preparations of cocoa may suit different persons—a position, indeed, I assumed in my paper, for the reasons I therein expressed—I again maintain that the mixed forms of cocoa are the best for general use, whether considered from an economical or physiological point view. "H. E." himself most correctly states that this deduction has already received the practical approval of the public, and to their judgment I now most gladly leave the further discussion of this question.—I am, &c., JOHN HOLM.

Lifford-lodge, Barnsbury-park, N.
April 20th, 1874.

SIR,—I find from present publications that Mr. Holm continues to appear as the scientific advocate of those mixtures consisting of cocoa, starch, and sugar, sold as soluble "cocoas," while he begins now to denounce at the same time the use of "pure soluble cocoa." I have seen Mr. Holm in print many times lately; I also heard his paper on cocoa at the Society of Arts, and I must confess he has taken great trouble in teaching us that the only true and valuable cocoa is "obtained by the above-named mixture, of which the late Mr. Dunn, of the firm of Dunn and Hewett, was the original inventor, and with which firm he (Mr. Holm) is connected, and that their mixtures, or so-called soluble cocoas, are highly commended, and in favour, and that the public have greatly benefited by their mode of supplying them with cocoa."

Had Mr. Holm stopped here, satisfied with the practical success he tells us his firm has obtained, I could have quietly left it to him to show him that a reverse existed to the beautiful picture he unfolded before our eyes; Mr. Holm willed it differently. Up to this point he convinced himself, and perhaps many others, that cocoa, sugar, and farina make cocoa, but now, carried away by the effect his assertion had on some minds, he boldly comes forward to prove that unadulterated cocoa (unmixed as he has it) is not cocoa at all. Mr. Holm's argument is, to say the least of it, ingenious. In the manufacture of "pure soluble cocoa," the superfluous cocoa-butter contained in the cocoa-bean is necessarily and wisely removed, and this has proved to be the very mode required to render cocoa the valuable article of food which its constituents prove it to be, because the flesh-forming and heat-giving parts are in "pure soluble cocoa" so proportioned that the stomach assimilates the whole, while with the cocoa-bean and the above-named mixtures (Mr. Holm's assertion notwithstanding) they pass through the body mostly undigested, and therefore unused.

Here was the handle to the sword to be brandished before the unscientific mind of the general public, and Mr. Holm on his own authority declares that cocoa-butter is the most valuable part of the cocoa-bean, and that "pure soluble cocoa" is not a pure article at all, but must be classified with "skimmed milk." Mr. Holm may with as much reason call meat no meat, because we do not buy and cannot swallow the whole proportion of fat in an ox, as to try and make out in his case that "pure soluble cocoa" is anything else but cocoa. Moreover, as he is so convinced of the value of cocoa-butter as an article of food, I place before him the means for becoming a great public benefactor by offering to supply him with a large quantity of cocoa-butter at a very reasonable price.

Whether mixtures of cocoa with more or less starch and sugar, not to speak of other ingredients sometimes found in them, can at all be compared in quality with "pure soluble cocoa," I leave to others to judge, also the question whether in the unadulterated article the public do not receive more value than in mixtures. The intention of the present communication is amply attained if I have succeeded in preventing the science of cocoa to become as much sophisticated as its manufacture has been for a long time.—I am, &c., HERMANN ESCHWEGE.

6 and 7, Coleman-street, E.C.

GENERAL NOTES.

The Central Uruguay Railway.—This line has been completed to Darazua, a distance of $88\frac{1}{2}$ miles, with the exception of a permanent way on the last length of $6\frac{1}{2}$ miles. The stations are being actively pushed forward to completion, and the whole of the rolling stock is in running order. The line has been inspected as far as Florida.

The Upper Nile.—The Egyptian Government is about to despatch an expedition for the exploration of the Upper Nile. The objects of this expedition, of which Ali Pacha is to be at the head, are to determine the geological and physical constitution of the Valley of the Nile and of the Red Sea. One of the most important questions to which the expedition is to direct its attention is the possibility of establishing a diversion of the Nile into the old river valley, called by the Arabs the "Valley of the Waterless River," as this would gain a large quantity of land for agricultural purposes, and greatly shorten the passage from the Soudan into Egypt.

Grain Traffic in America. — A correspondent of the *Chicago Tribune* proposes to carry grain from the West to New York by means of a wire cable, to which would be attached bins 5ft. long, and capable of holding two bushels each. At distances of 10 miles would be stationed engines of 150 horse-power, to be used in working the endless cable, the operations of which would be precisely like the ordinary elevator, except that it would carry its load horizontally instead of lifting it. The inventor thinks that by this process wheat can be moved from Chicago to New York at a cost of 10 cents per bushel, after leaving a margin for repairs and interest on cost of construction.

Infant Labour.—The working men of Holland have taken up the question of the employment of young persons in a very energetic manner. More than 100 workmen's unions, including upwards of 12,000 members, were represented at a general meeting which took place some time back at the Hague, when resolutions were carried to the effect that no young person who had not completed his or her twelfth year should be employed in any factory or workshop; that between twelve and fifteen years of age the maximum working hours should not exceed six; that no young person should be ever allowed to work between the hours of 8 p.m. and 6 a.m.; and that three hours should be devoted to primary instruction. The meeting voted an appeal to the Government for inspectors to be appointed to enforce the execution of these rules. A resolution was also carried asking the Government to regulate by parliamentary action the system of co-operation in favour of the working classes.

Ship-lights. — Since the deplorable loss of the steamer *Ville du Havre*, the French Transatlantic Steam Company has been engaged with experiments for supplying their vessels with better signal lights than they now possess, and a number of persons interested in such questions were recently invited to witness experiments with a new ship-light at the point Seguin. The apparatus used had the ordinary appearance of a ship-light such as is placed at the bows of a steamer, but a greater contraction of the rays of light is obtained by means of reflectors placed behind and on each side of the light. Two steam-tugs were employed, and it was found that the new lights were visible at the distance of ten miles at sea.

NOTICES.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque, Post-office order, or Cheque Bank cheque, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

On the Modified Turkish and Vapour Bath, by J. L. Milton. Presented by the Author.

The Antiseptic Treatment, by Dr. Evans. Presented by the Author.

The Blood of the Aristocracy, by Dr. W. W. Evans. Presented by the Author.

The following commercial wall charts, to illustrate lectures, have been presented by Dr. Yeats:—

Historical Chart: Showing the Rise, Progress, Culmination, and Decline of Commercial Nations from 1500 B.C. to 1870 A.D.

Principal Caravan Routes of Eastern Commerce, Ancient and Modern.

The British Empire in 1873.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

The following arrangements for Wednesday evenings have been made:—

MAY 13.—"On the Importance of a Special Organisation for the Diffusion of Sanitary Knowledge." By Major-General SYNGE

May 20th.—"On Simplicity as the Essential Element of Safety and Efficiency in the Working of Railways." By Captain H. W. TYLER.

CHEMICAL SECTION.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

MAY 8.—"On Sugar Refining, with special reference to Finzel's Sugar Crystals." By Dr. GRIFFIN. On this evening DR. LETHEBY, M.B., M.A., &c., will preside.

MAY 22.—"On the Manufacture of Chlorine." By W. WELDON, Esq., F.C.S. On this evening Professor A. WILLIAMSON, F.R.S., will preside.

CANTOR LECTURES.

The third course is by Professor BARFF, M.A., "On Carbon and Certain Compounds of Carbon treated principally in reference to Heating and Illuminating Purposes."

The object of these lectures is to explain the scientific principles involved in all heating and illuminating processes, and to apply those principles to practical purposes. The absorbent properties of carbon will be briefly noticed.

LECTURE V.—MAY 11.

Coal gas, its composition and purification, and its illuminating properties.

LECTURE VI.—MAY 18.

Heat of combustion; how heat is communicated, and how quantity of heat is determined.

LECTURE VII.—MAY 25.

Consideration of furnaces, stoves, lamps, &c., in which the principles stated in the former lectures will be applied.

All the above Meetings and Lectures are open to Members, each of whom has the privilege of introducing two friends.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

MON. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Professor Barff, M.A., "On Carbon and Certain Compounds of Carbon treated principally in reference to Heating and Illuminating Purposes." (Lecture V.)
Royal Geographical, 1, Savile-row, W., 8½ p.m. Capt. J. H. Glover, "Geography and Resources of the Country between the River Volta and Coomassie."

TUES. ...Royal Institution, Albemarle-street, W., 3 p.m. Professor Rutherford, "On the Nervous System."
Medical and Chirurgical, 53, Berners-street, Oxford-street, 8½ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. Joseph M'C. Meadows, "On Peat Fuel Machinery."
Photographic, 9, Conduit-street, W. 8 p.m.
Anthropological Institution, 4, St. Martin's-place, W.C. 1. Mr. Francis Galton, "On Statistics obtained from Schools." 2. Mr. Francis Galton, "On the Excess of Female Population in the West Indies." 3. Rev. H. W. Watson, "On the Extinction of Families." 4. Major H. Godwin-Austen, "On Ancient Stone Monuments of the Nágás."

WED....SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Major-General Synge, "On the Importance of a Special Organisation for the Diffusion of Sanitary Knowledge."
Geological, Somerset House, W.C., 8 p.m.
Royal Literary Fund, 10, John-street, Adelphi, W.C., 3 p.m.
Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m.
Archæological Association, 32, Sackville-street, W., 4½ p.m. Annual Meeting.
Royal Horticultural, South Kensington, S.W., 1 p.m.

THUR....Royal Institution, Albemarle-street, W., 3 p.m. Mr. N. S. Maskelyne, "On Physical Symmetry in Crystals."
Aeronautical, 8 p.m. (At the HOUSE OF THE SOCIETY OF ARTS.) General Meeting.
Mathematical, 22, Albemarle-street, W., 8 p.m.

FRI.......Royal United Service Institution, Whitehall-yard, 8½ p.m. Captain Glover, R.N., "On the Volta Expedition during the late Ashanti Campaign."
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Dr. C. W. Siemens, "The Steamship *Faraday*, and her appliances for Cable Laying."
Philological, University College, W.C., 8 p.m. Annual Meeting.

SAT......Royal Institution, Albemarle-street, W., 3 p.m. Mr. R. A. Proctor, "On the Planetary System."

[The Editor will be glad to receive notices of papers for insertion in the above list.]

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,121. VOL. XXII.

FRIDAY, MAY 15, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ALBERT GOLD MEDAL.

The Council have awarded this Medal for the present year to C. W. SIEMENS, D.C.L., F.R.S., "For his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvements in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to Manufactures and the Arts."

PUBLIC MUSEUMS AND GALLERIES.

On the recommendation of the Committee, the Council have fixed Wednesday, May 20, for a General Meeting on this subject. To it will be invited the Mayors of Corporations, Chairmen of Art and Science Schools, and others interested in the question. The object of the meeting will be to name a Deputation to wait upon the Prime Minister, and urge upon him the importance of bringing all National Museums and Galleries under the authority of a Minister of the Crown, with direct responsibility to Parliament; and also of causing all such Museums to be made conducive to the advancement of Education and Technical Instruction. The chair will be taken by the Right Hon. Lord HAMPTON, at 12 o'clock.

ECONOMICAL USE OF FUEL.

A meeting of this Committee was held at the Testing Houses, Western Annexe, International Exhibition, on Saturday, 9th instant. Present—Major-General F. Eardley-Wilmot, R.A., F.R.S. (in the chair); Mr. F. J. Bramwell, F.R.S., Dr. Mann, Rev. A. Rigg, Dr. David S. Price, and Capt. Scott, R.N., with Mr. S. W. Davies.

TECHNOLOGICAL EXAMINATIONS.

The following donation has been received:—

The Worshipful Company of Clothworkers (annual donation) .... £10 10s. 0d.

INSTITUTIONS.

The following Institution has been taken into Union:—

Belfast Working Men's Institute.

ENDOWMENT FUND.

The following subscriptions have been received towards the establishment of an Endowment Fund for the Society:—

	£	s.	d.
G. T. Saul	5	0	0
W. R. Spicer	5	0	0
Colonel A. Angus Croll	20	0	0
G. W. Hart	2	2	0
Charles H. L. Woodd, F.G.S.	5	0	0
John E. Evans	2	2	0
Sir Walter E. Trevelyan	50	0	0
E. T. Blakely	1	1	0
W. R. Sandbach	50	0	0
Thomas Dixon	1	1	0
W. Atkinson	50	0	0
John Noble	20	0	0
James Bentley	20	0	0
J. Jonas	1	1	0
Samuel Jackson	5	5	0
Charles Goding	20	0	0
F. Mocatta	10	10	1
Jonah J. Wells	10	10	0
Charles Downes	2	2	0
G. T. Saul	2	2	0
Mrs. Charlotte Holmes	10	0	0
John Knowles	25	0	0
Sir John Le Couteur	1	0	0

PROCEEDINGS OF THE SOCIETY.

CHEMICAL SECTION.

A meeting of this Section was held on Friday, the 8th inst., Dr. LETHEBY, M.B., M.A., &c., in the chair.

The paper read was—

ON SUGAR REFINING.

By **Frederick W. Griffin, Ph.D.**

When I was requested to read a paper before this time-honoured Society upon the Sugar Industry, with which I am but indirectly connected, I felt at considerable loss how best to deal with the subject. Its full development would require, not one evening but many, whilst I should be unequal to do justice to it. I am placed at a disadvantage as compared with the able gentlemen who have preceded me in this course, inasmuch as I have no really new invention or facts to bring before you. I think, however, that by mainly confining our attention to the more scientific aspect of two or three special points, we may render the meeting not altogether unprofitable. I may say at once that as the paper is not likely to give rise to prolonged discussion, and as I have a good deal of illustration, I shall have to crave your attention for nearly the full period.

Considering the present enormous consumption of sugar, which has come to be regarded as almost a necessary of life, it is remarkable to note how comparatively recent has been its general introduction into Europe, which hardly dates four centuries back. Like most of the arts and industries, the manufacture of sugar took its rise in the far East, and has followed the sun's course westward round the globe. In China and India it

has been made from the earliest times. Pliny describes the *saccharum* brought from India as "a honey from canes like gum, white and brittle"; and Humboldt considers the Persian and Arabic name *shukkur* identical in sound with our sugar, to be derived from the Sanscrit. The Crusaders seem to have introduced the knowledge of sugar into Western Europe on their return from the Holy Land. Their monkish chroniclers speak of their chewing "a sweet honied reed called zucra" as a means of subsistence when their provisions ran short; and one of them gives the earliest description extant of the preparation of sugar from the cane as practised in Syria. Sicily appears to have been the first place in Europe where sugar was manufactured, and as early as 1148 considerable quantities were made there from cane grown on the island. The cultivation of the sugar-cane did not attain any great development in the West, till it was introduced at the end of the fourteenth century by the Spaniards (probably by Columbus himself) into the West India islands, and subsequently to the neighbouring coasts. In 1676, the Barbadian sugar trade alone employed 400 vessels.

The process of refining was invented and first practised in Venice, then the centre of luxury, the supply of raw sugar being drawn from Egypt and Sicily. Antwerp became later the chief seat of the industry, and we largely imported refined sugar thence; but in the reign of Henry VIII. (about 1540) two sugar-houses were established in London, which for 20 years mainly supplied our demands. The use of sugar made rapid strides in this country. Hentzner, a German traveller who visited England in 1598, in describing Queen Elizabeth (then in her 66th year) writes, "her nose is a little hooked, her lips narrow, and her teeth black (a defect the English seem subject to from their too great use of sugar)." Undeterred by this somewhat apocryphal drawback, the English taste for sugar has gone on increasing till we now consume at least as much as all the rest of Europe put together; more than a pound per week for every man, woman, and child in the United Kingdom. Indeed, the great Counterslip Refinery (to which I shall have to allude presently) alone furnishes more than 4 lbs. per head yearly, which is probably an eighth part of the total sugar refined in the kingdom.

I will briefly describe the production of raw sugars, in which I shall be aided by some of the pictures prepared to illustrate Professor Gardner's interesting popular lecture on "Sugar," at the Polytechnic Institution, and which (with various specimens and models) he has most kindly lent for this occasion. These we will throw on the screen behind me by the electric lantern. Large quantities of good sugar are produced in Canada and the Northern United States from the sap of the sugar maple, a forest-tree which attains a height of 60 or 80 feet, and by the brilliant crimson of its fading leaves, adds much to the beauty of the autumnal scenery of those districts. The trunks are tapped about February, as practised by the Indians before the colonisation of the country, and the collected sap is boiled down to granulation and drained. The produce is consumed at home, and (except a portion made from the root of the beet) the whole of the raw sugar refined in this country is obtained from the sugar-cane. This is a gigantic reed belonging to the invaluable family of the grasses, which grows to a height of from 10 to 15 feet, and is propagated by cuttings taken from the top-joints of the stem. This diagram (from Payen's *Chimie Industrielle*) gives a good general idea of the cane in its young and mature state, and also of its structure, by sections transverse and longitudinal. Like other grasses, the sugar-cane is stiffened by a hard silicious cuticle or rind, and is further strengthened by annular joints or knots at short intervals, from which spring the leaves, and in the cuttings the rootlets beneath, and the young plant above. These cuttings are set in small trenches, about eight inches deep, and at the least five or six feet between the rows, but they are now more generally laid four to six feet apart in shallow furrows, formed by a small plough. The leaves are large and drooping, three to five feet in length, so that the plant has a handsome appearance when growing luxuriantly in masses. (In the *Victoria Regia* house at Kew Gardens the sugar-cane may be seen in vigorous growth.) The Tahiti cane (of which there is a stalk on the table, and from which the fine Mauritius sugar is made) has to a great extent replaced the common or "Creole" cane from India, as it is hardier, quicker, and more luxuriant in growth, and affords a better yield of sugar. When the leaves have fallen off and the stalks become yellow (which is in ten to twelve months for the Tahiti, and twelve to fifteen or sixteen for the Creole cane) they are cut off close to the ground, and immediately carried to the crushing mill for the expression of their abundant saccharine sap, which constitutes 85 to 90 per cent. of their total weight when fresh, the woody fibre and rind not exceeding 10 to 15 per cent., hence the interior is very soft and spongy. The mill consists of three or five large iron rollers kept slowly revolving as the canes are drawn and crushed between them. All this machinery (the fly-wheel more especially) requires to be very strong and massive, from the irregularity of feeding and action causing much jerking and strain on it. In the Great Exhibition of 1851 we used to see stout deal boards passed through the cane mill shown by Messrs. Pontifex, and emerging as a soft pulp. These mills were formerly driven by the wind, as you see in this diagram, but this uncertain motor is now replaced by steam, the fuel for raising which, as well as for the subsequent operations, is chiefly the crushed cane dried in the sun or by the waste heat of the fires. For each horse-power of the engine about 100 gallons per hour of expressed juice is obtained. This is an opaque, frothy, yellowish liquid, of a faint but agreeable balsamic smell, and containing about one-fifth of its weight of sugar, which is all crystallisable. This is first clarified and rendered more stable by heating at once with a small quantity of lime made into a cream with water, and called "temper." This coagulates and partly carries down the albumenoid nitrogenous matter, which would speedily give rise to fermentation. The clear yellow liquor is heated more and more strongly in a series of pans, the calcareous scum which forms being carefully skimmed off, and it is then boiled down till on cooling in large tanks it will "grain," or imperfectly crystallise. The moist

mass so obtained is drained for several weeks, to allow the liquid molasses to run off as much as possible before packing in hogsheads or bags for shipment. The boiling down used to be carried on with little care, and at a high temperature in open pans, whereby much molasses was formed at the expense of the sugar, rendering it dark and clammy, thus deteriorating its value and causing great loss of weight by leakage during the sea voyage. Dr. Evans remarks:—"Had the planter intended to convert the cane juice into birdlime, he could scarcely have invented a more successful method of accomplishing his purpose." This wasteful system had been superseded in Java, Mauritius, Havana, and many of our own colonies by the use of the vacuum-pan and other improved processes, whereby a very superior class of sugars is produced, more profitable alike to the producer abroad and the refiner at home.

Professor Gardner has kindly lent me an excellent working model of a vacuum-pan, which I will devote a minute to showing you in action. We will suppose this liquid to be a syrup boiling down under ordinary conditions, when its temperature would be above 212°. At this heat the purest sugar solution like this would rapidly darken and pass into the state of uncrystallisable treacle. If the pressure of the air is removed by a powerful exhaust pump, joined to a condensation of the vapour by cold, the syrup will boil nearly 100° lower, so that the change will be comparatively very small and the syrup little discoloured. We remove the flame and close the exit pipe while this vessel is full of steam, elastic as the air. If we pour cold water on the outside, the steam will be condensed, and the syrup being relieved from pressure by the vacuum so formed, will start again into ebullition and continue to boil till it has greatly cooled down. In a good vacuum-pan we can bring the pressure down to a single inch of mercury, instead of the ordinary 30 inches, and the syrup will then boil as low as 120°, and even that will render this white liquor yellow. These vacuum-pans are of copper, heated by steam circulating through coils of copper tubing, and are often of gigantic size. I will show you a photograph of one of the largest in existence, which is at work in Messrs. Finzel's refinery, where an even larger one is being erected. This is about 12 feet in diameter, and will work off nearly 30 tons of sugar at each boiling.

The maximum of bad manufacture is reached in the Jaggary made by the native Hindoos by methods unaltered from immemorial times. Much of this is refined in this country, though its use is hardly to be commended, containing, as it does, all kinds of filth. The cane is crushed in a rude wooden mill resembling a huge mortar and pestle, and the juice is simply boiled down in earthen pots till it forms this nearly solid half-burnt mass, containing, according to my determinations, only 73 to 77 per cent. of crystallisable sugar.

Before passing on we will throw on the screen a copy of the chart prepared for the museum of the Royal Gardens at Kew, to show the distribution of the sugar-cane, the areas occupied by its cultivation, or in some cases those which are peculiarly suited to it, being coloured red. You will observe that this is the case with the peninsula of India; parts of China and Australia; Java, Mauritius, and other islands; a portion of the south-eastern division of Africa, and the Gold Coast on the west; and the West India Islands, with Brazil, and immense tracts of North and South America.

You cannot fail to note that all these localities possess a tropical or sub-tropical climate, and are situated not far from the sea coast, considerable heat and moisture being essential to the full development of the cane. Dr. Livingstone, however, found it much cultivated along the Zambesi river towards the interior of Africa. The climate of southern Australia seems well adapted to the growth of the cane, and its cultivation is rapidly extending. Excellent Australian sugars were shown in last year's International Exhibition, but for some time to come the whole of the produce of the colony will be required for its own consumption. Our latest acquisition, the Fiji Islands, may some day yield us a supply of raw sugar, as the cane thrives well in them. Here is a sample of the sugar badly made there at present, so that it is of low quality, and marks only 83 per cent.

By far the greater part of the sugar consumed on the Continent is made from beet-root, which in the fresh state contains about 12 per cent., and, unfortunately for us, a considerable amount of this sugar (last year 26,000 tons), is imported into this country. I say, unfortunately, because it is of far inferior quality to that produced from the cane. The sugar is accompanied in the expressed juice by considerable quantities of various nitrogenised principles, which are estimated to amount to 11½ per cent. of the weight of the dry beet, or nearly one sixth as much as of the sugar itself. These nitrogenous matters induce fermentation and all kinds of chemical changes, and can only be eliminated by the highest refining. Moreover, even the manufactured beet-sugar is saturated with an essential oil of a most offensive glue-like smell, very disgusting when the sugar is in quantity, and difficult to get rid of entirely. I will pass round a specimen of raw beet-sugar that you may smell and judge for yourselves.

The manufacture of beet-sugar took its rise in the exigencies of France when commercially isolated during the wars of the first Napoleon, and it has attained to huge proportions. The production in Europe in 1843 was only 55,000 tons; ten years later (1853) it had nearly quadrupled, being 200,000 tons; in 1863 it was 452,129 tons, more than double; while last year (1873) it had reached the immense total of 1,142,896 tons, more than one-third the amount of cane-sugar produced by the whole world, which is estimated to have been that year a little under three million (2,954,722) tons. This extensive cultivation affords large agricultural employment, and keeps down the price of sugar abroad, hence it is a great boon to continental Europe. The introduction of its produce into this country is, however, much to be deprecated, as if it cannot be called a true adulterant of the more wholesome and palatable cane-sugars which are so abundantly supplied to us by our colonies and commerce, it is at least a deteriorant, if I may be permitted to introduce such a word.

Now the first concern of the refiner, like other manufacturers, is with the quality of his raw material. Crude sugars, as imported, vary much in their saccharine richness, which ranges from about

75 to 98 per cent. of pure crystallisable sugar. Practical buyers acquire by experience considerable skil in judging of the refining value of a raw sample from its colour, feel, smell, and taste; its hard, sparkling "grain," or soft, dull character; but even their conclusions are sometimes found to be very erroneous when brought to the touchstone of scientific analysis. Hence the accurate valuation of the raw sugars offered in the market is of paramount importance and demands the closest attention. We will enter on it in some detail, all the more because it is my special field. Various processes have been devised, but only two widely adopted, a chemical method and an optical one. The chemical process, due to Barreswil, a French chemist, though the earliest, was introduced no longer than thirty years ago (1844), and is based on the reaction between glucose sugar and the salts of copper, whereby the sugar becomes converted into oxidised acids by taking away part of the oxygen in the oxide of copper. I add caustic soda to a solution of sulphate of copper; the alkali seizes on the acid of the metallic salt, displacing the oxide of copper, which falls as a blue precipitate. If we previously mix the solution of copper with an alkaline tartrate, such as Rochelle salt, no such precipitate appears, but the liquid becomes of an intense blue colour. (The tartrate appears to form a sort of double salt with the copper, which alkalies cannot decompose.) If this blue liquid is boiled no change takes place, nor yet when it is mixed with pure cane-sugar; but the smallest trace (even a millionth part, according to Trommer) of the glucose found in fruits and honey, and into which cane-sugar readily passes under the action of acids or ferments, will determine an immediate change. The oxide of copper will part with half of its oxygen to the glucose, and be reduced to suboxide, which is no longer held in solution, but falls as a yellowish powder, becoming dense and dull red on boiling. This can be collected and weighed, with suitable precautions, and indicates the presence of as near as may be one-half its own weight of glucose. Thus if we took 100 grains of a sample of raw sugar, dissolved it in water, and boiled with an excess of this tartro-cupreous solution, obtaining a precipitate which weighed 8 grains, it would show, to begin with, that our sample contained 4 grains, or 4 per cent. of fruit-sugar, which is practically uncrystallisable. But what we chiefly want to know is the proportion of cane-sugar in the sample. To arrive at this, we must take a second 100 grains, and boil its solution for some minutes with about one-fortieth of its bulk of hydrochloric acid. Under the influence of the acid and heat, the cane-sugar will fix the elements of water and pass entirely into the state of glucose. On repeating the process, we might find the weight of the precipitated sub-oxide of copper to be as much as 202 grains. From this we deduct 8, due to the pre-existing glucose which we determined in the first trial, leaving 194, which corresponds to a little over 92 of cane-sugar. Our sample consists therefore of 92 per cent. of cane, and 4 per cent. of fruit-sugar, the remaining 4 parts being salts, sand, extractive or colouring matter, and moisture. I have spoken, for the sake of simplicity, of employing 100 grains of the sugar, but in practice we should only use 5 or 10 grains, so that this becomes a delicate analytical operation. It is also a somewhat tedious one, involving the thorough washing and drying of the precipitate, so that we only resort to it for syrups and raw sugars of low quality, as the dark colour of the liquid is immaterial. For ordinary samples, a much more expeditious way of applying the test is to take a measured volume of the standard copper solution, heat it to boiling, and add from a finely-graduated burette a very weak solution (containing at most 1 per cent.) of pure sugar, which has been changed to glucose by heating with an acid, until the last trace of the blue colour just disappears on boiling. If ten measures are required with pure sugar, whilst eleven are needed with an equal weight of the sample dissolved in the same bulk of water, a simple calculation will show that it contains a trifle under 91 per cent. of sugar. Of course in this case also a double trial has to be made; the first to determine the amount of glucose in the sample, and the second to ascertain the extra quantity when we have artificially converted the cane-sugar into it.

The results are accurate enough in skilful hands, but the process requires great care, with very delicate weighing and measuring, since from the smallness of the quantities operated on, any error becomes seriously multiplied in the percentage results. But there is a yet more serious drawback. The test-liquor will alter by keeping, so as to give a precipitation by heat alone, which in either modification of the process would count as so much sugar. This obliges us either to throw away at once the standard solution prepared at some cost of time and trouble, or to determine the amount of precipitation and deduct it, which opens a wide door for error when the work is in careless or unscrupulous hands. The chemical method has therefore been in great measure superseded, both here and abroad, by the optical one, which is expeditious and in most cases exact. This brings to our aid the most recondite phenomena of that marvellous force called light. The optical saccharimeter invented by Biot, and brought into practical shape by the skill of the elder Soleil, was rendered precise and easy in its technical application by the labours of Clerget. To explain its principles in full would require a succession of lectures, but I will endeavour to give you in few words a notion of the fundamental facts on which it is based, aided by Mr. Browning's large electric polariscope. We will allow a small beam of light to emerge from the lantern which will produce a spot of light upon the screen. If my assistant places a rhomb of calc-spar in the path of that ray, it will be split into two divergent ones, producing two spots of light upon the screen, and on turning round the crystal, the spot formed by the ray which is most refracted or bent out of its course, and which is called the extraordinary ray, revolves round that formed by the ordinary ray, which is but little deflected. This doubling of the ray is entirely due to the molecular arrangement in the substance of the calc-spar itself, for the thicker it is the wider apart will the images be separated, while glass or rock-salt cut into the same external shape will produce no effect of the kind. Now the eye cannot detect any difference between the rays which have passed through the crystal and produced those spots, and that which is now simply

streaming from the lantern; but if we examine them more closely, we shall find they have been profoundly modified. This beam would pass, as you see, through a crystal of calc-spar held in any position, doubled it is true, but still perfectly freely; but if a second rhomb of calc-spar were placed in a proper position in front of the first, we should find that only one of the rays would pass, the other being completely snuffed out. If we slowly revolved this second crystal, we should find that the bright spot would begin to fade and the other to appear dimly, till, at the half-quarter revolution, both would be equally bright. At the full quarter, or 90°, the ray which at first passed with freedom will be completely extinguished, while that which before was stopped out will alone be seen. Twice in every revolution we should have the image formed by the ordinary ray, and that alone, and twice the one given by the extraordinary ray, and that solely. The beam seems to have acquired sides as it were, or rather properties which are opposed to each other in the opposite directions, a sort of *polar* character which suggested the name "Polarised" for light thus modified. We may call the crystal which produces this change, the "Polariser," and the second one which tests the condition of the modified light, the "Analyser." But in applying this polarised light to a lantern, for purposes of demonstration, or to a microscope as an aid to working out delicate structure, we do not want two images or a double field, and this was ingeniously got rid of by Mr. Nicol, of Edinburgh. He cut off the acute angles from the rhomb of calc-spar, and cemented them together by transparent Canada balsam, so as to form a rhomboidal prism which is still known by his name. This bends or turns aside the extraordinary ray so much further than the natural crystal would, that it is thrown against the opaque blackened fitting, and is there absorbed and lost, and only the ordinary ray emerges into view. A large Nicol prism is now fitted on the front of our lantern, and we have a disc on the screen which is formed by the ordinary ray of the pair really produced by the prism, and this is entirely polarised. If we placed in the path of this ray a piece of glass of any shape, the beam would pass with equal freedom in any position, and the same is the case with this second Nicol prism if the optic axes of the two prisms are parallel. But turn the second, or analysing prism, a quarter of a revolution, and you see the light is as completely blocked out by it as if it were a plate of metal instead of a glassy crystal. Turn the analyser round slowly, and the light will begin to pass till at the next quarter revolution the disc will again be bright. Thus in each rotation we have this succession—bright, dim, dark, dim, bright, dim, dark, dim, and then bright, as we started. Now, doubly-refracting bodies will depolarise light, that is, restore it to its ordinary normal condition. We will place between the prisms, when their axes are crossed, so that we have a black field, a slice of such a substance, which might be mineral, animal, or vegetable; a cutting of calc-spar, of quill, horn, or muscle; but we may more appropriately take a section of the sugar-cane, which has been prepared for me by Mr. Barnett, the skilful microscopic mounter, of Tottenham, who has also smaller sections under the microscopes, polarising and otherwise, on the table, which you can examine after the paper if time permits, and so see more of the structural arrangement. The sugar-cane, however, does not sectionise well, as it is so soft and vascular. However, there is its image traced in light upon the black ground, for every ray which has passed through its substance has lost its polar character, and can therefore freely penetrate the analyser, while all the still polarised rays around are stopped back by it. If we interpose between the crossed prisms a film of selenite (which is likewise a double refractor) of a certain thickness, the beam will pass freely in all positions of either of the prisms, and will also display a rich colour, the thickest film giving a red, the thinnest a violet. If the selenite film be rotated, the colour will be vivid at each quarter revolution, and nearly disappear at the intermediate points. If it remain stationary, and either prism be rotated, a still more remarkable effect will be produced. The colour will fade away to the 45°, but at the quadrant it will not reappear as before, but be replaced by its "complementary," that is the colour with which it would produce white light. At the semi-revolution we get the original colour, and at the third quadrant the complementary again. Thus, if the original colour is red, we have the following order in each revolution — red, colourless, green, colourless, red, colourless, green, colourless, to red again as at first. If we started with blue, it would alternate with orange, and purple with yellow. If we take a wedge of selenite, we shall find it crossed with rainbow-like bands of the prismatic colours, and if we examine a slice of many crystals cut across the optic axis, we shall have these bands arranged circularly round the axis, which is generally the centre of a cross, black or white according to the position of the prisms. Sugar shows this very well, as you see in this section of a fine crystal of it. A slice of quartz (also cut across the axis) acts in a remarkable manner. It twists the polarised ray round a considerable distance, to the right in some crystals, to the left in others, which are called accordingly "right-handed" or "left-handed" quartz. It also colours the ray according to its thickness and position, like selenite. This twisting of the ray is almost peculiar to quartz among solid bodies, but it is exhibited by various organic substances when in solution, and by none more markedly than by sugar, and curiously enough its two chief modifications answer exactly to the right and the left-handed quartz; cane-sugar turning the ray to the right, and glucose to the left. If we interpose a vessel filled with solution of sugar between the prisms crossed so as to give a black field, the beam will at once pass, and we shall have to rotate the analyser a certain number of degrees (which can be exactly measured) before the light will again be extinguished. The amount of this deviation is strictly proportionate to the quantity of pure dry sugar present in the liquid. If a certain solution, so examined, marks 40° on the scale, and we dilute it with an equal bulk of water and try it again, it will mark exactly 20°, or half as much; and so for all dilutions. Here then we have a precise measure of the quantity of sugar present, and by taking equal weights of pure sugar, and of any sample which we wish to try, dissolving them in the same volume of water, and filling the tube of a suitably-

arranged instrument with the solutions, we can accurately compare one with the other, and so arrive at the percentage of the sample. Many points, however, have to be provided for, which is admirably done in this beautiful instrument, the Soleil saccharimeter, now best constructed by Duboscq, of Paris. The light employed may either be daylight or artificial; that from a paraffin lamp is best, as it is white, pretty constant in quality, and always at command. It enters the instrument through a small circular hole at the back, and is polarised by a Nicol prism rendered achromatic. The extraordinary ray is turned so far aside as to be "stopped out," and only the ordinary ray, perfectly polarised, passes on. At the other end we have an eye-piece and an analysing prism, the rotation of which would render the field alternately bright and black as you saw just now. But we have here a plate of quartz which acts like a selenite in making the field always light, and at the same time coloured according to its thickness and relative position. The tint of this plate is the point to which we work, and it is cut to such a thickness (·14763, or about 1-7th of an inch) as to produce, when the axes of both prisms coincide, a pale violet, called by Biot "teinte sensible" or "teinte de passage" (the sensitive or transition tint), as the slightest displacement of the prisms makes it incline more toward pink or blue according to the direction of the movement. This plate is, however, really composed of two half-discs, the one of right-handed and the other of left-handed quartz, so that when we look through the eye-piece we see a circular field caused by the image of the round aperture, and crossed vertically by a dark line which is the join of the semi-discs. The two halves of the field may show a variety of colours, but when the prisms are adjusted so that their axes are precisely parallel, both will be of the pale violet "sensitive tint," as you see in this painted diagram. If we interpose a tube filled with solution of sugar, we upset the equilibrium altogether; the colour will be wholly changed and the two halves will assume opposite colours, for the rotatory power of the sugar, if cane, will be added to the similar action of the right-handed quartz of the one segment, and lessen to an equal extent the left-handed rotation of the other. The field may then show one half green the other orange. To restore the original state of things we must precisely neutralise the action of the sugar, and this is ingeniously managed by the "compensator." This consists of two long wedges of quartz, thickest at the ends, which can be slid over each other, backward and forward, just behind the eye-piece, by a pinion worked by a button so as to make their joint thickness greater or less. For cane-sugar the zero has to be moved towards the left, when the halves will change to red and blue, and then approximate closer and closer, till at the exact point of counterbalancing, the whole field will present the original pale violet tint. The frames containing the wedges carry graduated plates on the top, so that the amount of movement can be read off, and the division is so arranged as to show the percentage at once without calculation. Thus pure sugar would mark 100 on the scale, or 100 per cent. But the quartz wedges are of a certain thickness at the point marked zero, and this would interfere with the action of the semi-discs, so that it must be neutralised. This is effected by placing behind the compensator a plate of quartz of the opposite rotation (left-handed if the wedges are right-handed) and worked to precisely the thickness of the double wedge when set at 0, so that its action is virtually extinguished. So much for the instrument. The sugars must be examined under precisely similar conditions, so we take a certain definite amount of the sample. This brass weight furnished with the instrument is marked 100 (it weighs about 254 grains) and that quantity of sugar dissolved in 100 cubic centimetres of water will, if pure, mark 100 divisions on the scale. If the sample contain only nine-tenths of its weight of pure crystallisable sugar it will read 90, and so forth. We accurately weigh out the sugar to be tried on a counterpoised watch-glass, transfer it through a glass funnel to one of these flasks, rinsing all the surfaces clean with a jet from the washing-bottle, shake at intervals till the sugar is dissolved, then add water to bring the level to the mark on the stem indicating 100 c. c., and fill up the tube of the saccharimeter with the solution. This tube is 20 centimetres (a little under 8 inches) long, and is closed liquid-tight by discs of plate-glass, screwed down by these brass caps. If all sugars were nearly pure, and their solutions colourless, this would be all that would be needed, but raw samples have more or less colour, and this must be removed, as anything beyond the feeblest yellowish tint seriously degrades the sensitive violet, and renders the observation less easy and precise. We decolorise by adding a little solution of subacetate of lead (which coagulates some of the impurities) to the liquid in the flask, then make up to the mark on the neck, and treat with one-fourth of its bulk of bone-black. This powerfully absorbs the colouring matter, as in the actual refining. The French method is to pass the solution through granular black contained in a narrow tube, a plug of cotton wool at the bottom straining it off clear. I greatly prefer the use of black in fine powder, agitating the solution mixed with it briskly for a few minutes, and then filtering through paper. This decolorises far more perfectly, rendering solutions of somewhat dark Havana and other sugars as colourless and limpid as water, but I am not aware whether it has been tried by others. When time allows, it is well to filter several times through the black so as to get the maximum decoloration, as the subsequent polarising is rendered all the more precise. Books generally say the solution, "decolorised if necessary," &c.; but the treatment with the black is not optional, but indispensable, even with the purest sugars, or serious errors would arise. The scale of the "Soleil" is graduated to show the correct percentage after the solution has been treated in the usual way with black, which absorbs and retains a certain amount of sugar. (The first portions of a syrup run through fresh black will show five or six per cent. less sugar than the remainder of the liquor.) Hence if we omit the treatment with charcoal, whether it be needed for decolorisation or not, we shall get our results too high. In a careful verification of this instrument, I found that the standard weight of pure sugar uniformly showed, not 100, but 102 on the scale, and that this was not due to errors in construction was proved by taking 150 of sugar,

which gave 153, an excess in the same proportion. When the solution was previously treated with grain-black in the French manner, I constantly got the correct reading of 100 or 150 within the trifling limits of error. The dust-black, from its great extension of surface, absorbs rather more sugar, and gives a constant deficiency of about half a per cent., which may be added to the observed figure. Landolt, of Bonn, considers the error of observation with different observers using different instruments, to be within 1 per cent. For myself, using the same instrument, I should place it at half a per cent., for repeated determinations of the same sample at different times do not vary more than that from each other, and are often sensibly identical. I do not mean to say that even 1 per cent. will give a decided difference in tint between the halves of the field, but by turning the button carefully, as we make it alternately pink to the right and pink to the left, the educated touch can place it midway with considerable precision. Greater delicacy would be desirable, but as it is practically extremely difficult to obtain samples which represent the real average of a large bulk of raw sugar, even so nearly as that, we the less feel the want of closer results. Great care is required in all the manipulations, and the liquids should be of the temperature of the air of the room, which should be pretty constant. It is immaterial whether we work at 50° or 70°, but the sugar solution must not sensibly alter in temperature after it has once been made up to the standard bulk, as any expansion or contraction would make it virtually weaker or stronger. When there is a sufficiency of the sample, and it is not below the medium colour, it is well to take 150 parts instead of 100, as the errors of observation remain the same, and so are somewhat lessened when the result is reduced to two-thirds to obtain the percentage. With darkish solutions of low sugars we have to shift a particular tint from right to left, and take the mean of pretty concordant observations of both limits. This can, of course, only give approximate results; hence perhaps the chemical or copper process is better for syrups and very coarse sugars. This gives figures with such samples even 2 or 3 per cent. above those of the polariscope, which we know to be somewhat too low; but it is by no means certain that the copper results are not too high from a reducing action of some of the indeterminate impurities of these low samples.

I may say a few words as to the average percentages of raw sugars as determined by some thousands of careful polarimetric observations. The most constant in quality is Java, which seldom falls below 96 and ranges from that to 98 or even higher. Fine Mauritius ranges from 95 to 98, but the syrupy kinds hardly average more than 90 or 91, some being as low as 86 or 87. Havana varies widely; the ordinary kinds generally run from 91 to 95, 93 being a very frequent percentage, but some of the finer kinds rise to 96 or 97, and I have found exceptional boxes nearly pure, showing 99 or even 99½. The second-class, as West India (Demerara, Barbadoes, Trinidad, Cuba, &c.) and the still inferior Brazilian sugar, (Pernambuco, Bahia, Paraiba, and others), vary so much, even in different parts of the same cargo, that it is almost impossible to give a special average for each. Collectively they range from 80 to about 93, but it is only exceptionally good cargoes which much exceed 90 in actual out-turn. It is notable that while fine sugars, Java, Mauritius, or Havana, generally land nearly or quite equal to the shipping sample by which they were bought, the inferior kinds are usually considerably below it, and the more so the lower the quality; in some cases 2, 3, even 4 per cent. less. This may of course arise from the sample having been unfairly taken, so as not to represent a true average of the bulk, but it may also proceed from deterioration on the voyage. Such sugars are always moist and acid, conditions highly favourable to the change of cane-sugar into glucose, especially in the damp hold of a ship under a tropical temperature. I can only speak to the fact, which is apt to mislead the refiner in buying. Nor are the analyses of experts to be too implicitly relied on. Here is a fine Mauritius, which on repeated trials was found to be 97 per cent. (this is an instance by the way of the shipping sample and the bulk of the cargo precisely agreeing). On the bottle is a pretentious-looking analysis, which sets it forth as 94¼ per cent. only. This is by a commercial tester, a druggist, and—pray do not laugh, though the fact would be ludicrous were it not pitiable—also a public analyst for food and drugs under the Adulteration Act. I would that time allowed me to dwell, even briefly, on this precious legacy of the science-scorning Cabinet of Ayrton and Lowe, for it is one of the most mischievous bungles ever perpetrated by an English Government. Even as it is now worked, it is tyrannical towards the smallest offenders, whilst gigantic frauds and wrong doings are passed by, and the public is deluded into a false sense of security. As to the motley tribe of public analysts, surgeons, druggists, all sorts of smatterers and pretenders, with a few bright exceptions—dumb dogs which cannot bark, or bark in the wrong note and season—their doings threaten to bring analysis, nay science itself, into general contempt. The Act must soon be altered—possibly without being improved—and I only allude to the subject to offer a suggestion. The Society of Arts has launched or aided many valuable public movements, and I think could scarcely undertake a more worthy task than to bring to a focus for the guidance of our Legislators, concurrently with the report of the Parliamentary Committee now sitting, the opinions of those really competent to form a correct judgment on this vital but difficult question.

Besides its value as a palatable adjunct to our food, sugar is important in a dietetical point of view. It forms a valuable element in the production of the vital heat through respiration, and is undoubtedly fattening. (Indeed, one of the benefits of the abolition of the sugar duty will probably be the large consumption of the inferior kinds by the agriculturist for the fattening of stock.) Hence it becomes of consequence that we should clearly understand the relative advantages and drawbacks of the different forms of sugar. Raw sugar (which is most favoured by the grocer) is decidedly objectionable unless of the very finest quality, and it is so mixed and manipulated that it is difficult to make sure of that. It contains considerable quantities of woody fibre from the crushed cane, which

has not been separated by filtration; often much gritty sand; innumerable sporules (or *quasi* seeds) of fungus; colonies of the sugar-mite; nitrogenous matter; and treacle, or glucose in its different forms. Let us glance at these in succession. The woody fibre is simply indigestible; the sand attracts attention when the sugar is dissolved in tea or otherwise, and is popularly supposed to be added by the grocer. I cannot say whether the charge might ever have had any real foundation when sugar was much dearer than at present, but low sugars when imported frequently contain a notable amount of sand whose accidental introduction could not be readily accounted for. In a small cargo Messrs. Finzel once found 12 tons of sand, but, of course, this was an extreme case. Stones, lumps of rock, and old iron; in one instance a cannon-ball; in another a set of slave-manacles have been found at Counterslip in West India hogsheads, to be paid for as so much sugar. Well, sharp, angular sand is certainly not a desirable ingredient in a cake or pudding. *Fungus spores* are deleterious from the extreme rapidity with which, under suitable conditions, they develop into a spreading vegetable growth; but more objectionable still is the animal product of the sugar, the *acarus sacchari*, of which I will show you a photograph. This was first described by Dr. Hassall, who may be termed the father of modern anti-adulteration science, which is also deeply indebted to our chairman. He characterises it as oval in shape, with eight jointed and spiny legs armed with formidable hooks, and altogether similar to the itch-insect, than which, however, its organisation is still more formidable and forbidding. It seems to burrow under the skin in the same way, producing the irritating pustular disease known as "grocer's itch" from its attacking those who are constantly handling raw sugars. Such living beings can hardly fail to be injurious when swallowed, especially as they are difficult to kill. Dr. Hassall remarks:—"The acarus clings to life with great tenacity, for very warm water does not always kill it, and it may frequently be found in a living condition even after twenty hours' immersion." This persistent vitality joined to their burrowing powers renders the presence of these creatures in our food the more obnoxious, and they exist in nearly all raw sugars. Hassall found them in 78 out of 83 samples of brown sugar purchased in London, and in many, in considerable numbers. Dr. Cameron, the able and indefatigable sanitary chemist of Dublin, estimated that the sugar supplied to one of the workhouses there contained at least 100,000 to the pound. It is the nitrogenous matter which supports the existence alike of fungus-germs and acari, and the relative abundance of these is a pretty correct measure of the proportion of the albumenoid principle. As I have said before, most nitrogenous bodies are not only unstable and prone to decay themselves, but impart their own changeability to other organic materials, with which they may be in contact. Hence a solution of brown sugar will speedily ferment and turn sour, and jam made with it, unless boiled down hard, will quickly spoil, although pure sugar is one of the best preservatives. The last item, the treacle, is the source of the coarse saccharine flavour which attracts the uneducated palate, and quite as much as fancied economy renders raw sugar popular with certain classes; but the inferior kinds are far from cheap, as they are extremely heavy. Dr. Hassall, as the result of his inquiries, "felt compelled, however reluctantly, to come to the conclusion that the brown sugars of commerce are, in general, in a state wholly unfit for human consumption;" and Dr. Cameron writes:—"In the interest of the consumer I advocate the exclusive use of refined sugar. I unhesitatingly assert that no one who pays any attention to the purity of his food, and is aware of the nature of the impurities so frequently abounding in the raw article, could, without a feeling of loathing, make use of it."

The white moist sugar of the shops, technically called "pieces," is free from woody fibre, sand, fungus spores, or acari, since it has been refined; but it is often moist and clammy, so as to weigh heavy in proportion to its sweetening power, and as it is frequently made in part from raw beet-sugar, it is apt to retain traces of its offensive volatile oil, and its abounding nitrogenous matters, rendering it liable to ferment.

Before, in conclusion, speaking of lump and crystal sugars, I must remind you that the separation of pure sugar from the syrup, containing glucose, colouring matter, nitrogenised principles, and various salts, depends on the marvellous phenomenon of crystallisation. As an illustration, I will instance nitre. Hot liquids dissolve a larger amount of most salts than when cold; boiling water dissolves twelve times as much nitre as water at 60° can either take up or retain. Hence, as a solution of nitre saturated when boiling cools, the greater part of the previously dissolved nitre will be deposited, and as its particles when separating from a mobile liquid have perfect freedom of motion, they balance themselves into that special geometrical shape which is as characteristic of many bodies as their colour, smell, or taste. See how the particles of nitre by unerring molecular attraction have formed into a regular figure, which in their case is a long six-sided prism, and built up their perfect structure, atom by atom, with a precision which art cannot equal. Such processes have been going on around us from the birth of time and will continue to the end, yet I confess I can never look on them without fresh wonder and admiration. Different substances crystallise in different forms, while others refuse to crystallise out from a liquid at all, and on this rests the purification we seek. The impurities of crude nitre are colouring matter, which will not crystallise, and common salt, which forms cubes, having no relationship whatever to these long crystals, hence they will both be separated. The mason when building a wall would never try to fit a square block into an oblong hole, nor to fill up the gaps with a liquid; neither will the nitre. The square blocks of salt are rigidly excluded from its minute architecture, and the still-liquid colouring matter can find no place in it. So with a solution of sugar. The sugar atoms build themselves up into short six-sided crystals which reject every trace of the salts and treacle, the colouring and nitrogenous matters of the syrup. The substance of the sugar crystal will be as pure as the force of nature, controlled by art, can render it. Ice crystallised out from sea-water in icebergs is perfectly free from salt, and Faraday found that the ice from Norway and the North American lakes was abso-

lutely pure though from water by no means so. I will endeavour to demonstrate this purification in a manner visible to the eye. We have in this glass a solution which was saturated while hot with sulphate of soda, mixed with a considerable amount of carbonate of soda, which for our present purpose we may look upon and call the "impurity," to be got rid of in refining. As the liquid cooled, a large portion of the sulphate of soda crystallised out, attaching itself to a weighted line, by which we can readily lift it. I will set the mass to drain for a minute or two, while I add some hydrochloric acid to the liquid from which it has separated. This produces, as you see, a most copious effervescence, by setting free the carbonic acid gas of the large quantity of carbonate of soda actually present. I will add much of the same acid to the water in this glass, in which I will hang the mass of sulphate, after rinsing its surface by dipping it two or three times into clean water. There it is dissolving tranquilly in the acid without a bubble appearing, so that it can contain no trace of carbonate, which was all left behind in the mother liquor. You will see this better if we throw the magnified image of the whole upon the screen. You observe dense streams of the heavier solution pouring down from it, showing that it is rapidly dissolving, but no solitary bubble tells of a taint of carbonate; it is sulphate of soda chemically pure, and so is sugar when similarly obtained in bold regular crystals, the surfaces of which have been properly rinsed and cleansed. I had intended to give some experimental illustrations of this, but I found time would not permit. Pure Sugar-Crystals were introduced to the market 25 years ago by the late Mr. Finzel, of Bristol. There are some peculiar points connected with their manufacture. If the concentrated syrup boiled down in the vacuum-pan were simply run off slowly and cooled, it would crystallise well enough, but in crusts or masses, which would be most inconvenient in use. Sugar-candy, which we all know in long sticks of crystals aggregated round threads which are stretched across the pan of syrup, takes a week to form, but we require perfect isolated crystals, and far more rapidly produced. To the astonishment of all scientific men, who are in the habit of considering perfect repose during a prolonged cooling as a condition essential to forming regular crystals, these sugar-crystals (many of which are sufficiently perfect to serve as crystallographic specimens) are produced in the syrup while tumultuously boiling down in the vacuum-pan itself. I was amazed on looking for the first time through the glass-pane in the side of the pan to see the boiling syrup, while tossing and heaving like a foaming yellow sea, full of large regular crystals, often thrown up against the glass to be as quickly washed down again. This agitation renders each crystal independent and perfect all round, with no tendency to adhere into masses. It probably also increases their purity. Faraday found that perfectly colourless and neutral ice could be obtained by partially freezing water mixed with indigo dissolved in sulphuric acid, but only when the liquid was kept stirred with a feather. When the syrup is sufficiently boiled down it is run out of the bottom of the pan just as you see it in this bottle, a pasty mass of these pure white crystals bathed in a somewhat impure and yellow syrup. All this colour has been produced by the boiling, even at the low temperature of the vacuum-pan, for the liquor as it ran in after treatment with the black in a column 20 to 40 feet high was as white and limpid as water, as you see in this sample. The purity and beauty of the crystals will both depend in great measure on the perfection with which their surface is cleansed from the mother liquor. This is admirably affected by a happy adaptation of centrifugal action, which was patented in 1849 by the late Mr. Finzel. The soft mass, whilst still hot, is thrown into a perforated drum, which is spun round at the rate of about 1,000 revolutions per minute. The liquid syrup is quickly thrown off through the sieve-like sides which retain the crystals in a uniform layer. By watering this once or twice with white liquor every surface of each individual crystal is washed and freed from the last trace of the syrup, and in a few minutes the crystals are scooped out of the machine pure, white, and dry, fit to place that moment on the tea-table or on the grocer's counter. I will show you the process in action on a very small scale with a miniature model from Messrs. Manlove and Alliott, the makers of these machines. Here is the mass from the pans, diluted a little, as it is now cold. On working the machine, and after a short interval, "liquoring," as it is called, we take out the crystals white and pure, but somewhat damp for want of adequate time and speed.

The purity of this crystal sugar, as made by Messrs. Finzel, is something marvellous, and difficult to match among artificial products. By Dr. Hassall's analysis it only contains one-tenth per cent. of all matter other than pure cane-sugar, four-fifths of this being a trace of surface moisture. Dr. Cameron found only a two-thousandth part of moisture and ash. My own carefully-conducted analyses give results between these authorities. I find about a twelfth per cent. of foreign matter, mostly superficial moisture, the ash being only a ten-thousandth part. For all practical purposes we may term Finzel's crystals absolutely pure. We cannot speak with equal confidence of loaf sugar. To manufacture this, the syrup is purposely made to form a small "grain," or imperfect irregular crystals, and the mass is ladled into conical iron moulds set with the point, which is perforated, downward. This aperture is unstopped when the contents have become cold, and the bulk of the liquid drains out. Small portions of white syrup are sprinkled from time to time on the top, or broad end of the loaf, to wash away, as far as possible, the remainder of the treacly liquor. But from the minute size of the grains their surface is very great, and as they are aggregated into a porous mass of small cells like a sponge, it is almost impossible to obtain in practice such a thorough and perfect cleansing as the centrifugal machine gives to the larger, bold, hard crystals. Hence (the inferior kinds more especially) loaf sugar retains traces of the uncrystallisable impurities, and amongst them, doubtless, those nitrogenous ones which cause fermentation. It is true that their absolute weight must be very small, but they are active for mischief. Just as a particle of putrescent matter which can be introduced by the point of a needle or lancet will cause septicæmia or poisoning of the whole blood of a healthy subject, and even

destroy life, so a mere trace of a nitrogenised ferment can set up a destructive change in large quantities of vegetable materials, such as preserved fruit. Syrup of pure sugar is one of the very best antiseptic or preservative media, alike for animal or vegetable substances, but it must be pure. Brown sugar used in preserving fruit will cause abundance of frothy scum, and the jam will afterwards be apt to ferment and spoil. The inferior kinds of loaf sugar produce the same effect, though in a lesser degree, while the pure cystal sugars are practically found to give greater economy at starting, from their high sweetening power, and far more permanence in keeping. Moreover the bulk of the lump sugar now offered in the shops is made abroad, chiefly by the French, and sold to us at a much lower price than in their own markets. This is made from a mixture of cane and beet-root sugars, and some of it, and also of foreign crystals which I have met with, smelt when dissolved in warm water like the bilge-water of a ship. To sum up my experience, and speaking merely as a scientific man, without any personal bias, I emphatically say that I consider that crystals like those on the table should entirely replace the old fashioned loafsugar. Some object to the slower solubility of the bold crystals which are so popular and largely consumed in the manufacturing districts of England and Ireland. To meet this objection, Messrs. Finzel have lately introduced a new make, equally pure and beautiful, but considerably smaller in the crystal. This dissolves nearly as quickly as lump sugar, and is specially intended for the London market.

I must ask you to bear with me yet a few minutes while we throw on the screen some photographs, also kindly lent me by Professor Gardner. In the decayed and stagnant old town of Bristol there is one object of interest, the gigantic Counterslip Refinery of Messrs. Finzel, the most extensive in the kingdom, producing annually about sixty thousand tons of sugar, a large proportion being of the finest kinds. The packages of raw sugar are hoisted to the top floor, that the syrup may descend by gravitation alone, as far as possible, through all the operations. It is first dissolved by a happy application of the vacuum principle (also patented by Mr. Finzel), carefully strained, and passed through tall iron cylinders filled with granular bone-black, from which it runs as white and clear as water, thanks to the invaluable absorbent power of the black. Here is a bottle of the raw syrup after mere straining, dark coloured, in mass almost opaque; here the same liquor after the action of the charcoal. It is then ready to boil down in the vacuum-pans, for no trace of chemicals, lime, blood, or any foreign substance whatever is used in making these crystals. Fine raw sugars, water to dissolve, and black to decolorise them, are the only materials employed. The crystal pans are smaller than the one of which I showed you a photograph some time ago, and are set on a raised platform like the quarter-deck of a man-of-war, and almost as scrupulously clean. Steam, which hoists the sugar and then dissolves it, boils the syrup in the vacuum-pans, and works the huge pumps which exhaust them, plays a large part in all refinery work, and the chief boiler-house is a wonderful sight. Sixteen great boilers, each 35 feet in length, are ranged in long perspective, the coal which they consume being transferred direct into their fires from barges in the floating harbour outside. Here is a view of the centrifugal machines; but, of course, it only shows their outward aspect, the perforated drum being inside. The crystals from the different boilings are not absolutely uniform in size or whiteness, and require to be mixed to a general standard. They are conveyed in large zinc pans on wheels to the "mixing-room," from the upper stage of which they are shot down into heaps on the floor below, where they are tossed backward and forward till uniformly mingled. There are often four to five hundred tons of the crystals thus piled up in mounds (the place will hold 1,000 tons), and this may all disappear in a couple of days unless replaced. Standing among these banks of pure, white, glittering crystals, one may fancy oneself transported into Alpine scenes of snow and ice, and on a bright day the glare is almost trying to the sight. There are numerous atmospheric bells overhead, each numbered, and when one is rung from the basement below, a corresponding trap in the floor is opened, and the crystals are quickly shovelled down its shoot into a cask placed beneath, to issue forth to the consumer a beautiful and a perfect product.

I must not add a single word, except to thank you for the patient kindness with which you have borne this lengthy and imperfect paper.

DISCUSSION.

The Chairman said there was scarcely time to enter on a full discussion of the many subjects introduced by the reader of the paper; for instance, the optical test for sugar, which was of immense importance, and the question of impurities and adulteration. But it occurred to him that as there were several gentlemen present who were practically acquainted with this subject it would be as well if they would direct their attention to two or three points of prime interest. To begin with, he thought it of great importance that they should consider what might be termed the practical value of the particular process now brought forward. They had not had an opportunity of going into the details of this method, which would have been very interesting, or considering the influences of particular impurities with regard to the quality of the product. They might also direct their attention to another important question, viz., what was the particular sugar in comparison with that which had been in ordinary use for ages past? No doubt the fact of its being pure in respect of its crystalline form was a great advantage, but he should like to know from those conversant with the subject whether there was really any chemical difference between ordinary lump sugar and the crystals on the table. Probably an analysis of the two would give some idea of the respective chemical properties of those two sugars, and that was a subject which he thought might be very advantageously discussed, so as to give the reader of the paper an opportunity of saying what were the absolute values respectively of the old-fashioned lump sugar and of the crystals. The two points suggested for discussion were shortly these—what was their value as determined by investigation in the laboratory, and as determined by their practical use?

Mr. W. Eathorne Gill said he had not quite gathered what was the difference between the manufacture of this crystalline sugar and ordinary lump, except in the use of the centrifugal machine. If there was any-

thing beyond he should be glad to hear of it. As to the relative solubility, that was probably accounted for by the fact that there were more surfaces in the small crystals than in the larger exposed to the liquid in which it was immersed.

Mr. John Newland remarked that the photograph which had been thrown on the screen of the very disagreeable looking insect described as being prevalent in many varieties of sugar would be very likely to alarm a great many persons, and he should like to know whether that animal was met with only in cane sugar, or whether it was also present in beet-root sugar. If persons had any objection to consuming sugar which had been in any way mixed up with insects of such a peculiarly disgusting character, and it was found on examination that this objection did not apply to any particular class of sugar, it would probably lead to that sort of sugar being used in preference. He would also ask whether it was not the custom of scientific analysts, and those who manufactured sugar of whatever description, to continually taste different samples, and whether they would in this way introduce large quantities of these insects into their system from time to time. Therefore if they did so with comparative safety to themselves and arrived at a good old age, he wished to know what was the practical value of frightening the public by calling attention to such matters.

Mr. McComber would like to know the difference in the saccharine matter contained in 1 lb. of these fine crystals, as compared with the moist sugar sold in the market, in order that the difference might be recognised otherwise than by the taste. He had often heard the crystals objected to on the ground that they dissolved slowly.

Mr. Bramwell, C.E., said it would have been more satisfactory if Dr. Griffin had stated the exact amount of impurity in good ordinary loaf sugar. He had given the percentage of impurity in the crystalline as made by Messrs. Finzel as a very small fraction per cent., but when he came to speak of loaf sugar he only stated the impurities must be more, but how much more he did not state. It appeared to him that the difference between this mode of manufacture and that of loaf sugar was that there was a peculiar method of boiling, which ensured a large grain and therefore gave less amount of surface, so that when the faces of the crystals were washed in the centrifugal machine there were less surfaces in proportion to the weight; and it would be probably more easy to wash those faces than the greater surfaces of the small crystals when put into the mould in the ordinary method. After all, the crystals themselves must be equally pure, whether large or small, and it really was a question of getting the surfaces clean. Then came the question how far were the surfaces left dirty in the ordinary washing in the mould, where the cleansing was effected by the percolation of white liquid through them, a considerable time being occupied in the operation. There the liquid washed the crystals by the action of gravity, while in the centrifugal machine the motion was greatly intensified, and the liquid which washed the faces passed through the crystals at a greater rate owing to the centrifugal action. It might be interesting to the meeting to know that the engineer to whom many years ago he himself was apprenticed invented and largely practised a mode of intensifying the action of gravity in sugar refining prior to the introduction of the centrifugal machine. His method was to put the whole production of the vacuum-pan on a fine stationary sieve some inches thick, and level it. Then a kind of vacuum was formed underneath, and the surface being wetted, either with the appropriate syrup or with water, the pressure of the air drove this syrup through the crystals and washed their faces in the same way as in the centrifugal machine, leaving the white crystal on the top of the sieve. This process was largely used in the colonies for some time, until it was checked by the Customs' regulations, which imposed a new duty, according to which at that time the duty varied with the degree of purity, and when this white sugar came to England it was called refined sugar, and charged a heavier duty. This showed that the making of granulated sugar and the washing of crystals by rapid action was not a novelty, having been practised very successfully many years ago. He was rather struck by a statement in the paper which did not quite agree with the somewhat extensive experience he had had lately amongst some of the largest sugar manufactories in the world, with regard to sugar-cane yielding 90 per cent. of juice, and leaving only 10 per cent. of woody matter. As a matter of fact, with the best machinery and average canes the percentage of juice was as nearly as possible only 66 per cent. Dr. Griffin had also stated that one horse power would yield 100 gallons of juice in an hour. He had tried very many engines when taking the quantities ground by the mills, and the very best results he ever obtained were four indicated horse power and a fraction for a ton of canes per hour, and to grind 18 tons of cane in an hour it required very nearly 80 gross indicated horse power. He had found an instance, where the men had been trying to make exaggerated results for his satisfaction, that they had got up as high as 12 indicated horse power, because they were working the mills unfairly, but when a steam engine indicator was put on it was very apt to tell the truth; therefore taking it at the best it would be found that instead of 100 gallons per horse power it would be more nearly 36. The only way he could account for this discrepancy was by supposing that Dr. Griffin had taken the nominal or commercial horse power, whilst he (Mr. Bramwell) took the indicated horse power on the piston, which varied from two to four times the nominal.

The Chairman asked if Mr. Newlands could state the amount of impurities present in loaf sugar.

Mr. Newlands said he had no pretensions to be a scientific authority on this subject, as his experience had not been particularly directed to the question of loaf sugar. Every one, however, knew perfectly well that in good samples the percentage of impurity was very slight, something like 1 or 2 per cent. He should not like, however, to pledge himself to the absolute amount of moisture or nitrogenous matter.

The Chairman said he understood the result of Mr. Newlands' experiences was that in 100 parts of loaf sugar there were 98·8 or 98·9 parts of pure sugar, the remainder being impurities, including moisture and mineral matter.

Mr. Newlands said that was so, but his experience had been rather limited.

The Chairman said he should like Dr. Griffin to state what percentage of the masquite was got in the form of these crystals, and, in the next place, whether the residuum or drainage presented greater or less difficulty in subsequent treatment than the drainage from ordinary loaf sugar—in point of fact, what qualities and characters of sugar were produced from the residuum; because it appeared to him of considerable importance to consider first whether there was a larger or smaller proportion of crystals obtained than under the ordinary process, and next whether a better or worse product was obtained in the subsequent treatment of the syrup which ran from these crystals than would be obtained from the drainings of ordinary loaf sugar. He did not quite understand either whether the crystals were washed in the centrifugal apparatus with ordinary water or with syrup, and this would to a large extent affect the expense as well as the character of the subsequent treatment of those syrups. Again, it seemed to him a matter of considerable practical importance how the syrup was evaporated in the vacuum-pan, whether the crystals were produced largely in the pan, or whether by subsequent cooling or heating they were developed after with-

drawal, and also whether in the conduct of the process the charge was entirely withdrawn from the vacuum-pan, or whether a portion was left as a sort of nucleus for the deposit of crystals in the subsequent treatment. He should also like to know the proportion of impurity in ordinary brown sugar as compared with that present in these crystals.

Dr. Griffin, in reply, said the most important question which had been put was as to the absolute amount of impurity present in loaf sugar. This varied very greatly, and ranged, he believed, from about 2 per cent. in the lowest samples to about ·5 per cent., or possibly in very fine samples ·25. It was not, however, so much the absolute quantity as the character which must be considered. With regard to this, chemistry and the balance were at fault, and until they could weigh that matter, which unquestionably would produce epidemic disease, they could not always estimate the total value of impurities by their absolute weight. Their nature eluded observation, but they knew from experience that the only way to arrive at a conclusion was experimentally, that where these traces of nitrogenous impurity remained they would set up fermentation, whilst if the substance were chemically pure this would not occur, so that if the amount was apparently small the effects might be very mischievous. The question as to practical sugar refining he could not answer satisfactorily, as he spoke only as a chemist and not as a sugar refiner. In the first place the entire building up of the sugar crystals took place in the pan itself, for after a very short cooling, on removal from the pan, the masquite was conveyed to the centrifugal machine to be there separated. The growth of the crystals undoubtedly took place in the pan, though this was a most extraordinary fact both to himself and scientific men generally. With regard to the nature of the residue he could only say that it might be entirely worked up into comparatively fine sugar, and this large refinery could be carried on if desired year after year, without the production of any molasses, or any low class of sugar whatever. With regard to the amount of sap and woody fibre contained in the cane there was no doubt that Mr. Bramwell, speaking from experience, was quite correct, because it was notorious that a very large amount of juice and also of valuable sugar was left in the canes, he believed fully 25 per cent. was wasted. He had referred in the paper to the theoretical quantity as determined by exact analysis, not the amount yielded in practice. Another gentleman had inquired whether those in the habit of tasting raw sugar did not swallow these acara to which he had referred; he could not answer for all his brethren, but for himself he could say he never did, for he had such a horror of those lively gentry, that he did not care to introduce them into his own system. He believed they were not found in beet-root sugar, at any rate he had never found them there himself; and he believed that the offensive oil which he had referred to as being present in beet-root was too much for them; and no one would ever dream of using raw beet sugar as an article of food. As had been stated by one of the speakers, the difference between this crystalline sugar and ordinary lump was simply in the use of the centrifugal machine. The substance of the crystals were beyond question pure, whether they were small or large, and the impurities were simply on the surface. Therefore, when loaf sugars were abundantly washed, no doubt they might be rendered fine and pure enough; but the bulk of the loaf sugar offered in commerce was very far from being so, much of the French sugar being almost a solid compact mass. The only way of comparing different classes of sugar and the amount of nitrogenous matters contained in them, which would induce chemical changes in the blood or in vegetable matter, as, for instance, in preserved fruit, was not by means of chemical tests or the balance—because the whole might be imponderable—but by carefully trying the substances against each other, and then if it were found that one slightly impure substance set up fermentation, and the same when perfectly purified did not, a practical solution would be arrived at.

Mr. Bramwell asked whether the sugars made from the residuum of the first crystals contained more or less nitrogenous matters than ordinary loaf sugar? If they contained more they must be more impure.

Dr. Griffin said no doubt the pieces made from the residuum of the crystals must contain far more nitrogenous matter than the worst loaf sugar, and they were sold as an article of food. Of course, all moist sugar, or pieces, as it was technically termed, was fermentable, and all contained traces of nitrogenous matter.

The Chairman then proposed a vote of thanks to Dr. Griffin, which was carried unanimously.

TWENTY-SECOND ORDINARY MEETING.

Wednesday, May 13th, 1874; Thomas Webster, Esq., Q.C., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Allen, Franklin (secretary of Silk Association of America), 93, Duane-street, New York, U.S. America.
Anderson, J. R. W., Tallisker Distillery, Portree, Skye.
Burn, Dr. Alexander, 23, Marloes-road, Kensington, W.
Guerrico, Alberto A. De, 31, Sussex-square, Brighton.
Heron, Sir Joseph, Town-hall, Manchester.
Lansdell, Mark J., 38, Gracechurch-street, E.C.
Lockyer, William J., Pembroke-villa, Elgin-park, Redland, Bristol.
Sigismund, Dr. J. Mordaunt, 10, Weymouth-street, Portland-place, W.
Thicke, Frank E., 5, Great Queen-street, Westminster, S.W.
Townshend, Captain John, R.N., Lona, Weston-super-Mare.

The following candidates were balloted for and duly elected members of the Society:—

Brown, J. T., 3, Chesham-villas, Sudbury, Harrow.
Cownley, A. J., 7, Oxford-terrace, New Peckham, S.E.
Hanbury, Cornelius, Plough-court, Lombard-street, E.C.
Higgins, Clement, M.A., F.C.S., 2, Dr. Johnson's-buildings, E.C., and 103, Holland-road, W.
King, Joseph, Trelearen-house, Blundell-sands, Liverpool.
Penney, Edward, 17, Lime-street, E.C.
Roberts, Isaac, Rock-park, Rockferry, Cheshire.
Vine, Daniel Charles, 1, Marden-villas, Ashley-road, Upper Hornsey-rise, N.

The paper read was—

ON THE IMPORTANCE OF A SPECIAL ORGANISATION FOR THE DIFFUSION OF SANITARY KNOWLEDGE.

By Major-Gen. Synge, R.E., F.S.A., F.R.G.S., F.R.C.I.

A self-evident proposition is admitted to be difficult of proof. An axiom may be stated, but is supposed to be incapable of demonstration, and the attempt even to reason on the difficulty of substantiating logically that which commands instinctive assent leads at once into the region of metaphysics. I should venture on yet more subtle ground were I to hazard entering upon the inquiry why self-evident propositions or truisms stand preeminent among the things universally neglected in practice. Yet my subject, namely, "The Importance of a Special Organisation for the Diffusion of Sanitary Knowledge," places me in this difficulty

and takes me into this region. For when I have stated it, shall I not have enunciated a self-evident proposition? Who is there that will dispute the value of knowledge, provided only it be real? Or who will deny the value of health? Who will question that the one bears upon the other? Health cannot be maintained without knowledge, whether that knowledge be instructive, intuitive, or acquired. And who is there to be found bold enough to affirm that our existing habits in matters relating to the maintenance of health are satisfactory? If there be such an one, I should select him as the strongest and most conclusive embodied evidence it were possible to procure, or to adduce, of the necessity which exists for the diffusion of knowledge leading to a better condition of mind. If, on the other hand, there be none such, my proposition is in great part admitted, and, in so far, my object attained. If the habits of a great proportion of our population be in many respects not conducive to, but subversive of, the due maintenance of health, who will gainsay the propriety of, if there exist not the absolute necessity for, a special organisation to spread sound knowledge on sanitary subjects; but an organisation armed with that authority which is derived from conviction brought to bear rather than with that comparatively unreal and unstable force which may indeed be procured by the instrumentality of legal enactments, but which is never willingly submitted to when enacted contrary to conviction, and which never carries, and never can carry, the same inherent power as stands inseparably connected with settled conviction founded upon the knowledge of the true; and this is, to my mind, the sound definition of science—science is true knowledge of the true. In accordance with these views, I seek, in bringing this subject under your consideration, to arouse the energy of action, so that it may be applied directly to the performance of this task, and this Society be moved to form a distinct branch, which I hope will cover the land, and which shall base its action on somewhat of the following principles and outline of suggestion. First, on patient and continuous investigation of what is true in that class of subjects pertaining to health which is usually ranged under the term "Sanitary;" next, on clear and concise compilation of the evidence on which each step in such investigations shall rest, and which shall proceed to diffuse or spread such knowledge, but which shall leave entirely free and unfettered by any recommendation of legal enactments the adoption or the non-adoption of the results which may seem to flow from the establishment on such evidence of the premises in question. I shall presently seek to direct your attention at somewhat greater length to the grounds on which I press this advocacy of perfect liberty; but I introduce it thus early to your notice because, for my own part, I am as thoroughly satisfied of the policy, as I am of the propriety, of limiting legal enactments to such negative injunctions as fetter liberty only where it degenerates into license, and of never attempting to command an individual or a community to tread in some particular positive path. Particular enactments, however much they may possibly be deemed right at the time, may all the while be wrong; but this is the least evil aspect of the question. The intrusion of legislative or government direction beyond the function of maintaining order tends to unman a people, and is both a cause and symptom of decline. This, even if the legislation and direction be right in themselves; but the legislation of wrong is the violation of law, and treason against its majesty. Law forbids our injuring our neighbour, but law is powerless in the direction of direct benefit. We cannot by any means whatever do any positive good to our neighbour by means of a legal enactment. We can and we ought to abstain from doing our neighbour harm, but every needless, and, much more, every injuring enactment is organised wrong to our neighbour, and wrong in the worst form. The only enactment I should desire would run in ordinary phraseology enough; it would be an Act to amend by repealing other Acts. The necessity of combating at every turn the love of forcing our shibboleths on others has led me into this necessary digression; but returning to the direct means I would suggest for diffusing sanitary knowledge, I would propose that the Society of Arts request the Council of the Annual International Exhibition to give permanence, and prominence together with that permanence, to that sanitary, architectural, and engineering department which forms so instructive, timely, and valuable a feature this year. Also that it should invite the Council of that Exhibition to cause lectures to be delivered by the exhibitors or others, bringing forward, with all the advantage to be derived from the examples at hand for inspection, their own views in explanation of the works they have produced.

I have jealously guarded against the intrusion of compulsion by means of legal enactment, although it is the pet abomination of the hour; but I would also guard against being supposed to be content to begin and end with the mere machinery of exhibitions or lectures either there and here. I have a very different aim in proposing the formation of this important branch of the Society of Arts. I believe that with very rare, if with any, exceptions our scientific institutions fall short of exercising the influence and carrying the weight they might and should, if they followed more invariably the rule of bringing to a practical conclusion and pronouncing a definite judgment on the questions brought before them, and formed sub-committees charged to see approved conclusions carried into practice by science, that is to say, by sufficiently diffusing sound knowledge on the particular subject. And this is what I propose that we should do. A geographical problem, for instance, unfollowed by an expedition, is of limited value. It would have still less if not even an opinion on the value of the problem is authoritatively pronounced. Let me give you two striking examples, which sufficiently illustrate what latent force is wasted by that neglect. It is not at all too much to say that had the course I advocate been adopted in these instances, the whole political aspect of the world, and the distribution of power, would have been different from what they are. Communication from ocean to ocean over the British territories of the American continent, federating the whole empire in a defensive and commercial league, would have been a work accomplished many years ago; the Suez Canal would have been an English, not

foreign enterprise, and Russo-Persian railways would not have antedated the Euphrates Valley line. Again, were there not sufficiently apparent obstacles in the way, the valuable papers brought before the Royal United Service Institution, and the yet more valuable discussions they elicit, would have a very different effect were they, or could they be followed up by committees of that body charged to investigate and to support or to refute the theses brought under consideration, and charged to bring the result of their deliberations publicly before the Administrative Department. How different under such conditions might be the strength and the efficiency of both our gallant services, and by how much diminished that magnitude of the Taxpayers' Bill, which has led to the deplorable and dangerous result of the arms of the service and consequently of the country being characterised, not in satire nor in wrath, but as a supposed matter of fact, as the spending departments, till the defence of the country has thus practically fallen into the care and custody of accountants. Happily any difficulties which may stand in the way of the course which I propose, were it suggested in the cases I have just given as illustrations, do not at all exist for us here. I have adduced these illustrations hoping that you will think of them again and again, till they have helped to impress indelibly upon your minds the immense but unsuspected power latent in manly effort, through associated independence and its immense superiority in attaining result over anything than can possibly be brought about by any other means. In spite of an Act with some Latin words hard to peasant understanding, which has substituted "urban" and "rural" for "town" and "country," and which has done very little else, there is no department of the Government charged with decreeing and determining what is conducive to health; but if there were we should be wholly free from any special allegiance to it. Our freedom, however, in this matter is not merely complete. We are actually invited by the circumstances of the case to take up the ground which has been left clear, I fear, not from any intelligent understanding, that it is wholly beside and beyond the province of administrative government to decree and determine what shall be the laws of nature which are to govern bodily health, and that it is a proper function of administrative government to cause such laws, which are a part of nature, or in other words inherent in the creation, to be discovered and recognised. I say it is less, I fear, to any clear apprehension of this fact, that we are indebted to our freedom in the matter than it is to the hopeless perplexity of minds which have travelled in the groove of evolving legal enactments out of their inner consciousness, and which, when they look to that inner consciousness for sanitary light, find nothing and evolve that. I think I shall sufficiently establish this statement by a single illustration. Legal enactments at the present moment compel the introduction of an enormous bulk of putrescible matter into the fluid we drink and are supposed to wash in. That fluid is thereby itself made putrid. It consists of gases which, in contact with putridity, change their qualities, and evaporate in new and pernicious formations. The bulk of the fluid remains more or less putrid. These legal enactments again step in and forbid the fluid in that condition to remain in the river bed. The victims of this double compulsion meekly ask what they are to do, but the inner consciousness has exhausted its resources, and gives neither voice nor answer. It remains an utter blank. The victims find themselves the mere sport of a power which commands them under irresistible penalty to bring about a state of things which the same power declares makes water unfit for river beds. First, the adoption of a particular mode of attaining a certain end is made imperative, and next, justifiably enough except for this previous circumstance, it is declared that poisonous water, or water in a condition calculated to do injury to health, shall not be poured into river beds; but when it is asked of administrative government, which is answerable for this state of things, "What are we to do?" there is given first the reply, "repurify," but to the farther question of "How?" the response is like those echoes of Killarney which add to the sounds they reverberate, and the answer is, "Anyhow! we neither know nor care." To suppose, however, that legal enactments which result from what the present Prime Minister is peculiarly apt to call "the wisdom of Parliament," or "Parliament in its wisdom," stop here, would be to suppose an error. Simply to forbid poisonous water, or water that is in a state injurious to a sound state of health, being poured into river beds were a desirable, if not an absolutely necessary rule. It would be a rule in consonance with law in its right sense, that is to say, in harmony with right, morality, and reason. Legal enactments have found their way out of such a dilemma as this which would have involved them in a state of things foreign to their customs. The mode of escape was simple and indescribably efficacious. They did not *proscribe* any measured degree of *corruption*, but they *prescribed* a standard of *purity*. It answered every purpose. It sounded magnificently grand and lofty. It was not evil that was to be forbidden, positive good was to be ordered, and purity in water was to be established by Act of Parliament. The first question, however, was, "What is purity in water, and what is its standard?" To determine the order of the universe seems to exercise an irresistible fascination over the framers of legal fetters. Here an exceptionally fortunate opportunity for the indulgence of this morbid fancy was presented. It offered first an illimitable field for every sort of wrangling. Chemists, lawyers, legislators, each and all could have their say, and all help to the one end of avoiding practical simplicity through having raised a thoroughly non-pertinent issue. The success has been complete. The introduction of a so-called standard of purity instead of the prohibition of defilement has left the determination of that standard undetermined, and it has left the great water arteries of the country in the evil state in which it found them. The "standard of purity," so declared the "Rivers Purification Committee of Scotland" composed of dukes, marquesses, and other peers, and baronets, and of merchants, manufacturers, and proprietors of Scotland, who associated themselves together to end the pollution of their waters, "The standard of purity would destroy the manu-

factures of the country." On the other hand, the manufacturing town of Bradford, in Yorkshire, has been under injunction to prevent its pouring its pollution into a stream much fouler than the Bradford flood. To enjoin and to forbid, to puzzle and perplex, these are the results of legal enactments, and such appear to be their revelry and their delight. So far as the limits of time allow me with regard to other points I must bring before you, I dwell at some length and as impressively as I can upon this point, because I believe it to be the very root, not only of many social evils under which we suffer, but I believe the fondness for legal enactments and the blind credulity that puts its trust in them, are threatening us with some danger of that hopeless and despicable condition in which the sense of manhood has died out. It is a lazy, cruel, and immoral thing to thrust upon others our views or our interests through the intricacies of a tyranny which is not at all the less real for being cloaked by hypocrisy and tempered by folly, and although the embodiment of this evil is in the enactments themselves, these only come into being through the operation of that feeling which seeks more and more to place all life under government rule and supervision, instead of jealously guarding against every encroachment on individual liberty, and every form of usurpation over moral law. The charms of compulsion when applied to others seem daily more and more to deaden, till they threaten to obliterate the sense of morality and the power of distinction between right and wrong, to extinguish the very love and sense of liberty, and that jealousy of injustifiable interference, both the effect and cause of the former manliness of English character, and the foundation alike of the past greatness and the present prosperity of the country. "Government without a Parliament," said the great Lord Burleigh of the reign of Elizabeth, "is an object of terror, Government with a Parliament is an object of desire;" but he added, "England can never be undone but by a Parliament." Government by Parliament he described as an infallible mode of compassing the ruin of the country. Even that prescient statesman, however, has left no record that proves he foresaw that we should delight in being poisoned by Act of Parliament.

A man of modern times, not his inferior it may be in wisdom, has said—"If we adopt the recent English idea of factious contention as the meaning of politics, no man can be a politician and a Christian; but if politics be the knowledge of our duties as citizens, there can be no Christian that is not a politician."

The remedy then, for the grievous abuse and injury which result from unjust, ill-considered, and ever mutually destructive legal enactments, is to be found in the diffusion of knowledge and the performance of our duties as citizens in respect of cleanliness, and in the cultivation of character and manliness, just as on the contrary legal enactments have their root and origin in the indolence of inconvenienced incapacity. It is to press upon you to apply and energise in a direction in which they are very much required, the self-help and the capacity at the command of this influential and able voluntary association, that I bring this subject before you. I do it the more earnestly because the love of compulsion is a very prevalent, as well as a very dangerous disease. Men vary in opinion on many matters; but there seems a dangerous agreement in the desire to "compel" their neighbours to act upon their individual or sectional convictions. This emulation can end only in destruction. This perpetual appeal to power acts as an incentive to singularity of opinion, and the truant infant that began life by knocking over his companions, grows into the angry legislator who thrusts his nostrums or his self-will upon his fellows, enrolling them in Acts of Parliament, and labelling them "with compulsion." On some sanitary questions I have found myself not in consonance with the majority—at least it was so at one time—but I found myself confronted with an evil greater, in my apprehension, even than poisonous waters; those who shared my convictions on these matters shared those of my antagonists as to the means of giving effect to convictions, and adopting the precept of evil for evil, wanted to make running in the arena of factious contention, and to meet the legal enactments of their adversaries with others of their own.

In passing on to the consideration of the subjects that come within the category of sanitary science, I come to a branch of the subject with which I feel that it is quite beyond my power to deal exhaustively, I mean so comprehensively, as to include satisfactorily in general terms its wide and multifarious ramifications. It is imperative, nevertheless, that I should venture at least to indicate those prominent parts of sanitary science of which I have no hesitation in affirming that the general knowledge and general observance are alike imperative and indispensable to the maintenance of the health of concentrated populations in an unvitiated condition. And here I feel also that the task is very much lightened if we continue a due regard to the principle I have already submitted to you, namely, that associated efforts in material subjects, as well as legislation on social matters, should be restricted to negative conditions, but that in this direction the one should be vigorously exerted, and the other be rigidly enforced.

If we accept this principle, and proceed to base the outline of sanitary effort upon it, we shall at once be brought to these conclusions; and first in regard to the atmosphere. Its normal state should not be unnecessarily made worse, and never so except upon sufficient cause shown. It follows as a logical sequence that between rival pretensions to deal with that law of decay, of which putrefaction is an inseparable part, that which *cæteris paribus* prevents such decay or putrefaction, or other deterioration, from so much as reaching or affecting the atmosphere, is to be preferred. Should there be none such, the next best, in the abstract, is evidently that which most nearly approaches to prevention, and most effectually remedies such as may be inevitable. The question of cost is in principle altogether subordinate. It only enters as a matter of detail. There and then, however, it may assume commanding proportions. For instance, the case may be conceived in which an injurious taint of the atmosphere may inevitably and inseparably attach to a particular manufac-

ture. On the other hand, it is quite conceivable that the manufacture characterised by this defect may be of very great importance, and the locality in which it is carried on might be one in which the injurious taint was all but confined in its effects to those conducting the manufactory or directly benefiting from it. Moreover, the actual state of science as to repurifying the atmosphere from the taint might be at a low ebb. There might possibly be no particular remedy whatever except at a cost and by exertions that would prove fatal to production; or if there were one it might be unknown or undiscovered, which amounts practically to the same thing. To lay down a hard and fast rule made to apply alike, and under similar enactments to such vitiation, and to vitiation, wanton, vicious, and preventible, would be exactly what our legal enactments have done and pretend to do, and affords but another illustration of the mischief in practice, as much as in principle, of that fond resort to Parliamentary fetters and hand-tying which, for my part, I deem a worse remedy than almost any evil against which it may be directed.

The tribunal I invite you to form would be wholly free from temptation to fall into such errors. Its mission will be to enlighten; it cannot legislate. Its object primarily would be to attain and to spread "true knowledge of the true," and it would be guided throughout by deductions derived from impartial and patient investigation. It would ascertain and make known the circumstances attending upon each subject which it investigated. Whilst, therefore, taking the very humble, but all-powerful position of being strictly bound to ascertaining what is fact, and absolutely hindered from pretending to determine what wishes, theories, and pretensions can be converted into facts, it would embrace a scope and freedom of application at the present time, unhappily, utterly unknown among us, and, moreover, altogether unattainable until we substitute for the arrogance of legislative decrees the humility of the observance of facts.

Identically the same principle applies to the next indispensable to life, water. In lieu of a vague, imaginary, and utterly inapplicable prescription of a visionary standard of purity, the negative law would evidently lead to a proceeding as feasible in practice as simple in enunciation. Intense absurdity when clothed in the form and invested with the force of legal enactment is tyranny and cruelty, as well as absurdity; but the intense absurdity, I say, of compelling water to be mingled with putrescible matter, and then forbidding the corrupted mass to flow in the channels of the river beds without providing any remedy, is sufficiently apparent. I propose, therefore, that this Society, which undertakes to deal on the basis of true knowledge with the interests of science, art, and manufacture, should take up with a vigour and earnestness proportioned to the magnitude of the interests at stake, and should render impossible the continuance of this condition.

In the face of the tribunal I invite you to inaugurate, and which it is in your power to form effectively, no manufacturing town could have its industry laid under that form of interdict our legal courts term "an injunction," whilst the legislative body, occupied with party strife and with conundrums for the compulsory propagation of knowledge as it is defined by Act of Parliament, and an administration entirely bewildered, look on in helpless bewilderment, ignorant of the ignoble part they play in laying down an eternity of enactments on matters they are too indifferent and careless to investigate.

Again, in contrast to this condition the negative law would merely enjoin that water which might be used (or abused even) in any manner any one saw fit, should not leave the premises or the city in a worse condition than it reached the householder or the city. This furnishes the solution supplied by reason, and is as appplicable to a single householder as to a city. Leaving our municipal institutions intact, it would enable the authorities in such matters to determine on any rules that they saw fit, both as to atmosphere and water, so long as they come within these limits, whilst at the same time they could work little or no positive ill to their neighbours.

Precisely the same principle holds good as to land. I shall not enter into the subject of the ownership of land, I will take it as I find it. Our legal exactments, be they wise or not, enable land to be taken by the community in its supposed interests. I am free to own that I think the judgment, moderation, and full compensation usually shown and accorded, when this legal right is exercised, are among the most encouraging and gratifying evidences of the deep good feeling and thorough honesty of purpose, which I am glad to believe underlie any errors into which we may fall from that rapidity of life and multiplicity of avocation from which we cannot now separate ourselves even if we would. Thus, while I should invite the Society to form a Sanitary Section, and ask the Society itself through it thoroughly to investigate and thoroughly to test all uses of land which might pretend to sanitary result, but of which the sanitary result might be called in question, and fearlessly to deliver and support the conclusions it may arrive at, I would also invite it scrupulously to leave all action on such conclusions altogether to the municipalities and land owners of the country.

I may, however, as well forestall or endeavour to forestall, an objection which may very possibly suggest itself to some by no means uninfluential members of this Society. I am aware that an opinion is in some quarters entertained that we, or at least that certain parties are in possession of all knowledge, now or ever to be attained, on sanitary matters. Those who think so point with emphatic satisfaction to our actual state, reasoning not unnaturally from their own point of view, that these their convictions need only to be acted upon in order to produce that which we all desire, namely, the most perfect sanitary condition which it is possible to attain. This opinion is held, and very stoutly maintained, by men whom I have called not uninfluential. They are so far from being uninfluential, that the great metropolitan area, in a microscopic fragment of which we are assembled, has been brought under the pains and penalties with which, in their fondness for enforcing their views by the instrumentality of legal exactments, they grace their convictions. I shall not question the soundness of those convictions on this occasion. I do not think it the occasion on which to express any opinion beyond the one opinion that forms the

all-in-all of the object of the present address. I desire to concentrate your attention on the value of an association which shall spread its influence by means of evidence made universally accessible and plainly demonstrative, and that shall hate pains, penalties, and compulsion more than we do poison. In that spirit I invite the co-operation and support of the persons I refer to as cordially and as earnestly as I do that of all others; and what I beg of them is, not that they should throw away their convictions, but that they should trust to the force and value of the evidence on which no doubt they believe those convictions to rest, and that they would break off the miserable fetters with which they have been the means of enslaving the volition of all the millions inhabiting the metropolitan area. I wish them to believe in the free trade—if I may avail myself of a cant term to convey my meaning rapidly—in the free trade or interchange of knowledge, and in the right of every man to pursue any course he pleases, so long as that course inflicts no injury to his neighbour. I must however prepare to meet a farther objection. I may be told that my principle is a theory, or that it is impracticable, or—shall I put it in plain words—is nonsense. I might be told that it is impossible for an individual householder to deal with putrescible matter of the various kinds incidental to our existence without offence and injury to his neighbour; that no new tribunal whatever is necessary to determine a self-evident fact, and that, moreover, a fact which the Legislature has recognised after mature consideration; and that the panacea exists already, and needs only to be universally and compulsorily applied. Surely the general dissatisfaction with the existing state of things affords an irrefutable reply to so wide an assertion, however confidently it may be affirmed. Were it possible for a moment to assume the premiss, is it not evident that the opinion that the premiss is sound is not so generally received as to be acted upon? It is impossible almost on any day to take up a newspaper that does not contain some reference to the miserable and dangerous conditions under which we carry on an existence needlessly endangered. Now it is a hospital that has to be reconstructed; then an epidemic spread by means of what it is customary to call milk; next we have an account of cabs alternating between loads of infection and persons to be infected; then contaminated bread; then towns under injunctions—rivers resembling nothing so much as sewers; and so on. Yet in all this category we touch but one form of the evil—for the sin and misery of over-crowding is not so much as noticed. I confess I feel almost overwhelmed by the importance and magnitude of the subject I have ventured to touch.

I would draw your attention to matters of health, and find myself inevitably pleading for everything that can give life value. I cannot keep clear of the moral importance of the subject. I have been told that dirt, over-crowding, drunkenness, and the unnatural fouling of water do not produce an aggravation of the death-rate, even when combined in all the concentrated intensity with which they rage in London. Singularly enough, though I am not at all prepared to accept the conclusion, I had myself, before I was so informed, attributed to a coincident neglect of the primitive religious obligation of cleanliness in all relations of life, the class selfishness, the party strifes, the filthy clothing, and the foul habits which disgrace so huge a proportion of our population. I am almost afraid, even in this assembly, of being deemed unpractical if I set before you the power of true knowledge as much more effective than the instrumentality of a code of rules; but my effort is directed precisely towards this object. The glory of man is dependant on individuality, and we can do nothing aright if we ignore this. We may get work done and we may create misery; we may degrade man and we may foster vice by treating him as droves of cattle are treated; we may rule and we may regulate him; we may render him almost an automaton or animal, but we can never by this means elevate him, never benefit him; we cannot take a single true step towards the lasting prosperity of the nation except by bringing home to him his own individuality and his personal office in the daily duties and functions of his life. I hope you will not deem this a digression. On the contrary, the facts that constitute the danger of its being so regarded constitute the huge barrier in the way of all real sanitary amelioration. If once you realise that man's duty is to work, but that it is his privilege and his right to be clean in his person, clean in his clothing, clean in his dwelling, clean in the clusters of dwellings, I make bold to say the day is won, the victory secured, the triumph of science certain, for it will be carried out in action.

And now I will venture to add but one consideration more upon this head. I, for my own part, am persuaded that cleanliness is economical and filth the foulest wastefulness. I will put this very generally. Take the instance of smoke, which I have not touched upon as yet. In a country teeming with manufactures, compelled by reason of its low temperature to maintain an exceptional amount of domestic fuel consumption, and possessing a fuel which improperly applied is peculiarly dirty, no arrangement could well be devised more wanting in cleanliness than suffering the perpetual escape of falling smuts sullying, smudging, spoiling everything they touch, and lodging, nestling fixedly everywhere. Our houses are built of rough-surfaced material, giving all possible harbour to this dirt. But all that dirt is fuel wasted, the product of misapplication, destructive to substances, and more or less prejudicial to health. Again, millions of tons of friable material are carted at enormous cost into our streets, to be ground into powder by our horses, our vehicles, and our feet. Whilst undergoing this process it is impregnated with animal manure, then wafted round about ourselves and carried into our rooms in clouds of dust, or it is watered into the consistency of mud and carted off again at a repetition of the original cost. We underlay our streets with sewers, drains, connections, gas and water pipes, all without method, system, or protection, and so add as much as we can to the danger, cost, and inconvenience that that we can accumulate. When rain falls we are in sore perplexity how to carry it off in subterranean rivers, yet we cart from a distance every drop of water that is used to prevent our being literally choked with dust. We employ water in a manner of which it is at least alleged that it cannot be justified in reflection, yet one of the most recent prominent

acts of this Society has been to point out, in the most forcible manner that it can, that the whole metropolis is in hourly peril of conflagration by reason of a scarcity of water. We know that under the most favourable circumstances town air cannot rival the mountain breeze in purity, but we construct a laboratory of foul gases, and distribute the outcome to freshen the atmosphere of towns. We have abundant evidence that water is the most effective known means of spreading certain phases of disease. Is it really on that account that we have rendered compulsory the immersion of the putrescible outcome of the largest and most numerous hospitals in the kingdom, those of the metropolis, into water? We know that all putrescible matter forms the natural fertiliser of and is a necessary addition to earth. Is it really on that account that we decree by legislative enactment to throw it into water, by which that value is lost? Now all these acts, unjust as well as silly, arise out of the contempt of individual right and the neglect of individual duty. They all proceed from the substitution of injunction of a means, and of direct action, for the negative commandment of working no ill or prejudice to our neighbour.

I have stated that I feel it impossible for me to deal at all exhaustively with the ramifications of the subject I have brought before you. My difficulty is twofold. First the abstract difficulty of even enumerating the many causes at work injuriously to affect the air around us, and our water supplies, and the earth on which we tread. Secondly, I desire especially to avoid on the present occasion falling in any way into the error I condemn, that, namely, of assuming any particular modes of dealing with any portions of these subjects to be perfect, and then pronouncing it to be so. My object, on the contrary, is to induce not only the fullest and most convincing process of investigation possible, but also that the force of influence which such investigation may tend to give to particular methods may be diffused as widely as is possible. I should, however, deal with even this province very unsatisfactorily and imperfectly if I failed to give you any evidence whatever of the wide divergence of opinion that now prevails, or of the comprehensive range of the questions to be dealt with.

Let me then adduce the example of a single dwelling placed in the area occupied by a concentrated population; that is to say, I take as an example a house in a street in a town. I have spoken of air, water, and earth, but at once another indispensable requirement intrudes. There must be heat. Beginning at the basement there are two alternatives, radically contrary the one to the other, that first suggest themselves. Shall the basement contain furnaces or drains? Shall it be underlaid with heating apparatus, or with encased liquids and gases; Dry or damp? Endangered or absolutely safe in respect of gaseous emanations and foul smells? Shall the heat be diffused by insensible and active or by present and inactive arrangements? Shall there be fireplaces in each room and chimneys, or an equable heat and one chimney? Shall the exterior be washed or not? Of porous or impervious material? Shall putrescible substances be thrown into water, or shall other arrangements be adopted? If the former, how is the putrid fluid to be dealt with? In bulk, or on the premises? If the latter, what are the arrangements to be? Shall house slops be cleansed in bulk or in detail? Shall all slops be thrown together, or be collected according to their characteristics? Shall each house, if not each room, be dealt with separately and distinctively, or, is it, under certain conditions, better to deal with blocks, rows, and houses in the aggregate, both as to warming and waste waters? If water be not employed as a carrier, how are substances usually conveyed by water to be removed? If it is employed, by what means is its repurification to be attained?

Then as to a street. What is the best way of disposing gas and water pipes and telegraphic wire so as to avoid perpetual tearing up? Which is the best pavement for foot passengers? What is the best substance for a roadway? What are the proved characteristics and the known cost of each foot of roadway material? Is it desirable to consider a separate material for equestrians as much as in recent centuries footways have been introduced? Are trees and shrubs so beneficial as active sanitary agents that their introduction should be looked upon as desirable wherever possible? Should the rain water which falls upon the streets be collected through street filters and be elevated into reservoirs for purposes of street and exterior house washing and watering, for fountains and other purposes, or be hurried away in a conglomerate of mud as hastily as may be possible? Is dust, the dry refuse of impregnated mud, injurious to health or not? Is is preventible by other means than mud puddling?

These are but samples of the simplest form of questions that arise, and, with the reiteration of my conviction of how very small a portion of the subject after all they touch if I were to offer them as exhaustive, I am compelled to leave them. I have not so much as touched on overcrowding, which is a moral rather than a structural evil. Still I may safely say, that what I have brought forward is important, and I have only to show you farther how wide is the divergence of opinion that is now advanced in regard to some of the questions.

In opposition to the optimist views to which I have referred, I will first take at random the expressions of opinion recently delivered when, on the invitation of the Council of the Royal United Service Institution, I invited the attention of that institution to some suggestions for sanitary improvement in barracks, camps, and hospitals. The chairman, Surgeon-General Mouatt, V.C., C.B., said, "For my own part I cannot see any practical solution." It would be difficult to adduce testimony more decided in favour of the formation of the organisation now proposed to you. Surgeon-General Gordon, C.B., said "It strikes me that we have not quite arrived at that state of knowledge when we can bring forward our opinions as definite. When infection enters it is too late to apply disinfectants. There is an infection that is communicable by water, there is an infection that is communicable by air, and there is an infection that is communicable by both air and water." Colonel St. Leger Alcock stated of a poor-law union, "At night, after the doors were shut, the bad air [? ventilation] that came up through the sewers was

perfectly intolerable." He added, with regard to a lecture on sanitary subjects, that a poor woman said, "I have lost eight children. Had I known what I have heard this day, I do not think I should have lost one." Referring to the smallpox hospital at Hampstead, he further said, "The objection that it would bring the disease into the neigbourhood was looked upon as almost frivolous; but it did. There was communication through the sewers between the houses and the hospital."

Colonel Murray, late of the War Office and Home District, and now commanding Royal Engineers in Ireland, limited himself to saying he was at his own wit's end. He is, I am persuaded, a very fair sample of many thousands ready to welcome the operations of the organisation suggested to us, if only they be adequately conducted. He did say, explicitly, "I shall be very thankful if anyone can give a plan which may be applied in practice." On the other hand, Mr. R. Rawlinson, C.B., took a completely opposite view. On the occasion in question, I advocated the agency of fire, after the application of charcoal, for the destruction of germs of infectious disease. Mr. Rawlinson expressed his views at considerable length, and I understood them as totally adverse to that opinion. I also understood him to say that the subject was exhausted, and all knowledge attained. However this may be, he stated that he had "never heard more fallacies crowded into the same space of time;" that water did not give off impurity by evaporation to an injurious extent; and he added that London with its lanes and alleys, and houses six and seven stories high, crowded from top to bottom, life of the least possible value, health with the least possible chance, inhabited by gin-drinkers and foul livers of all kinds, had a death-rate of only from 22 to 26 per 1000. So impressed with the fallacies of the paper and the danger of any weight being attached to it was Mr. Rawlinson, that he closed his remarks with this singular sentence, "The paper is not one I can accept, and, in fact, if I did accept it, I should so incriminate myself that my next business would be to go and jump into the Thames and drown myself." Surely this is carrying partiality for Thames water, even in in its present condition, too far. He has added to his remarks made at the time the following note in the Institution's *Journal*, "General Synge said that fire would alone destroy the germs of disease; but an ordinary fire will not do this. Experiments have shown that a considerable percentage of gases pass into, and through, a furnace fire, unconsumed up the chimney, and to the open air."

There is another strong evidence of the value which will attach to our proposed organisation, and to the necessity for it. I do not mean merely rescuing Mr. Rawlinson from the fate he somewhat needlessly invoked off Barking Creek, but I refer to the refutation, on his so generally accepted authority, of a common enough idea that noxious vapours passed up a chimney become innocuous. If I am not mistaken, short of whatever heat may have been in the chimney in question, this is precisely—the heat element, however, being altogether omitted — the theory of sewer ventilation by shafts!

On the occasion in question, however, I did not refer to ordinary fires, but to distillation and destructive combustion in red-hot closed retorts, and as I do not pretend to any scientific knowledge whatever upon the subject personally, I had simply confined myself to the chemical papers of the discoverer, and to the medical testimony of the health officer of Glasgow, as well as that of Dr. Andrew Feargus of the same city. I had known their opinion, given for the express purpose, to have been acted upon, and I take from the substance of letters expressly addressed to me on the subject by Dr. Russell the health officer, and by Dr. Andrew Feargus, the following unqualified statements. Dr. Andrew Feargus says that the water-carriage system causes decomposition injurious to health, and very much increases the power of infectious matter to spread disease; also that on the contrary a chemical treatment, which he goes on to specify, and which consists simply in the application of charcoal, renders decomposition impossible, and meets every sanitary requirement. Dr. Russell says, "No hospital should discharge into public sewers," and adds with reference to the system I had seen, approved, and recommended with particular reference to hospitals, that "it would answer perfectly, and attain the end of destroying the possibility of infection spreading from hospitals in the manner referred to."

The testimony of Mr. Simon as to the preventibility of many forms of disease is probably known to you all. He says:—

> "It cannot be too distinctly understood that the person who contracts cholera in this country is, *ipso facto*, demonstrated with almost absolute certainty to have been exposed to . . . pollution . . . that the diffusion of cholera depends entirely . . . upon the numberless filthy facilities for fouling earth, and air, and water, and for the infection of man. Sodden earth, reeking air, tainted water—these are for us the causes of cholera."

Cholera, however, is but one of many kindred; diptheria had not been epidemic till water was misapplied. Dr. Richardson's table of diseases from organic poisons adds thirteen others to the list. "It is to be hoped," says Mr. Simon, "this sort of thing will come to an end, that so much preventible death-rate will not always be accepted as fate, that for a population to be poisoned by its own art will be deemed ignominious and intolerable."

There only remains for me now to submit, for your adoption, as I trust, the principles of the following programme. I have intentionally drawn them comprehensively, so as to embody, as far as possible, principles only, leaving the detail of arrangement to be framed by a sub-committee which might be appointed to consider the matter, and to final adoption by the Society on the recommendation of its Council. The following is the programme I would suggest:—

1. The Society of Arts, impressed with the importance of the subject, forms a Section for the special purpose of the Promotion of Sanitary Science.
2. It invites, through the Lords-Lieutenant of Counties, the formation of Auxiliary Associations in every county and shire of the United Kingdom for the same object.
3. It proposes that these be incorporated with the Society.
4. It recommends the formation of Societies for the same purpose in all the several parts of the empire.
5. It will communicate with this object with her Majesty's Secretary of State for the Colonies, with a view of bringing the efforts of this Society before the several parts of the em-

pire, through such channels as in the several cases the governors, for the time being, of her Majesty's possessions may recommend.

6. It will make known its action in these respects to her Majesty's Secretary of State for Foreign Affairs, and will request suitable opportunities for inviting, through the channel of her Majesty's embassies, legations, and consulates, the co-operation of such bodies as may be formed in foreign countries for similar purposes.

7. The primary object of the Section shall be to promote the improvement of all arrangements affecting the health of populations in respect of the vitiations of the atmosphere, of water supplies, and of soil, which are incident to human and industrial existence.

8. The Section, in strict subjection to the Society, is purely honorary, and will not in any way connect itself with any commercial undertaking which may arise out of its action or otherwise.

9. It will, however, investigate proposals for attaining any of the objects for which it is constituted, whether or not they be brought forward commercially, and the Society will, upon the recommendation of the Section, approved by the Council, grant gold and silver medals and diplomas of merit, signifying distinct approval, and these shall be accompanied by letters, specifying the grounds on which such recommendations and approval are made and given.

10. The Council of the Society will apply to her Majesty's Commissioners for the Annual International Exhibition to make permanent the display of engineering and architectural appliances which form a feature of this year's Exhibition.

11. They will also suggest to her Majesty's Commissioners for the Annual International Exhibition that arrangements be made at once to enable exhibitors of such appliances this year to deliver such explanations of the several objects they exhibit as can be illustrated with the advantage of the examples upon the ground.

12. They will suggest that this arrangement also be made permanent in so far as they may relate to any novelty hereafter introduced, or of such features as it may be deemed desirable should be continuously made known.

I may briefly add that this draft and the outline of the scheme on which it is based have grown out of a special effort which I undertook individually, owing to the convictions of nearly my life-time, but which I deemed might at length be brought forward successfully when the attention of the country was momentarily concentrated upon the subject, owing to the terrible calamity with which it was threatened in the alarming illness of the heir apparent to the throne, the patron of art, and the approver of science—his Royal Highness the Prince of Wales. My energies were fully aroused, and my hesitation ended by a case of blood-poisoning which occurred at nearly the same time in the house of a very near relative of my own. My occupations interfered with my giving the indispensable attention to all the details necessary to working out this object independently; but, without troubling you with a list of names, or parading the influential encouragement by which I was supported, I will only say that I was fully convinced the proposal needed only to be suitably launched to meet with ensured success, and to attain in a great degree many of its objects. This step, I trust, has been gained tonight. At all events, my thanks are due, and are most heartily given to the Council of our Society, which has favoured me with the present opportunity of bringing the subject under your consideration. I trust that you will join in these grateful acknowledgments, and approve the course which I propose. With regard to the imperial and foreign societies for similar objects to which I have referred, I will only add that I have reason to hope that the action the Society may take will be warmly supported and readily followed. In the Austrian empire more particularly my communications have met with a very kind and appreciative response. Not only has the nucleus of such an organisation been already formed in that empire, but I actually received solicitations for permission, on the part of noblemen of distinction in that country, to become subscribers to any effort that might be organised here.

DISCUSSION.

Colonel Alcock desired to impress upon the meeting the importance of the proposal made by General Synge for the formation of a society for the diffusion of sanitary knowledge. He did not himself profess to have any knowledge of such matters, and in that respect he probably represented a very large constituency, but he had no doubt scientific men would be willing to come forward and instruct them. There was no doubt that the death rate was very largely increased by ignorance of sanitary laws, and whatever difficulties there might be in the way of establishing such an organisation as had been referred to, he had no doubt they would be overcome, as had happened in the case of the Charity Organisation Society. Such a society as was now proposed was a desideratum in a national sense, because the town population was constantly increasing at the expense of the country, and there was a consequent deterioration constantly going on in height, physical power, and endurance, so that in a generation there would be an increasing percentage of the population unfit for military service. It was also an imperial question, for in our colonies and dependencies the same difficulties were arising, sometimes in an intensified form, and being generally met by the same expedients as were adopted at home, any additional information obtained would be of great service.

Mr. Ford thought there seemed a kind of reaction setting in in sanitary matters, there being a proposal for repealing the Smoke Nuisance Act as regarded bakers, and the Act for abolishing slaughter houses, &c., in the metropolis. The question of road materials had also been referred to, and it seemed to him that the public were content to adopt anything, for some materials were used which absorbed everything which fell upon the road, until the effluvia of ammonia arising therefrom became offensive. In some cases, coal tar had to be sprinkled at night to conceal the noxious emanations that were given off. All these matters required to be watched, and he thought the Council would be conferring a great benefit on the public by taking the matter up.

The Chairman said the Council would of course take the matter into consideration, but he was not prepared, at present, to say they would enter upon it further. Some of the matters referred to seemed more suitable for the action of an independent society, and hardly to come within the jurisdiction of the Society of Arts.

Major-General Scott, C.B., said he would confine himself to one or two facts, showing the great ignorance prevalent with reference to sanitary matters. Some few years ago he was in a garrison town when the Crimean soldiers were sent home, sick and wounded; a larger amount of ventilation was required than existed in the barracks, and to secure this large openings were made in the wall, over the beds of the patients, the results being that a great number of them were killed from the draughts, and then the doctors found out that they had not applied the ventilation properly. In reference to this point he might mention that he had seen in Manchester a short time ago, a very admirable apparatus for ventilating a crowded room. It was applied to a room where prisoners were being tried, and consisted of a number of tubes brought up through the desks in front, and similar tubes at the back, just to the height of the people who sat there; and although his impression at first was that the draught would be too great, this was not so, because the air was shot up with such force that

it became mixed with the general air of the room; in fact, he had never been in a better ventilated room. This appeared to be a plan admirably adapted for giving that comfort and health so much required in public rooms, though it might not be suited for dwelling houses. The sewage question was a subject upon which the country required a good deal of enlightment. Many towns had been infatuated with the idea of disposing of their sewage at an enormous profit, but this notion was now being dispelled, for the companies instead of offering fortunes for it, required payment for taking it. If this had been the case some years ago, he thought they would have been considerably in advance of the position in which they now were.

The Chairman said the paper referred to what might be done by the International Exhibition, but as they understood the International Exhibitions would not be continued in their present form, he thought it a subject well worthy the consideration of the Society whether there might not be a perpetual collection of sanitary apparatuses, and means of affording instruction by lectures.

Mr. Hale thought General Synge had spoken too strongly about Acts of Parliament. Mr. Ford had referred to the question of slaughterhouses in the metropolis as a nuisance. He thought the number of slaughter-houses in the vicinity of butchers' shops was less than formerly.

The Chairman said what he understood General Synge to contend for was that an Act of Parliament ought not to admit of a limited standard of purity, but ought to prescribe that there should be no impurity at all, and that he considered a very vital question.

Major-General Synge, in reply, said there seemed to be no diversity of opinion as to the benefit which would be derived by the country at large if the Society of Arts would organise a direct agency for the diffusion of sound sanitary knowledge; but a little misapprehension appeared to exist as to why he did not propose to resort to legal enactments. It was not so much on account of any inherent legal defect in any particular enactment as from the general effect of over-legislation. We were forced to use water in a particular manner within a definite area, and then another authority stepped in and decreed that the result of that action should not go into the river beds, the natural receivers of water; and still another body, the Thames Conservancy, joined in the same prohibition, and there was nowhere to turn for information and assistance. For years before he left the service to take up this subject, he tried every public department he could hear of, going from one to the other, until he found that all he had ever heard of "how not to do it" gave but a very faint idea of the reality. He thought it high time, therefore, that a voluntary association should be formed which should disseminate information. The evil was daily increasing, the water supply getting less, and the population getting thicker and thicker. There was a limit to the water supply, but there was none, he hoped, impending to the increase of population. Why introduce an artificial one? Why bring about a pestilence to sweep off thousands of lives? And why limit the force and spread of knowledge, by calling for forced action in any shape or form? The points which had impressed him in connection with this subject were, first its importance; and next, how to give it effect; and almost every one to whom he spoke, said immediately, "Oh, you must get an Act of Parliament." For his own part, much as he valued sanitary reform, he considered independence of character of yet higher importance.

The Chairman, in proposing a vote of thanks to Major-General Synge, said that the real matter involved in the discussion was the question of Government interference. They must all feel that the less the Government interfered the better; but still there were cases in which Government must interfere, and that interference could only be by Act of Parliament. Water was now universally adopted as the carrier of dirt and refuse, and they might as well try to reverse Niagara as to say that it should not be so, although a new state of circumstances had arisen. It might be very convenient in small towns and country places to adopt other means, no doubt admirable, and in the abstract better, but where they had large populations concentrated it would be a chimera to suppose they were not to continue using water as a carrier. Still, that which was removed from one place must not be allowed to be a nuisance to another. General Scott and others had dealt with the question of sewage, and various contests had taken place as to whether it should be applied to land for irrigation purposes or defecated and converted into cement; but probably that which was more convenient for one place was less convenient in another. The observations made by Mr. Ford were rather beyond the limits of the Society's action, because they had no Sanitary Section; but the Council could, without any departure from the true principles of the Society, lend its rooms for discussion, so as to aid in the formation of such a society as had been referred to. There were many subsidiary matter which the Council might take up, for instance, the sewage question, the proper construction of houses so as to ensure their being fire-proof, vermin-proof, and thoroughly ventilated; the walls also might be made washable, for which purpose General Scott had introduced a cement answering every purpose. The Society might give premiums for the construction of such houses with great advantage. Looking at the death-rate, he considered it frightful that in one town it should be nearly double that in another, when by adopting certain precautions it might be avoided. This was a matter for legislation, as it was beyond the power of any philanthropic society. The Legislature only could prohibit things which were injurious and prejudicial to the public, and with all its defects Government interference was necessary for such purposes, though, of course, individual liberty must be as little interfered with as possible.

The resolution was passed unanimously.

COMMITTEE ON THE MEANS OF PROTECTING THE METROPOLIS AGAINST CONFLAGRATION.

ON THE EXPOSURE OF MUSEUMS AND OTHER PUBLIC BUILDINGS TO DESTRUCTION BY FIRE.

On the motion of Mr. McLagan, a member of the Committee for Investigating the means of Preventing the Spread of Fires, a return has been laid before Parliament of "the precautions taken against fire at certain public institutions wholly or partly supported by public funds." The returns relate chiefly to museums and other institutions in which the members of the Society take a peculiar interest, but the facts disclosed, as relating to the dangers of these buildings and the collections they contain, are fraught with important instruction on the common condition of exposure of the whole of the edifices of the metropolis, public as well as private, which it is proper to state.

And first, as to the construction of these edifices, as respects fire prevention.

The return from the British Museum states "that the basement of the building is constructed chiefly of brick, with piers and groined arches, except a few cases where cast-iron columns are used instead of piers, the floors being of either stone, slate, or cement. This part of the building is fire proof." But "in the department of antiquities, and in the printed book and other departments, the floors are of oak, with curved iron plates beneath resting on iron girders. The ceilings throughout are

lath and plaster, with fir ceiling joists." This description applies to the whole of the museum except the reading-room and the new libraries erected within the large quadrangle. "Generally," says the return, "except in the basement, the materials of the building are only partially incombustible." The return from the National Gallery states that "the floor of a portion of the rooms of the ground story in each wing, the rooms under the dome and others adjoining them, are of the ordinary timber construction with iron girders. The floors of the picture galleries in the east wing are of similar construction, but have margins, about one foot wide, formed of concrete in the thickness of the floor timbers. . . . . The ceilings of the rooms generally are of lath and plaster, with fir ceiling joists; internally the walls are plastered or cemented, except those of the picture galleries, which are lined with wood for dryness and facility of hanging. . . . From the above it will be seen that the materials are only partially incombustible, though a large portion of the building is of the ordinary fire-proof construction."

Of the South Kensington Museum it is stated that the temporary buildings, erected in 1857, "nearly all of them have ordinary wooden floors, and are in no way fire-proof, as was reported to a committee of the House of of Commons in 1860." The permanent buildings are stated to be fire-proof, and can be cut off from the temporary building by double iron doors.

As to the buildings not belonging to the Science and Art Department, "the passages of approach are of wood, and the room on the ground floor is of wood. The walls of the rest of the building are mostly of brick, but some are of timber framework plastered. The floors, stairs, &c., are of wood. . . . There are no party walls. Some of the internal division walls are of brick, others are of timber framing plastered and boarded. The roofs have timber framing, covered in some parts with pine, in others with asphalted felt or on boarding."

Of the Geological Museum, Jermyn-street, "the floors of the theatre, museum, and parts of the galleries are of ordinary timber construction on iron girders, and are boarded. . . . The materials of the building are only partially incombustible."

Of the Bethnal-green Museum, "the outside walls are of brick, the floors are of wood, and not fire-proof."

Of the Royal Hospital, Greenwich, a considerable portion of the floors, "throughout the buildings are constructed of framed timbers and joists, which would readily ignite."

The Military Museum at Woolwich is described as having brick walls, "internal fittings of wood . . . . roofs, timber covered with lead."

The construction of the Edinburgh Museum of Science and Art is of the common mixed construction of combustible and incombustible materials, and the return states it to be in a somewhat critical condition in the event of the breaking out of a fire in any of the adjoining premises.

The British Museum may be cited as an instance of the dangers to which such constructions are exposed, especially those containing natural history specimens preserved in spirits. The internal arrangements of that building for preventing the spread of fire, the trained firemen always in readiness with first-class water appliances, according to the description in the return, appear to be excellent; nevertheless, it would be possible for the public some night to see a lurid light in the direction of the Museum, and to be told that it was in flames; to learn that from an unknown cause or other, some of the thousand bottles of natural history specimens, preserved in spirits of wine, containing mixtures of oleaginous matter, had burst out into a mass of flame, which it was impossible to withstand, that it had with astonishing rapidity set fire to the wooden specimen cases, and reached the lath and plaster roofs, and spread over the whole building with the rapidity of the fire at the Alexandra Palace. Or it might be that the flames of some adjacent building had during a hurricane wind swept over and set fire to lath and plaster, with the fir ceiling joists.

If the plans of these buildings had been submitted, as it is considered ought to be done with all large buildings, especially buildings containing objects the loss of which is irreparable, it would be required that the materials should be wholly incombustible. It may be shown that incombustible materials and constructions are available, that compete in quality, and even for temporary buildings in economy, with the common timber constructions, and are susceptible of advanced ornamentation. But this is not deemed to be an occasion for specifying them.

Such being the common conditions of exposure of national collections from the extent of combustible materials allowed to be used in the construction, the next point of examination is as to the common means of prevention in use, internal and external, by supplies of water.

The common internal means is by water-tanks on the roofs. As a rule the apparatus, seldom used, is rarely if ever in a condition for use when wanted. Experience shows this to be especially so with tanks. Edifice after edifice has been destroyed with provision of full roof tanks, that were to have rendered destruction by fire impossible. The fire usually cuts off access to the opening into the tank, or the key for turning the cocks is not to be found, or the cocks from long disuse are stiff and immovable. This may be obviated by frequent use by well-appointed, trained, yet expensive establishments, as is done at the British Museum.

But apart from such special trained services, and of very ample internal supplies, the sufficiency of internal distributory apparatus, and of its action for the protection of large buildings must be mainly dependant upon the external and general common arrangements for the protection of all buildings. This is exemplified in the instance of the South Kensington Museum. The return in relation to it states that "throughout the buildings and grounds are laid four such mains in connection with those of the water company in the neighbouring streets, so that the supply of water is constant so long as the company's mains are in action. The pressure varies very considerably. In the daytime it is usually as low as 60 feet (not sufficient to command even the lower roofs); sometimes it is as low as 20 feet. At night it is usually 120 to 160 feet, and often a good deal greater."

An extensive fire may break out at the lowest point of protection, and if it break out at the highest, it may by the number of drains, at the same time, and without speedy re-improvement, under the intermittent system, be very soon brought down to the lowest point of pressure.

The loss of power by the intermittent system of supply needs some explanation to those who are not conversant with it. At present the waste of water generally in the metropolis, from this and other causes, is proved to be upwards of two-fifths of the quantity pumped, or some fifty millions of gallons daily. At Manchester, where the proportion of large consumers for trade purposes, the consumption of water under the system of constant supply and better regulated house services is twenty gallons per head of the population. In London, as already stated, it is thirty-three gallons per head. The extra thirteen gallons are pure waste, arising chiefly from defective house service apparatus, from neglected and stiff ball-cocks to butts and cisterns, defective taps in the most numerous and poorer class of houses; this is a waste that everywhere goes on at the same time as the actual consumption, and thus lowers force. At Manchester, where the consumption is one-third less, the jets from the combined force are one-third higher, and in scarcely 3 per cent. of cases is it necessary to send for moveable engine force to give them additional height.

Here, on the intermittent system, the 60 feet jets in the day would, on the constant system, be 90 feet, and on the occurrence of a fire during the greatest amount of consumption, that private consumption would be off during the time, and the chief pumping stations would be telegraphed to and be put in action, to concentrate force and sustain it against the extraordinary consumption for the time on the spot. The return states that there is in the open court, an open tank in the ground, which holds about 25,000 gallons, and is available in case of the mains not being charged, for a fire-engine near, which could be brought to bear on the surrounding buildings. These are not considered sufficient; the cisterns do not hold much more than enough to command the buildings, and the fire-brigade (*i.e.*, the force of sappers kept on the premises) is not numerous enough to work an engine more than a few minutes. It must be borne in mind that with water at high pressure in the mains, one man with a hose attached to a hydrant, could, in most cases, do as much as eighteen men working an engine, and get to work in much less time. Truly so. This has been repeatedly demonstrated now for a quarter of a century, and is now and again proposed, that with proper arrangements of hydrants, the power, not of one alone, but in a large proportion of cases of two and more working engines, shall be kept within a few yards of every dwelling, to be applied in two minutes of time. The difference of result of proper immediate arrangements for relief, as compared with the present system maintained in the metropolis, is illustrated in an instance given from South Kensington. "In March, 1857, at about 4.30, a fire broke out in one of the temporary wooden buildings at that time used as art schools. The alarm was given to the police, and a man was detached in a cab to the nearest brigade station. Before the arrival of the Metropolitan Fire Brigade engine, the detachment of the Royal Engineers had completely got the fire under, and had saved the contents—principally pictures—of the building. Mr. Braidwood, then the chief of the Metropolitan Fire Brigade, complimented the Royal Engineers on the way in which the fire had been put out. He said it was the prettiest stop he had ever seen, but unscientific; and that with his men he should not have attempted to extinguish the fire, 'which by the time of his arrival would have got too far ahead,' but would have directed their efforts to pulling down the adjacent buildings, in order to prevent the fire spreading."

In Mr. Thieke's paper on "Timber Houses," published in last week's *Journal*, Smalesbury Old Hall was mentioned. The correct name of the house is Samlesbury Hall; it is near Preston, in Lancashire.

The Duke of Westminster will preside at a public meeting to be held at the Rooms of the Society of Arts on Thursday afternoon, the 21st of May, at half-past three o'clock, to promote the objects of the National Training School for Cookery.

It is probable that the whole of the St. Gothard Tunnel will be arched. No accident has taken place up to the present time sufficiently serious to impede the works; neither have any important geological or mineralogical discoveries been made.

The Valparaiso newspapers are now printed on home made paper, a factory having just been erected at Limache, near that city. It is the first in South America. The Limache factory is reported to turn out paper equal to that imported from Europe, free from the cost of importation and heavy Custom-house duties.

According to the Parliamentary paper on "The Expenditure and Progress of the British Museum," the total number of visitors to the general and special collection during the past year was 576,019, being an excess of 27,529 over the previous year. The number, although above that for 1870, 1871, and 1872, has not yet reached that for 1869, which was 584,427.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

H.R.H. the Prince of Wales presided on the 9th inst. at Marlborough-house, over a meeting of Her Majesty's Commissioners for the Exhibition of 1851. There were present—H.R.H. the Duke of Edinburgh, H.R.H. the Prince Christian, the Marquis of Lansdowne, the Marquis of Ripon, Lord Spencer, Lord Granville, Lord Aberdare, Sir Charles Adderley, Mr. Childers, Sir Wm. Knollys, Sir H. Bartle Frere, Mr. Lyon Playfair, Sir Anthony Rothschild, Sir Thomas Bazley, Sir Richard Wallace, Sir Wm. Anderson, Sir Thomas Biddulph, Mr. Edgar Bowring, General Ponsonby, General Probyn, Mr. John Evans, Mr. Field Gibson, and General Scott, secretary. The Commissioners considered the best means of devoting the permanent galleries of the present Exhibition buildings to public museums and galleries of science and art. They resolved that the series of International Exhibitions should be discontinued after the closing of the present Exhibition in October.

For the purpose of affording technical instruction to artisans in connection with the International Exhibition, an association has been formed which has the approval of the Working Men's Club and Institute Union. The Earl of Lichfield has set the example of subscribing for a large number of artisans' tickets to be placed in the hands of the council for distribution.

The French Annexe opened yesterday (14th May), at 12. A most complete and interesting collection has been sent by the Municipal Administration of Paris, representing the different public works executed in Paris during the last forty years. This collection, which consists of beautiful models and first-rate architectural drawings, is arranged in the wing of the French Annexe nearest the lace gallery, and is said to be well worthy of the attention of the Metropolitan and other Boards of Works, as well as the City of London authorities.

The following is the return of admissions for the fifth week, ending May 9th:—Season tickets, 1,368; payment, 10,245; total, 11,613.

The amount of ore mined in Ohio in 1873 is reported at 336,758 tons, employing 2,238 miners.

Dr. Hoffman, of Berlin (formerly of London), is said to have produced an exact imitation of the flavour of the vanilla plant from the juices of certain pines.

Car wheels have now become a permanent item of the American export trade. In the year 1871 the number exported was 2,317; in 1872 it was 4,760, and in 1873 it rose to 7,515.

A large hill, consisting almost of pure sulphur, was discovered about two years since, 900 miles west of Omaha, and thirty miles south of the Union Pacific railroad. It is said to be almost puro sulphur, containing only fifteen per cent. of impurities.

The imports of South Australia during 1873, amounted to £3,700,000 and the exports to £4,580,000, the increase upon 1872 being roughly given as £900,000 in the one case, and £840,000 in the other. Of the exports, £770,672 represents minerals, against £812,737 for the previous year.

The gold-mining industry of New South Wales shows a considerable falling off in the returns for 1873 as compared with those of 1872. The Western district gave 268,418 oz., against 307,266 oz. for 1872; the Southern 50,692 oz., against 74,807 oz.; and the Northern 9,086 oz., against 14,271 oz.

EXHIBITIONS.

PHILADELPHIA EXHIBITION, 1876.

The following has been communicated from the Commissioners through Mr. F. O. Horstmann:—

It is matter of no little chagrin to those Americans who are interested in the success of the International Exhibition which is to commemorate the centennial anniversary of their national independence, that very erroneous statements respecting it should have found circulation in English journals. Telegraphic despatches and the correspondence of one of the London daily newspapers have represented that Congress has refused to appropriate money in aid of the Exhibition, and that the project has found little popular favour beyond the locality in which the Exhibition is to be held. For these reports there is just this much foundation—that at the time when efforts were made to obtain the 10,000,000 dollars of capital required, by means of a popular subscription in shares of 10 dollars each, the United States were overwhelmed by the financial panic precipitated by the failure of Messrs. Jay Cooke, and Company, and, for the moment, the raising of any large sum by means of a popular subscription became obviously hopeless. Nevertheless—as it appears from a recently published statement made by Mr. John Welsh, the President of the Centennial Board of Finance, which is the body incorporated by Congress for the monetary administration of the Exhibition—the citizens of Philadelphia, the councils of that city, and the legislature of the State of Pennsylvania, aided by a subscription of 100,000 dollars from the neighbouring state of New Jersey, have already subscribed about 4,000,000 dollars, or nearly one-half of the total sum required. And in proof that the interest in the matter is not merely local, as has been alleged, Mr. Welsh mentions that subscriptions by individuals have been made in no fewer than 24 of the States and territories comprised in the Union.

It is true, however, that the managers of the Exhibition had misgivings as to the safety of relying solely upon the system of popular subscriptions, at a time of such general financial depression, as a means of providing for an Exhibition only two years off. In this exigency they appealed to Congress for an appropriation of 3,000,000 dols. towards the existing deficit, believing that such a guarantee of the stock would leave no doubt of the ready disposition of the remaining shares. In Congress there was the usual opposition which is invariably encountered by any money Bill; but it is not the case, as the telegraph has reported, that the grant has been refused by either House, the action so misrepresented having been simply its reference to a committee for the perfecting of the details of the Bill. During the delay involved by these legislative processes, events have occurred which make it quite impossible to entertain the plan broached by some objectors to the announced Exhibition—that of limiting it to a display of American products only. This scheme has been set at rest by the arrival of acceptances of President Grant's invitation to participate from the Governments of the Netherlands, Belgium, Switzerland, Germany, Sweden, Liberia, Equador, the Argentine Confederation, Brazil, Chili, Mexico, Hayti, and the Sandwich Islands. Under these circumstances it is so obviously impossible to vary the plan already announced that the idea of doing so is not seriously entertained by any considerable portion of the press or people of the United States. Indeed, there is very little room for doubt that Congress will readily make the grant required.

It was inevitable that there should be opposition to the holding of an International Exhibition at Philadelphia, and perhaps the really surprising thing is that it has proved so limited as it is. In the first place, a number of persons had ideas of their own of the manner in which the national centenary ought to be celebrated, and resented the adoption of another plan. Then, several cities were ambitious of being made the locality of the Exhibition, and felt aggrieved when Congress gave the preference to Philadelphia, on the twofold grounds of its historical claim as the scene of the promulgation of the Declaration of Independence, and of its greater accessibility from all parts of the country and from abroad, than any other point having associations with the War of Independence. The jealousy on the score of locality has almost died out, and the people of both New York and Boston—the principal rivals—have long since declared themselves in hearty accord with the Commission having conduct of the Exhibition. With the originators of the rejected plans, however, the case is different. They appear to cherish them the more tenderly in proportion to the coolness of the reception they find elsewhere; and, though very few in number and almost without sympathisers, they are and seem likely to continue active in cavilling at all measures taken in behalf of the Exhibition. The favourite arguments of these malcontents were embodied in the correspondence of the *Daily News*, already alluded to, and may, in a general way, be reduced to two assertions—1, that an International Exhibition at Philadelphia would be but sparingly attended; 2, that sufficient time does not remain for its preparation. The latter allegation comes with an ill grace from those who have been primarily responsible for the loss of time; but, in point of fact, there still remains as much time as was used in the active arrangements for the Paris Exhibition of 1867, or that at Vienna in 1873, and it need scarcely be remarked that Americans, when fairly enlisted in an enterprise, are in the habit of accomplishing great results with surprising rapidity. The Commission, instead of being at sea as to the plans of their buildings, as has been stated, have those plans thoroughly perfected, and are prepared to commence building and, if such necessity should arise, to push on the work of construction by day and night. In their premonitions of non-attendance at the Exhibition, the obstructives take the somewhat fanciful view that the collective Governments of Europe are animated by such abhorrence of abstract republicanism that they and their subjects will abstain from participation in the Exhibition, because of its commemorative feature. They assume, for instance, that the sentiment of the English Government and people is unchanged from that of George III. and Lord North, and that they will take this occasion of resenting the loss of their colonies by ignoring the existence of the United States. But, apart from this, they also refer to the precedent of Vienna, and ask, in the words of the *Daily News* correspondent, how we can look at Philadelphia for "the expected throngs who would not go to the fascinating Austrian capital." Without disparagement to the attractions of Vienna, it is to be observed that, whereas it lies in an out-of-the-way corner of Europe, whither nobody goes except for that express purpose, Philadelphia is so centrally situated that within a radius of 250 miles reside one quarter the population of the United States, whose natural propensity to travel, reinforced by the interest of the occasion, may be counted upon to draw them by millions to Philadelphia. A similar consideration exists in the case of European manufacturers, who are fully aware of the comparative importance, as markets for their wares, of the United States and the Austro-Hungarian Empire. As far as an abundant attendance, both from America and Europe, is concerned, there need be little apprehension about the success of the Centennial Exhibition. Nor is there more room for doubt that it will be held, and ready in ample season.

Although it is not long since postal cards were introduced in the United States, the enormous number of one hundred millions have been printed and issued.

OWEN JONES MEMORIAL.

A meeting of architects, manufacturers, and others interested in decorative art, was held last Monday, at the house of Mr. Alfred Morrison, 16, Carlton-terrace, for the purpose of recognising the eminent services which Owen Jones rendered to the decorative arts over a long series of years, and of organising measures for inviting public assistance. **Mr. Morrison** presided.

Mr. Cole, C.B., related the preliminary steps which a few of Owen Jones's friends had taken, in order to bring the subject before the meeting.

Mr. Godwin proposed, and **Sir Digby Wyatt** seconded, a resolution to the effect that there should be a public recognition of Owen Jones's services to decorative art, to be embodied in such form or forms as might seem best, after the amount of subscriptions had been ascertained. And it was decided by a subsequent resolution that in any case there should be a mosaic portrait of Owen Jones to be offered to the nation. A hope was expressed that sufficient funds would be forthcoming to have a bust, which might be repeated and placed in different institutions; to establish a medal to be awarded to students in decorative art, to be coupled, if possible, with a travelling scholarship. It was also resolved that an exhibition of his various designs, and of manufactures executed from them, should be made, to be opened to the public in June.

A numerous committee was then appointed, Mr. Coleridge Kennard and Mr. E. Pigott undertaking respectively the duties of honorary treasurer and secretary; Mr. Morrison, Sir Digby Wyatt, Mr. Cole, Mr. Peter Graham, and Mr. Delarue, were appointed an executive committee.

A subscription list was at once opened.

CORRESPONDENCE.

PATENT OFFICE MUSEUM.

SIR,—Having read the letter of "C. E." in the Society of Arts *Journal*, of May 1st, I quite join with him in his condemnation of the past neglect of the Patent Law Commissioners as regards their museum at South Kensington.

But it was not with unfeigned regret I read of the appointment of a curator to the neglected museum; even if he was not appointed on the principle of selection by competition as adopted in the Civil Service examinations (which I suspect he was not), it is to be hoped it means work, not a pension, and I am inclined to accept the appointment as an earnest. The Commissioners, or those who deal with the fees arising from patents should be ashamed of their niggardliness; no doubt they now feel ashamed, and it is to be hoped are anxious to mend their ways. If there is an example which should, could, or would supply them with an incentive, it is to be found next door to them in the Museum of Science and Art—the South Kensington Museum, created by the zeal and untiring energy of one man. The funds had to be got—fought for annually—for building and the purchase of examples; yet it has grown to what it is in little more than 20 years. It had no surplus fund to aid and help it.

The Patent Office Museum was ushered into the world in 1857, a baby museum of great promise, but it has not grown nor thriven, the cradle which contained it at its birth still contains it; an evil eye has blighted it. It is a nineteenth century illustration of the old, old fairy tale of the "Sleeping Beauty," not, however, assisted by wand of fairy or magician, but by the wand of parsimony, grasped by her Majesty's Commissioners of Patents, or their advisers. Let them "take a thought," and amend the error of their ways; on them rests the responsibility of arresting progress.

The waggon of the Commissioners of Patents filled with specie of the value of £1,012,920 "stops the way." They are dogs in the manger, they will neither eat the hay nor permit it to be eaten. The waggon must be sacked, one third of money distributed to help their starved museum, one third to stimulate invention by the spread of scientific instruction, one third for the production of duplicate models of machines used in centres of industry to explain the why and wherefore, the principles of the machines which aid manual labour, where local museums should be placed, and where they should have been placed long ere this.

I have no desire to be hypercritical, but does not "C. E.," when he alludes to the Watt, &c., mean Mr. Gibson (not Boulton) Watt? He writes vaguely about the Watt collection of models, &c., "which has never yet seen daylight." It is quite clear he at least has never penetrated into the garret workshop of James Watt, in Heathfield-house, nor does he know that the models at the Soho have been exhibited twenty times over. The garret and its contents is admirably described by Muirhead, and better by Mr. Smith, in his lives of Boulton and Watt. With its contents I am well acquainted. There are no models there; but there are his tools of every kind, his sculpturing machine, models he used to copy from, and much of no interest. That collection should be the property of Birmingham, and should be transferred to its local museum. There Watt laboured, thought, and invented, and realised his inventions in Birmingham; therefore, enshrined in its museum should that collection be placed.

I cannot agree with "C. E." in the destination suggested by him for the Watt collection or tho models, and I trust Mr. Gibson Watt will think twice ere he transfers the collection of his revered relative to at least the present Patent Office Museum at South Kensington. It already has the first practical steam-engine made at the "Soho" by James Watt.—I am, &c.,

Q. A.

Handsworth, April 6, 1874.

PYRITES AS A SOURCE OF SULPHUR, IRON, AND COPPER.

SIR,—As an appendix to the paper on "Pyrites as a Source of Sulphur, Iron, and Copper," published in your *Journal* of the 1st instant, allow me to insert the following remarks kindly offered by Messrs. Miguel Iglesias and Sons, of 9, King's Arms-yard, E.C.

All Tharsis ore is shipped at Huelva, besides other kinds, but a very large proportion of the pyrites imported into this country comes from the Portuguese and Spanish ports of the Guadiana. For instance, last year 250,000 tons of Tharsis and other ores wero shipped from Huelva, and over 200,000 tons from the Guadiana, almost entirely from the Portuguese port of Pomaron.

The importations from Norway are of considerable importance, probably exceeding in amount those from Belgium, Cornwall, Wicklow, Westphalia, Pomerania, and Sweden put together.

The average of 3,000 assays by the wet process for copper of ores of the Tharsis description is very close to that found by the writer, viz.—

Average (Messrs. Iglesias and Sons) .... 2·70
Do. (Messrs. Wright) .... 2·75

On the other hand, the average percentage of sulphur found is somewhat below that given by the writer, viz., 49·07. The copper percentage given by Clapham, also by Wedding and Ulrich (4·21 and 3·10 respectively) are considerably above the average of the pyrites imported.

Although the cupriferous pyrites imported into this country is all very similar in its average composition as regards iron, sulphur, and copper, the silver value of ores from different deposits varies very considerably, the average of one ore being from one-half to three-quarters of an ounce of silver per ton of ore, and the average of another being three-and-a-half to four ounces in each case, together with traces of gold.

Since the fact has been recognised that these metals can be profitably extracted, many thousand ounces of silver have been recovered, in addition to gold enough to repay the cost of working; and as the plant required is most inexpensive, it is greatly to be regretted that the process is not universally adopted. It is certain that, within the last ten years, silver and gold of a net value of at least a million sterling have been allowed to run away in the waste liquors from metal-extracting processes.

In reference to the process for preparing a factitious pyrites by fusing together oxide of iron and alkali waste, I am informed by Mr. Gossage that a patent for this purpose was taken out by Mr. W. H. Gossage on July 17, 1850 (No. 13,177), Mr. Bell's patent on the subject being dated November 17, 1852 (No. 772).—I am, &c.,

C. R. A. Wright, D.Sc.

TIMBER HOUSES.

Sir,—The ancient wooden church at Greenstead, near Ongar, is, I believe, the only specimen now in Britain. The probable date of the building is A.D. 1013. It is composed of wood, the sides being made of the trunks of chestnut trees, split or sawn asunder. These are set upright close to each other, and let into a sill and plate. At the top they were fastened with wooden pins (Gough's "Camden," vol. 2, p. 51). In Mr. Kent's "Footprints," it is stated an ancient timber tenement, called "Boscobel," from *bosco-bello*, or fair wood, near Tong, in Shropshire, was the quaint asylum of King Charles II., after the battle of Worcester. This most interesting timber house is engraved in "Old England," vol. 2, p. 177, No. 1957. Enveloped in a fog, when I was on Mount Washington, stone might have been mistaken for wood; but I saw several wooden dwellings elsewhere in the United States, suitable for human habitation.—I am, &c.,

Chr. Cooke.

London, 10th May, 1874.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

The following arrangements for next Wednesday evening have been made:—

May 20th.—"On Simplicity as the Essential Element of Safety and Efficiency in the Working of Railways." By Captain H. W. Tyler.

Chemical Section.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made:—

May 22.—"On the Manufacture of Chlorine." By W. Weldon, Esq., F.C.S. On this evening Professor A. Williamson, F.R.S., will preside.

Cantor Lectures.

The third course is by Professor Barff, M.A., "On Carbon and Certain Compounds of Carbon treated principally in reference to Heating and Illuminating Purposes."

The object of these lectures is to explain the scientific principles involved in all heating and illuminating processes, and to apply those principles to practical purposes. The absorbent properties of carbon will be briefly noticed.

Lecture VI.—May 18.

Heat of combustion; how heat is communicated, and how quantity of heat is determined.

Lecture VII.—May 26.

Consideration of furnaces, stoves, lamps, &c., in which the principles stated in the former lectures will be applied.

N.B.—As May 25 is Whit-Monday, this lecture will be postponed till Tuesday, May 26.

All the above Meetings and Lectures are open to Members, each of whom has the privilege of introducing two friends.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Mon....SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Professor Barff, M.A., "On Carbon and Certain Compounds of Carbon, treated principally in reference to Heating and Illuminating Purposes." (Lecture VI.)
British Architects, 9, Conduit-street, W., 8 p.m.
Asiatic, 22, Albemarle-street, W., 3 p.m. Annual Meeting.
Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m.
Social Science Association, 1, Adam-street, Adelphi, W.C. Dr. J. H. Aveling, "On the Amelioration of the Present Positions of Midwives."

Tues....Royal Institution, Albemarle-street, W., 3 p.m. Professor Rutherford, "On the Nervous System."
Civil Engineers, 25, Great George-street, Westminster, S.W., 9 p.m. President's Conversazione at the International Exhibition.
Statistical, 12, St. James's-square, S.W., $7\frac{3}{4}$ p.m. Papers will be read on—1. Mr. W. H. Millar, "Statistics of Deaths by Suicide among British Troops." 2. Mr. John Biddulph Martin, "The Elections of 1868 and 1874."
Pathological, 53, Berners-street, Oxford-street, W., 8 p.m.
Zoological, 11, Hanover-square, W., $8\frac{1}{2}$ p.m.

Wed....SOCIETY OF ARTS, John-street, Adelphi, W.C., 12. Special Meeting on Public Museums. 8 p.m. Captain Tyler, "On Simplicity as the Essential Element of Safety and Efficiency in the Working of Railways."
Meteorological, 25, Great George-street, S.W., 7 p.m.
Pharmaceutical, 17, Bloomsbury-square, W.C., 11 a.m. Annual Meeting.

Thur....Royal, Burlington House, W., $8\frac{1}{2}$ p.m.
Antiquaries, Somerset House, W.C., $8\frac{1}{2}$ p.m.
Chemical, Burlington House, W., 8 p.m. Dr. W. H. Corfield, "On the Sewage Question from a Chemical Point of View."
Society for the Encouragement of Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. John S. Phene, "On the Causes of Art."
Royal Institution, Albemarle-street, W., 3 p.m. Mr. N. S. Maskelyne, "On Physical Symmetry in Crystals."
Numismatic, 13, Gate-street, W.C., 7 p.m.
Philosophical Club, Willis's Rooms, St. James's, S.W., 6 p.m.

Fri.......SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Chemical Section.) Mr. Walter Weldon, "On the Manufacture of Chlorine."
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Prof. W. K. Clifford, "On the Education of the People."
Quekett Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., $8\frac{1}{2}$ p.m.
New Shakspere Society, University College, W.C., 8 p.m.
Royal Botanic, Inner Circle, Regent's-park, N.W., 8 p.m. Prof. Bentley, "On the Reproductive Organ of Plants."

Sat......Royal Institution, Albemarle-street, W., 3 p.m. Mr. R. A. Proctor, "On the Planetary System."
Royal Botanic, Inner Circle, Regent's-park, N.W., $3\frac{3}{4}$ p.m.

JOURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, MAY 22, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ECONOMICAL USE OF FUEL.

A meeting of this Committee was held at the Testing Houses, Western Annexe, International Exhibition, on Saturday, 16th instant. Present—Major-General F. Eardley-Wilmot, R.A., F.R.S. (in the chair), and Dr. Mann, with Mr. Le Neve Foster, Secretary, and Mr. S. W. Davies.

PROCEEDINGS OF THE SOCIETY.

TWENTY-THIRD ORDINARY MEETING.

Wednesday, May 20th, 1874; Vice-Admiral Erasmus Ommanney, C.B., F.R.S., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Black, J. M., 26, Bedford-place, Russell-square, W.C.
Chambers, Edward, 4, Mincing-lane, E.C.
Gamble, Lieut.-Colonel David, Windlehurst, St. Helen's, Lancashire.
Koch, Walter Edward, F.G.S., F.C.S., Universities Club, Jermyn-street, S.W.
Kynaston, Josiah W., St. Helen's, Lancashire
Piesse, Charles H., 303, Strand, W.C.

The following candidates were balloted for and duly elected members of the Society:—

Barklie, Robert, 35, Hopeton-street, Belfast.
Brown, J. Campbell, School of Medicine, Royal Infirmary, Liverpool.
Calvert, J. H., Subden, Whalley, Lancashire.
Corner, J., Whitby.
De Schreiner, Baron, Imperial Austrian Consulate, 29, St. Swithin's-lane, E.C.
Dresser, C. L., 30, Park-row, Leeds.
Eassie, Peter Boyd, High Orchard, Gloucester.
Evans, George Washington, LL.D., Reading, Berks.
Farr, E., 101, George-street, Altrincham.
Griffith, William, Beachborough-house, Portobello, near Edinburgh.
Hughes, Frederick Robert, Borrowstownness, N.B.
Hughes, John, Ivy-house, Hendon, N.W.

The Paper read was—

ON SIMPLICITY AS THE ESSENTIAL ELEMENT OF SAFETY AND EFFICIENCY IN THE WORKING OF RAILWAYS.

By Captain Henry Whatley Tyler,*
Chief Inspector of Railways, Board of Trade.

[The following paper was originally written for the Institution of Civil Engineers, at their request, and in the third person, in conformity with their rules, and a number of private proof copies of it were circulated in print by that institution; but the author was informed that it would have to be condensed for the purpose of being read, in abstract, at the end of another paper, which was a long and important one, on the 31st March; and, under the conviction that the matter and arguments contained in it would materially suffer from the adoption of such a course, he asked the Council of the Institution to allow him to withdraw it. On their acceding, he again offered it to them for their following meeting, a fortnight later, on the 14th April, and as they did not then desire to alter their arrangements, he placed it at the disposal of the Society of Arts. He is much obliged to that Society for receiving it on their first available day, and he hopes that the important subjects on which it treats may thus receive fuller discussion and more extended circulation. There is the further advantage that it can at once be placed complete at the service of the press, which could not, under the rules of the Institution of Civil Engineers, have been done if it had been read as a paper at that institution. It was originally intended to treat more especially on the question of interlocking points and signals, and of the block and permissive system of telegraphing trains, which had been coupled together in the "Subjects for Papers" at the institution; but in dealing with them the author became unavoidably committed to a paper on the best means of avoiding the great majority of railway accidents.]

The various classes of collision, and the accidents at facing-points, may together be roughly stated to comprise from two-thirds to three-fourths of the casualties to railway trains which are considered of sufficient importance to require investigation on the part of the Board of Trade; and questions as to the arrangement and working of points and signals, and as to preserving intervals of time or space between trains and their accessories, enter more or less into the causes of such casualties. In 1872 there was 179 such accidents out of 238 investigated train accidents; in 1871, 105 out of 159; in 1870, 97 out of 122.

Within the ordinary limits of a paper of this description it would be neither desirable nor possible to enter into all the details of the apparatus employed by the different railway companies for points, for signals, and for train-telegraph purposes, or to discuss all their relative merits or defects. Such a description would, if complete, fill volumes; and in such a discussion it would be very difficult to deal, as the author would always desire to do, in perfect fairness with all competitors. It would seem to be preferable and more useful to put forward in this paper the principles involved, the requirements to be satisfied, and the direction in which further improvements may be effected. It is only by close attention to the constant teachings of practical experience on various systems of railways that the present degree of perfection has been reached; it is only by patience and per-

* In the absence of Captain Tyler, the paper was read by Colonel Yolland, H.M. Inspector of Railways.

severance in the same method, under the same instructor, that further advances in real improvement can be made; and it is only by the full application, proper working, and careful maintenance of the necessary appliances, that their due result in the diminution of railway casualties can be obtained.

There is, perhaps, hardly any subject in regard to which there has been more misunderstanding, or greater confusion of ideas, than simplicity in railway working. The author and his colleagues have constantly been accused of requiring complication when they have been seeking to introduce simplicity; and in adopting, for this reason, the heading of the paper as his thesis on the present occasion, the author would say a few words at the outset as to what is and what is not simplicity in such matters. It is, or ought to be, the object of the inventor or engineer, in his designs or his projects, his schemes, his plans, or his work. It is usually the last result which, after the greatest amount of thought, is attained. The same is true in other fields of work. Even in literary labour, perfect simplicity of diction, of description, of argument, requires the greatest thought and care, and is the most difficult result to arrive at. The Latin words *simplicitas* and *simplex* convey, no doubt, the idea of singleness—of one thing; and a simple machine is in the same sense a machine of few parts, while a complicated machine is a machine of many parts. But simplicity of construction and simplicity in working are in many cases distinct and different from one another; and, further, complication in construction is frequently necessary to obtain simplicity in working. This is equally true of a machine, of a railway, or of a sentence. Simplicity in working, as desirable, being the thesis, confusion in working, as undesirable, is the opposite idea presented fer consideration in the present paper. As a confused sentence can sometimes only be made plain by dividing it into a greater number of parts; and as a machine can only in many cases be started and stopped, and made to work more easily, by adding to its parts in construction; so also a railway may be worked more simply, with less confusion, more efficiency, and less risk, by the addition of certain appliances and accommodation, and by their proper adaptation to local circumstances.

Ingenuity, care, and forethought are required in their application, and time and experience for their development and further improvement. Railway working, which was at first easily conducted, is becoming a science, with its separate branches; and the author aims at no more in the present paper than an outline sketch, which he hopes may be filled up by a full discussion. He ventures to think that the time has arrived for such a discussion, and to hope that full latitude may be allowed for the expression of opinions from all classes and all parties interested in the subject.

The first important branch, then, of railway working to which reference may be made is that of points and signals. When trains were few, and there was little risk of their interfering with one another; when they had the same regular stoppages, and the speed was not great; when junctions, stations, and sidings were less frequent;—then fixed signals were comparatively unimportant, the switches did not require to be so often moved, and facing or meeting switches were not the cause of so much risk. When the want of fixed signals was experienced, boards and lamps were fixed on revolving poles; and the expression "the board was on" or "the board was off" is retained amongst the engine-drivers on some of the older lines at the present time. The semaphore-arm, formerly so much used for telegraphic purposes, is now generally preferred as a railway signal. But its merits were not fully recognised until the "board" had passed through a great variety of forms, according to the ideas of the designers on different railway systems. The board was made round, square, triangular, oblong, fish-tailed, half-moon shape, long and thin, or short and stumpy, on different lines. In some cases two red discs, called spectacle-discs, were used for dang r, and one green one for caution; and on the broad-guage systems the disc was the all-right, while a cross-bar below it was the danger signal, and the arrow-head was used mainly as a time signal. So that the same indication was employed for danger on the narrow, and for all-right on the broad-guage railways. Then, again, additions were made to these boards, discs, or cross-bars, by turning the ends up or down, or by excrescences at one side or the other, or by various methods, to indicate to the engine-drivers whether they applied to an up line or to a down line, to a main line or to a branch line. As the speed of the trains increased, and longer distances were required for stopping them, the signals were raised, and auxiliary or distant signals, worked by wires from a distance, came into use; and these, again, were sometimes distinguished by their forms from the home signals, when both were used; and in many cases distant signals were used without home signals. The home signals were worked by means of handles on the posts; the distant signals by levers on the ground, in what were considered convenient situations; and the points were worked by levers also on the ground, but scattered about, opposite to them, and frequently between the lines of rails. By degrees stations and junctions became more complicated, and the points and signals increased in number, and were at greater distances from one another. The signalmen sometimes had to leave their signal-levers, for the purpose of working points more or less distant from them, and occasionally at the opposite sides of lines of rails, which might be occupied by trains; and sometimes the points were worked by one man and the signals by another. But the mistakes, misunderstandings, and accidents which resulted from such conditions,—under which a signalman either himself omitted to work his points and signals in harmony, or signalled forward a train for one direction whilst a pointsman set the points for another direction,—led naturally to the concentration of the signal and point levers in or around the signal cabins; and, to afford a better view to the signalmen over passing trains, waggons in sidings, or other obstructions, the cabins were raised to a greater or less height above the ground, and placed in convenient situations, according to local circumstances. But even then, when the control was more conveniently placed in the hands of one man, there was still, as the levers in or near a cabin became more numerous, a liability to mistake, from the signalman pulling

over a wrong lever; or the levers were fastened over by blocks of wood which the signalman forgot to remove; and, to prevent such mistakes, and serious accidents resulting from them, it became further necessary to interlock the levers with one another.

This important improvement was suggested, as being probably feasible, by Colonel Yolland, in a report dated January, 1856, on a collision which occurred on the 7th December, 1855, at the Bricklayers' Arms Junction on the North Kent Railway. It was patented by Mr. Saxby in 1856, and it made gradual progress between 1856 and 1860. By 1860 many further improvements had been made by different persons, and the inspecting officers of the Board of Trade began to insist on the use of locking apparatus at the junctions of new branches with existing lines. The principle was also carried out in that year at the signal cabin at the entrance to the Victoria Station. In January, 1862, the author made the following, besides other recommendations, in reporting on a collision at the Walton Junction, near Warrington, on the main line of the London and North-Western Railway, on the first of that month:—

"The points should be free to move when the signals are at danger. The signalman should be unable to lower his signal for any train to pass until he has first set his points right for that train. After having lowered his signal for a train to pass, he should not be able so to turn his points in the wrong direction for that train as to cause a collision; and he should not be able to make any mistake in the working of his signals that can lead to a collision between any two trains. These improvements will necessarily lead to some alterations in the cabin itself, and the opportunities will be afforded in carrying them out of giving the signalman larger windows, that he may have a better view in each direction, and of providing him with telegraphic instruments and telegraphic communication, by means of which he may at least be warned of the approach of the trains upon the different lines which are under his control. This being an arduous and important post, and one at which considerable complication, and a very heavy traffic over two junctions are combined, I think it would be wise to employ three men to do the duty, and thus to reduce the periods of labour from twelve hours to eight for each man."

Taking a simple case of a double junction between a branch line and a main line, with the main line to the right, the branch line to the left, and the down line running north, there are several modes in which accidents may occur. A down main line, or a down branch line train may find the facing points set in the wrong direction, or partially open; or the signalman may split a train, as it is called, by shifting the points when it is passing through them. A branch line up train may run through a main line down train, or a main line down train may run through a branch line up train; or their engines may meet at the diamond crossing; or there may be collisions under different conditions between main line up and branch line up trains at the fouling point of the up lines; or the leading points may lie in the wrong direction on the approach of a train on either of those lines; or a train which is being shunted back from the up main to the up branch line may be met by a down main line train at the diamond crossing. By the application of locking and other apparatus it is possible to prevent nearly all of these accidents from occurring, in the ordinary way of working, in consequence of any mistake of the signalman. Conflict between signals, and conflict between points and signals, may alike be avoided; and a good combination of locking-bar and bolt may be made to ensure that the facing-points are completely over before the proper signal is lowered, and may also prevent them from being moved during the passage of a train. It is, of course, impossible to provide against all the contingencies which may arise—such as, in certain cases, against the absolute neglect of engine-drivers to pay attention to the signals made to them; or such as a signalman, when two trains are running towards a junction at one time, setting his points and lowering his signals first for one of them, and then altering them and preparing for the second train, without allowing time for the first train to stop short of the junction. But provision may be made, and is made to some extent, even for the contingency of an engine-driver neglecting to obey signals. For instance, by making (in the example before referred to) the facing-points of the junction lead, as it is called, the trailing-points—that is to say, by so interlocking the levers that the former must be pulled over before the latter—it may be provided that any engine-driver approaching on the down line is necessarily turned along the branch down line, clear of the diamond crossing, when the points and signals are right for branch up line trains to pass over that crossing, or when a train is being shunted back over it. There is, however, no means of providing against accidents from engine-drivers neglecting to obey signals on the branch up line, either when a main line down train has entered the facing points, or when a main line up train is approaching the junction from the opposite direction.

In more complicated situations, when there are cross-over-roads between the main lines or branch lines, or both, and through-crossings, and sidings connected at different points with the passenger lines, or where passenger lines are more numerous, and are connected at various points with goods lines and with one another, then the locking system becomes more complicated. But it is then also of still greater utility in securing the traffic from accidents, which becomes otherwise more likely to occur in consequence of mistakes on the part of signalmen. The same principles are applicable, but each case forms a problem in itself, to be carefully worked out according to its own circumstances; the objects being, to give the signalman complete control over the traffic in every direction; to prevent him mechanically, as far as is possible, from making mistakes which may lead to accident; and to afford him the means of exhibiting a distinct indication to an engine-driver proceeding or waiting to proceed in any given direction. The control of the signalman is rendered more perfect by the addition of blind-sidings, so as to provide safety-points—where such are not in the laying out of the yard or lines otherwise available—to goods lines or sidings near their junctions with the passenger lines. These safety-points serve alike to prevent waggons from being blown out, or inadvertently run out or pushed out; and to prevent an engine-driver from proceeding against signals, and endangering the traffic on the passenger lines; but the levers of the safety-points require to be worked from the cabins, and to be properly interlocked with the other levers in the cabins.

Other devices or provisions for enabling the signalmen better to perform their duties may be mentioned, such as—the system of slotting, as it has come to be termed, the connections of a signal, so that the arm of it may be raised to "danger" by a signalman in either of two neighbouring cabins, but can only be lowered to "clear" by the joint action of the signalmen in both the cabins;—the application of repeaters of various descriptions, either to inform the signalmen of the working of any signals which may be out of their sight, or to afford a more distinct indication, where such is required, to the engine-drivers;—the means of information by telegraph as to when trains may be expected; clocks to furnish the correct time; register-books in which to record the telegraph-signalling and passing of trains, so as to secure the regular performance of the duties, and to provide a check on the working of the signalman in any one cabin by the working of the signalmen in cabins on either side of it. But there are objections in the ordinary way to an overlap of the signals worked from one cabin by the signals worked from another cabin, as involving a liability to deceive the engine-drivers; and it is important to afford the means of all necessary communications between the signalmen, that they may not be working at cross purposes, and to deprive them of all excuse for making unauthorised signals on bells or block instruments to one another. Private signals or systems of intercommunication have frequently led to misunderstanding and accident. The selection and regular training of fit men for the performanee of such duties; the employment of responsible inspectors for constant supervision and the preservation of rigid discipline; the command of a sufficient number of relieving men, to take Sunday duty and to replace signalmen absent from sickness or otherwise; and the maintenance in high condition of the whole of the apparatus, are matters of obvious importance; but experience has shown that it is by no means unnecessary to refer to them.

When these desiderata are all properly worked out, and carried out in practice, great simplicity in working is obtained. Each signalman has control over his position, and is in a great measure prevented from making mistakes which may lead to accidents. The engine-drivers have in every case distinct indications to guide them, and are also, in many cases, prevented from causing accidents, even if they neglect to obey signals. The dangers of facing-points are for the most part obviated. Under such arrangements, engines and trains may be turned in and out and across one another with marvellous rapidity and facility, and in a way that would be impossible without the protection that they afford. The more numerous and complicated the lines, the sidings, and the crossings to be worked, the more indispensable does such apparatus become; and it is then, frequently, a means of considerable economy in the number of men employed, as well as a means of avoiding much sacrifice of life and limb to running pointsmen, yardmen, and shunters, whose services are to a great extent dispensed with. The simplicity in working thus obtained is not, however, apparent at first sight to the uninitiated, who see only an array of levers, and are not aware of the way in which they are named and numbered for the guidance of the signalman; each signal-lever bearing the number of any point or other lever that requires to be moved before it can be pulled over, and being also described as to its own particular purpose on a brass plate or otherwise. And it is not yet understood or appreciated in many cases by experienced railway officers who have not devoted much attention to this special branch of railway working. The comparative simplicity of the system will be best understood by an examination, and by watching the working, of any complicated stations or junctions at which it has not yet been applied; and it may to some extent be conceived by remembering what the confusion and complication in working would be if these levers were of all sorts, sizes, and shapes, scattered about in various situations, worked by different men, and independently of one another. An idea of the way in which confusion may be avoided will also be formed by comparison with the elementary principle of another system once in force, and much persisted in as being correct, on one of the great railways of this country. A signal-post was placed at a junction with one arm on it applicable to two conflicting lines of railway. It was an eminently simple arrangement in more than one sense. But it had the disadvantage that when two engine-drivers approached a junction from two directions at the same time, and when, seeing the one semaphore-arm lowered, or a hand-signal waved, each thought it was intended for him, they advanced together towards the junction, and then could not avoid in some cases running into each other. It was only after repeated collisions from this cause, and consequent remonstrances from the Board of Trade, that this arrangement, simple in construction, but which undoubtedly led to confusion in working, was at length abandoned. A simpler arrangement still, as far as construction is concerned, is a mere hand-flag, or hand-lamp, or the arm of a signalman; but, unfortunately, they are not well seen, and they are liable to be, as they have too often been, overlooked or wrongly interpreted, especially when signals require to be exhibited in several directions at one time; and thus it becomes necessary for true simplicity in working to employ what are sometimes complained of as complications, in the way of posts, levers, rods, cranks, arms, lamps, and glasses; and to provide a separate signal for every purpose for which a signal is really required, to enable a distinct indication in every case to be exhibited by a signalman and received by an engine-driver.

The next branch of the subject is that which refers to the preservation of intervals between the trains. It is obvious that as long as any interval, whether of time or space, is actually preserved between any two trains, they cannot come into collision with one another. Collisions are liable to occur between trains following each other on the same line of rails; or, within fixed signals, at stations, sidings, junctions, &c. The greatest number of collisions occurs at stations or sidings, and within fixed signals. In 1872 there were 91 cases of collisions at stations or sidings, 32 cases at junctions, 22 cases from trains following one another, 5 from trains meeting in opposite directions, and 34 from passenger trains being wrongly

turned into sidings or otherwise through facing-points—out of a total of 238 train accidents investigated by the Board of Trade.

As soon as trains were run with sufficient frequency to endanger one another, it became obviously necessary to establish some system of preserving intervals between them; and the practice obtained of allowing a certain number of minutes to elapse, not only between their times of starting, but also between the times at which they should pass intermediate stations, and any junctions, or level-crossings in charge of gate-keepers, or other points at which servants of the companies were stationed; and the platelayers were also on many lines expected to warn any train which appeared to be following too closely upon a preceding train. In tunnels it was further found necessary to prevent one train from entering at one end until the preceding train had passed out at the other end, and this was the commencement of what is called the block system, by means of which an interval of space was secured in place of an interval of time between the trains. The time interval which came to be generally adopted was 5 minutes of danger and 5 minutes of caution, that is to say, the trains were to be kept 5 minutes apart from one another in their running, and were to be cautioned if they were not 10 minutes apart. But in the case of goods or slow trains preceding fast non-stopping trains, still greater intervals were required; and sometimes periods of 15 or 20, or more minutes became, as the differences in speed increased, insufficient safely to admit of heavy goods trains being started in front of express passenger trains. It was recognised at an early period that the simplest and best mode of avoiding collisions at stations and sidings was by keeping the main lines clear for passenger trains; and accordingly it was provided in the regulations that the main lines should not be interfered with, in the way of obstructions or shunting, within 10 minutes of a passenger train being due, and, sometimes, within 15 minutes of an express train being due. The proposal to divide the line into telegraphic sections, and thus to preserve space intervals between trains, was made by Mr. (now Sir William) Cooke, as far back as 1842, and was first practised, it is believed, on a portion of what is now the Great Eastern Railway, in 1844; and, subsequently, a train telegraph system was established on portions of the London and North-Western railway. This latter, however, was not a block system, or a space system, but a time system worked with the aid of telegraph instruments; and it is now known as the permissive system. Under this system, the line between London and Rugby was divided into sections averaging rather more than two miles in length, and the signalmen were required to telegraph the trains to one another—to turn their signals to danger on the passage of every train,—keep them at danger for 3 minutes, or more in certain special cases,—to exhibit caution signals after the expiration of the 3 minutes,—and only to give clear signals again after receiving "line clear" from the next cabin in advance. In the case of tunnels, no second train was allowed to enter until the preceding train had been signalled as "out," and a space system was thus introduced; but on other sections two or more trains were allowed to be travelling at the same time; and even if a second train reached a cabin before a preceding train had passed the next cabin, and within the three minutes prescribed for the exhibition of the danger-signal, the engine-driver was, after his train had been brought to a stand, to be warned of a train in advance and to be allowed to proceed. This system is worked by needle instruments, the needles being pegged over to "line blocked" or "line clear," as the case may be; and the vertical position of the needle is taken to indicate, either that the telegraph is out of order, or that the line is obstructed. On certain telegraph-posts special loops of the telegraph wires are provided, to be broken by the guards or breaksmen of trains in the event of sudden obstructions; and in long tunnels the loops are enclosed in boxes at intervals of about 100 yards. By breaking these loops, the guards or breaksmen are enabled to inform the signalmen at either end of a section, of an up-line, or a down-line, or a third line, or two or three lines, being suddenly obstructed by an accident to a train.

As regards the block system, there are many descriptions of means of instruments for working it, and various rules and regulations applicable to it on different lines of railway. The main principle involved is, simply, by the division of a line into block sections, and by allowing no engine or train to enter a block section until the previous engine has quitted it, to preserve an absolute interval of space between engines and trains. This may be done mechanically or electrically. Any means of communication with which the signalmen may be provided will enable them to inform one another of the approach of a train, of its entrance into a block section at one end, and of its exit from that block section at the other end. The raising or lowering of signal arms inside or outside the cabins, the beats on mechanical gongs or bells, the beats on electric gongs or bells, or the working of different descriptions of telegraph needles or instruments, may any of them be employed to afford indications of this description. But in many cases it is considered necessary to give further information, such as the description of the train, whether a through or stopping passenger train, or a goods or mineral train, or a ballast train, or a light engine; and to provide, besides the signals for line clear or line blocked, separate indications also for an acknowledgment signal, for an attention signal, for an obstruction signal, for an error signal, for a testing signal, for notice of shunting going on at a station, for a train to be shunted out of the way to allow another to pass it, or for a train to be stopped and examined in the event of something suspicious or wrong having been observed in it. Then, again, on some lines distinction is made between passenger trains, express goods or cattle trains, through goods or mineral trains, stopping goods mineral or ballast trains, and as to whether these are approaching, or whether they have entered the section. These and other indications are differently made on different lines. In some cases the block instruments are used for them; in some cases they are made exclusively on electric bells; in some cases single-needle speaking instruments are employed. On certain lines, the block system is used for the protection of junctions; no two trains which could

come into collision with one another being allowed to approach a junction at the same time. On other lines it is not so used, or is only used in the case of junctions approached on heavy falling gradients, or under other circumstances of extra risk. On some lines record-books or registers of the trains are carefully kept, and are found to be valuable safeguards against irregularities, the working of each signalman being checked by the record-book of the signalman on each side of him. On other lines record-books are not employed. Certain railways are worked on the block system by bells only; others by bells and block instruments, so as to afford the aid and evidence of sight as well as sound to the signalmen; and others by bells, block instruments, and speaking instruments. When the bell code includes a great number of indications, then the number of beats required, amounting to 10, or even 14 and 15, becomes so numerous that the men are liable to mistakes in counting them; and especially with the system sometimes employed of making, for instance, six beats mean one thing and three beats twice repeated some other thing. It is, in any case, all important that the two indications "line clear" and "line blocked" (from whatever cause) should be entirely distinct from all other signals; and the necessity for this was demonstrated in a recent accident, one cause of which was that an acknowledgment signal was mistaken for a line clear signal. One important question in the working of block systems is, the particular time when line clear should be given after an engine or train has passed a section cabin or signal. The lengths of the sections vary, necessarily, according to the nature of the traffic and with local circumstances. They may be measured by miles in some cases, and by yards in other cases. Whatever their lengths, if one train has passed out of a section before another train is admitted to it, there must at the period of admission of the second train be an interval of space equal to the length of the section between the two trains. But, supposing the first train, on passing out of the section, to be brought to a stand immediately after passing the section signal, then the second train, being admitted to the section, may also run up to that section signal and to the tail of the preceding train, and the interval between the trains will be reduced to nil. An engine-driver overrunning a signal to only a slight extent may in such a case come into collision with a preceding train. Different companies meet this question in different ways. On some railways the line is considered clear when the last vehicle of a train has passed the section signal; on other lines this is the case except during fogs and snowstorms; on others, again, different specified stations are differently provided for; and on other lines a difference is made in this respect between goods and passenger trains. The North-Eastern rule, for instance, runs as follows:—"In regard to passenger trains, the line in the rear section must always be considered blocked until the preceding train has either been shunted clear off the main line or has passed the advance semaphore where such signal is provided, or, where there is no advance semaphore, has passed the section home signal at least 300 yards on its journey in the next section." The question of protection by the distant signals in the case of trains so brought to a stand beyond the home or section signals, or in the case of an obstruction in a block section, formed the subject of a memorial in August, 1873, by the engine-drivers in the employment of this company, and the officers of the company appear to have acceded to the reasonable demand in this respect of their engine-drivers.

The following is a copy, as received at the Board of Trade, of this memorial addressed to Mr. Fletcher, Locomotive Superintendent of the North-Eastern Railway, and stated to have been signed by 650 engine-men on that railway:—

"We, the undersigned engine-men under your employ, beg most respectfully to ask you to intercede on our behalf for the better working of the block signals, as the way it is worked is contrary to the working on all other railways, and should the same practice be continued, the most disastrous consequences may ensue as bad weather approaches.

"What we complain of is the not working of the auxiliary or distant signal when a train is required to stop, as it is impossible to stop at the home signal if the distant signals are not worked, as we cannot see the home signals at many stations and block cabins till we approach within a short distance of them; and likewise we beg to call your attention to the slackness of the auxiliary wires at stations and block cabins as well, as they are kept so slack they will not raise the signals as we can understand them.

"Sir,—Should you not be able to get any of these bad arrangements altered, will you, please, cause more time to run the trains, so that we can stop at all cabins to ascertain if the road is clear for our safety as well as the public at large.

"We remain,

"Your most humble and obedient servants,

"Engine-men in your Employ."

It is interesting to observe in this case that the engine-drivers, who are likely, as we are sometimes told, to become reckless in working under the block system, themselves took steps to induce their superiors to alter regulations which were not, in their opinion, and as the result of their experience, sufficient to enable them to work with confidence and safety. They appear virtually to have declined to work, and to be trained to work, under a system of risk to which, in their opinion, the regulations of the company—which differed from those of other companies—exposed them. But it is to be hoped that those who were concerned, and took part in this question, will relate accurately and fully what occurred; and what were the views of the engine-drivers on the one hand, and of the superior officers of the company on the other hand, on this subject. A strong desire also was expressed to the author in the course of a recent inquiry, on the part of the engine-drivers of the London and North-Western Railway, running with fast through trains, to receive a caution signal, say at block-station A, when the line is not clear between block-stations B and C; or, in other words, to receive an additional section of warning by a caution signal in the event of an obstruction; as well as to have a greater proportion of break-power under their command. A tail-board by day as well as a tail-lamp by night is of great value in enabling each signalman to see at a glance as a train passes him whether the whole of it has gone by, and is now very commonly employed.

In the working of single lines by telegraph, a risk is incurred which does not arise in the case of double lines. In the event of irregularities in the running of the trains, it becomes necessary to alter the crossing places of trains proceeding in opposite directions; and from time to time accidents have occurred in this country and elsewhere in consequence of misunderstandings in making such

alterations. Such accidents led many years since to the establishment of, and to the preference by many for, the train-staff system of working single lines. In some cases a combination of train-staff and block-telegraph has been adopted, and this combination appears to afford, when it can be carried out, the greatest degree of safety. But the feeling in favour of working single lines by telegraph only appears again to have strengthened; and it must be admitted that it allows of greater freedom in dealing with the traffic, especially on lines of considerable length. It is most extensively practised in America, in India, and on the Continent of Europe.

Of all the difficulties that present themselves in railway working, the greatest is that of running trains in a fog. When the fog is so thick as to prevent the engine-drivers from seeing the signals, it then becomes necessary to inform them by other means of their condition; and, accordingly, platelayers or porters are employed as fog-men, to stand near the signals, to place detonating signals on the rails, and thus to inform the engine-drivers of the indications of the signals; or they convey in some cases verbal directions from the signalmen. The greatest difficulty and danger are incurred either when a fog comes suddenly on, and the fog-men are not at their posts, or when it lasts for a long time, and the fogmen are required for duty for an excessive number of hours. The system is at best an unsatisfactory one. Much ingenuity has been displayed, and numerous proposals have been made, with a view to supplying audible signals, detonating or otherwise, to be worked mechanically with the ordinary signals, and thus to afford additional indications to the engine-drivers. But there is always danger in trusting to expedients which are exceptionally employed; and it can hardly be contemplated, in any case, to make every signal on a railway audible as well as visible, either ordinarily or exceptionally, to the engine-driver. Such complications of sounds as would result at busy places might indeed raise an outcry. The running of fast trains at high speed through a thick fog must, under any circumstances, with or without the block system, be attended with great risk; and the only practicable arrangement appears to be to cause the speed of the trains to be reduced, during fog, according to its density, and according to circumstances; and to improve the organisation of fog-men and their duties. Some of the companies do not allow the use of great coats to men employed in winter on such duties.

There are, then, many points worthy of discussion as to the best mode of carrying out the details in the working of the block system. It has been found essential on very crowded lines, in tunnels, and other places of extra risk. The outcry against it of those chairmen of railway companies, who at the same time take credit for its adoption, and who are indebted to it for the comparative safety of the traffic on the most crowded portions of their lines, cannot be considered to be very serious. The system of presumed time intervals has failed, because those intervals could not in practice be preserved; and the permissive system for reducing the time intervals by the aid of the telegraph, and sending trains timed to travel, and capable of travelling, at various speeds, one after another, into the sections, with a caution to each, may also be considered to have failed, because it does not afford sufficient protection to the traffic. Under these time systems collisions have occurred from engine-drivers slackening their speed to avoid collision with trains in front of them, and being run into by trains behind them. The greater the variety of speed between the trains, the more does the weakness of such systems become apparent. They may at first sight appear simple, but they involve constant confusion and uncertainty, because it is impossible to calculate in railway working upon the time intervals which it is safe to allow between trains under ever-varying circumstances; and no rules can possibly be laid down to meet all cases. Simplicity in working is, after all, best obtained by a system which will secure intervals of space between the trains; but a sufficient margin of space should be preserved between them at the end of a block-section as well as at the beginning of it; and to avoid confusion in working, not only should the signalmen have control over the traffic, but also the engine-drivers should have ample command of their trains; and there should further be lines and sidings sufficient to enable the work to be performed without disobedience to the regulations, and under good discipline. One great advantage, in fact, of the introduction of the block system lies in the necessary and simultaneous introduction of extra accommodation and appliances, without which it cannot be properly worked.

The safety of railway traffic from the great majority of serious accidents, namely, from various descriptions of collision and from accidents in connection with facing-points, thus depends mainly upon two classes of men, and upon the apparatus, the means, and appliances, with which they are supplied. These two classes of men are the signalmen and the engine-drivers. The engine-drivers rely upon the signalmen to give them the proper indications, by means of their signals, as to whether the lines are clear or obstructed, as to whether the points are right or wrong; and the signalmen rely upon the engine-drivers to look out for and obey the signals that are made to them. The safe working of the traffic in this respect depends, therefore, upon a thorough understanding between these two classes of men. It depends, in fact, on the avoidance of mistakes, misapprehensions, or neglect (1) in the observance of signals by engine-drivers, (2) in the working of points and signals by signalmen, and (3) in the communications of signalmen with one another. In order to obtain the greatest degree of safety, it is necessary, as far as possible, to reduce the risk of such misunderstandings and neglect; or, in other words, pains must be taken to avoid confusion in working, and to substitute for it simplicity in working. Confusion in working must be more or less the consequence when rules and regulations are in force which cannot be carried out in practice—when hand-signals intended for one engine-driver may be received and acted upon by another engine-driver—when there is not a fixed signal for each purpose for which a signal is required—when signalmen or pointsmen are obliged to run about station yards, at serious personal risk, to work points and signals, without being certain as to what train may next approach them or when it may be expected—when, having

a number of levers without locking apparatus in or around the cabin, they are liable to pull the wrong signals and point levers over for an approaching train—when, in the absence of necessary means of communication, neighbouring signalmen are liable to work at cross purposes with each other—when, in the absence of sufficient goods lines and sidings, station-masters and signalmen are compelled to allow the shunting, sorting, and marshalling operations of goods trains to be performed on the passenger lines, or goods trains to be moved from one main line to another, while passenger trains are due or overdue in one or both directions—when engine-drivers of through trains or stopping trains, at junctions or sidings, have not reliable signals, properly placed, to inform them distinctly, in each case, when they must stop or when they may go forward—when, under the permissive, or any other time system, they are told of trains being two, three, or any other number of minutes of time in front of them, without knowing how fast such trains may be able to travel, or what trains may similarly be allowed to follow them, and therefore what speed they should themselves maintain to avoid, on the one hand, a collision with a train in front, or, on the other hand, a collision with a train behind them—when, in long heavy trains, timed to travel at high speed, they have not sufficient break-power to enable them to bring the train to a stand within a reasonable distance—when they cannot depend upon the guard hearing their break-whistles, and have only a limited proportion of retarding-power under their own control—when the lines cannot be kept clear for them at stations at which they are not due to stop—and when they find it difficult to maintain their time-table speed, and at the same time to approach each and every signal in the course of their journeys with the requisite amount of caution, according to the severity of the gradients, the slipperiness of the rails, the proportion of break-power, and the positions of and view afforded by such signals.

These elements of confusion in working, far from being theoretical or imaginary, have too often been practically illustrated by lamentable accidents on various systems of railways; and it is in the endeavour to avoid such confusion that the modern recommendations and requirements of the Board of Trade and its officers have gradually, as the result of experience over a great number of years in observing these causes of accidents, grown to their present condition. The object of these recommendations and requirements is to substitute simplicity for such confusion, as a means of greater safety and efficiency in working. Simplicity in working has thus been obtained in a very great number of cases, and has yet to be obtained in many other cases. It consists, as regards signalmen, in affording to each signalman, by proper signal and point arrangements, complete control over the lines, sidings, and traffic at his post; in preventing him from making such mistakes in the handling of his levers as may lead to accidents—mistakes which the most careful men are liable to commit sooner or later if they are not protected by locking apparatus, but which they are in a great measure prevented from making by such apparatus; in giving him sufficient warning of the approach of trains from different directions; in providing sufficient accommodation on lines and sidings to enable the main lines to be kept clear for the passenger trains. It consists, as regards the engine-drivers, in arranging that each shall have a distinct signal to look to for every necessary purpose, and that he shall have the means of properly obeying it, without any inducement to run risk in disobeying it. It cannot, of course, be expected, even when the utmost simplicity in working is arrived at, that there will be no more accidents to deplore, because, unfortunately, human agency must still be relied on, and human agency must always be, as it has ever been, fallible. So long as engine-drivers are men they will occasionally run past signals, so long as signalmen are human they will occasionally make mistakes and misunderstand one another. Neither the block system nor locking apparatus will, as the author has frequently stated, be a panacea for preventing railway accidents altogether; nor can any other improvements be expected to have such an effect. But it is equally certain that the number of serious accidents may be very much reduced, and especially on certain railway systems, when all the improvements above referred to have been carried out. The risk of the mistakes of signalmen in working points and signals will have been in a great measure neutralised. Goods trains will not so much encumber the passenger lines, and will not be engaged in shunting on them, and crossing from one main line to another, when passenger trains are due; and this, of itself, by a simpler form of working, will tend to prevent a large proportion of accidents. Delays will thus be avoided, also, both to passenger and to goods trains, and greater efficiency in working will be obtained. And this is no mere matter of speculation, because greater safety and efficiency have been and are obtained on those railways or portions of railways on which such improvements have already been introduced.

But it is necessary to consider next the arguments that are put forward in opposition to such improvements; and I may commence with the remarks which were addressed to the Institution of Civil Engineers by the President, on his recently taking the chair after his election to that office. When Mr. Harrison attributes to the author that he does not sufficiently appreciate the element of human frailty as contributing to accidents on railways, and leaves it to be understood that improved arrangements will not materially lessen the number of accidents and their serious results, the author would venture to reply that he estimates that cause of accident at no more and no less than has actually been found by the experience of many years to attach to it. There are, no doubt, as there always will be, accidents which occur from the inattention, mistakes, or neglect of officers or servants after all possible means have been provided for securing safety; but these form the smaller proportion, and in too many cases such mistakes or neglect arise in working under defective and even glaringly defective arrangements; while, on the other hand, it is marvellous to observe for how long a period those officers and servants whose fallibility is thus considered to be underestimated frequently carry on their work under such defective arrangements without causing accidents of a serious character. Inefficient men are sometimes found, also, at most important posts. The wonder really is—and it is

only fair to them plainly to say so—that the men who do the real practical work on the railways have made so few mistakes, when they have in so many cases been unprovided with proper means of performing their work. In order fully to prove the truth of this position, it would be necessary to adduce the experience of many years, which would occupy too much space here; but it will be sufficient for the present purpose to cite a few prominent cases in illustration of it, and some of them may be taken from the history of the North-Eastern Railway. The attention of that company appeared first to be seriously awakened to the necessity of interlocking point and signal levers on their existing lines, though they had for many years been necessarily doing it on their new lines, after the fatal accident at Thirsk, on the 9th of May, 1869, when a Scotch express train from the south ran through a pair of facing-points into a siding near the station, instead of pursuing its course along the main line. The signalman clearly could not have made the mistake which caused that accident if the lever by which the facing-points were worked had been interlocked with the levers for working the signals. He would in that case have been unable to lower his signals until he had first set the facing-points in the proper direction. Then, again, the collision at Brockley Whins, on the 6th of December, 1870, was one of the most disastrous in its results that ever happened on the North-Eastern Railway. In that case, an express up-passenger train and a down coal train, due to pass on opposite directions on two main lines without stopping, were turned into each other on a cross-over-road between these two lines. The collision was due, no doubt, to a mistake of the signalman, but under circumstances which would hardly be credited if they had not caused the accident. The signalman was provided with one lever for working together the two facing-points, one on each of those main lines, and thus with the means of the more easily turning the trains into one another and producing the accident; whilst that lever was not interlocked with the signal-levers, so as to prevent him from lowering signals whilst the facing-points were set in this dangerous position. Five persons were killed, and fifty-nine were injured, as the result of this example of simplicity in construction and confusion in working. Turning to other railways, the fatal collision on the 29th of June, 1867, at the Walton Junction, on the main line of the London and North-Western Railway—the most costly collision, as regards the amount of compensation, that ever occurred on that railway, in which eight passengers lost their lives and seventy were injured—would have been prevented if the signals and points had been interlocked. The adoption of this precaution had been specially recommended for the same junction by the author, on the occasion of a previous collision on the 1st of January, 1862, in the words quoted near the commencement of the present paper. Then, again, there was the collision at Kirtlebridge, in 1872, the worst example on the Caledonian Railway, in which eleven persons were killed and fifteen were injured, and which will, it is said, when all claims have been settled, cost the company about £50,000. In this latter case, the station-master himself turned a shunting goods train across into the way of a night express train from London for Scotland, after a signalman at a distance from him had lowered the signals to allow it to pass. But the station-master would not have made this fatal mistake, and it could not have been made at all, if the points had been worked from a cabin, and if the lever for working them had been interlocked with signal levers. These are a few instances which must, it is true, be set down to mistakes of officers or servants, but in which this element of human fallibility might and would have been completely neutralised if only points and signals had been interlocked with one another, and if thus simplicity had been substituted for confusion in working.

Another recent illustration of the arguments employed against such improvements in railway working is contained in the half-yearly speeches of Sir Edward Watkin, and coming from so practical an authority, they ought to be worthy of special attention. In addressing the shareholders of the Manchester, Sheffield and Lincolnshire Railway at Manchester, on the 28th January, 1874, Sir Edward Watkin is reported in the *Railway News* to have said that the Board of Trade "assumed that men were infallible instead of fallible; that they were always awake and attentive, and that they never could by any possibility make a mistake." Now it will be at once apparent that if the Board of Trade had any such conviction its officers would not have thought it necessary, for instance, to require that signal-levers and point-levers should be interlocked with one another, because if men were really infallible they would never pull over the wrong lever, and in that case the serious accidents above cited would, in fact, never have occurred. It is precisely because human agents are fallible that the various precautions referred to are required, to counteract as far as possible the element of such fallibility; and it is for that reason that locking and other arrangements become necessary. It is hardly necessary to say that Sir Edward Watkin has no warrant for making such an assertion, which, indeed, he himself partially refuted—according to the same newspaper—at the half-yearly meeting, on the following day, of the South-Eastern Railway Company. He then made a very different allegation in saying:—"But where the Board of Trade's heresy is, is in believing that by the adoption of mechanical appliances you can ensure almost absolute safety." So that the Board of Trade has two heresies—one in assuming the men to be infallible, and an opposite one in trusting to mechanical appliances. But he goes on himself to express confidence in mechanism:—

"I say it is heresy because it overlooks the fact that you have to work, without military discipline, your eight thousand or ten thousand men who are fallible. It is the mistakes of those men which cause the accidents, and not the failure of mechanism or deficiencies in the strength or endurance of material."

And again:—

"My notion of railway working is simplicity. These things increase complication. The Board of Trade requirements tend to make the thing complex, to make it difficult, and to multiply the causes which lead to error; and I think myself, if you will take the average of ten years after we have got all these new-fangled things into operation, it will be shown that the old simple arrangements of Stephenson, Brunel, and Locke are best; and, after all our experience, we may have to come back to the simple way of working, and to put many of these new-fangled things into the fire."

The author recently heard of an observation even more extraordinary than the above, which was addressed, not long since, by an aged Field-Marshal to a still more aged retired Lord Chancellor, as they were walking together at Hampton Court, and which was related to him by a friend who was with them. In the midst of earnest conversation in a loud tone—for they are both rather deaf—the field-marshal suddenly stopped, and thumping his umbrella violently on the ground, said, impressively, with evident reference to a bygone period, "When I went to see the Dook at Walmer, the Dook said that railways would never answer in this country; and, you see, here's this Wigan accident. The Dook was right." This sentiment is in one sense on a par with Sir Edward Watkin's proposal to "put many of these new-fangled things into the fire," and to return to the simplicity of older days. Exactly to what period of simplicity he would revert he does not point out;—whether to the days of no signals at all, and to the system of the fireman jumping off the engine to push over the switches without the aid of a lever; or to any particular epoch between that time and the present, he does not specify. But, seriously, can he believe, as chairman of the South-Eastern and the Metropolitan Railways, that by putting the apparatus—complicated, no doubt, in construction, but simple in working as compared with the duties to be performed—into the fire; by doing away with the locking apparatus and the block system at Charing-cross and Cannon-street, and at the various complicated stations on the Metropolitan Railway, with trains following each other and crossing the path of each other within periods numbered sometimes by minutes and sometimes by seconds, that the traffic could be carried on at all? He would find that not one day, nay, in some places not one hour, would pass without a serious accident and a complete block to the traffic. And, indeed, the author has had occasion himself to inquire into two accidents which have so occurred, during a temporary want of the apparatus, on the occasion of alterations or repairs.

Sir Edward Watkin's remarks were anything but complimentary to the common sense of his shareholders; and they were an insult to the memory of the illustrious engineers whose honoured names he dragged into such an argument. They would never have proposed to work the traffic of the present day with the simple arrangements of former times.

Speaking specially of the block system he further says:—

"It is very good, but it has a weakness I have often pointed out, namely, that it leads on the part of our servants to too great reliance on the machinery, and a weakening of the reliance on themselves."

And he takes credit for the South-Eastern Company—as other chairmen have done for other companies—for having been the first to adopt this system. He says:—

"But if there is any credit to be taken for the block system, I am here to tell you that the credit belongs to you, for the first railway in England (before the Board of Trade found out that there was any good in it) that adopted the block system was the South-Eastern, and the first railway that completed their line with this system was the South-Eastern. We got no hints from the Board of Trade. We acted on our experience, and it has been a valuable advantage (always with the drawback I have mentioned) in conducing to the safety and regularity of our work."

It is hardly, then, the apparatus connected with the block system which Sir Edward Watkin would propose to put into the fire. Is it the locking apparatus that he would wish to commit to the flames? Speaking at the South-Eastern meeting, he says, it will be observed, "we got no hints from the Board of Trade." Speaking at the Metropolitan meeting, in regard to a collision under the block system, he attributes it to Board of Trade meddling, as I shall presently show. But, in reality, the same hints and the same meddling applied to both railways equally, excepting that there were additional hints in the case of the South-Eastern Railway, which may be quoted, both as opening up another interesting subject for discussion, and as showing the risk that an officer of the Board of Trade may incur even when invited and doing his best to assist a company presided over by a chairman, who, like Sir Edward Watkin, attributes accidents which arise from a mistake of his signalman to the Board of Trade. Some months before the Charing-cross Railway was opened for traffic, the author was asked by the South-Eastern Company to make a preliminary inspection of it, and to confer with the officers of that company as to the best mode of dealing with the signal and working arrangements; and he had, as he always has, great pleasure in being of any use in that respect. Besides the general arrangements, which were agreed upon without much difficulty, an important question arose, in regard to the working of the block system. It was proposed by the company to work the Charing-cross line by bells only, as other parts of the South-Eastern Railway were worked, without block instruments. But the author ventured to dissent from that proposal, and to express the opinion that, considering the importance of the line, and the nature of the traffic which it was likely to accommodate, it was absolutely necessary to provide visual as well as audible instruments, to give the signalmen, in fact, the advantage of a record before their eyes as to the conditions of each block-length—whether it was obstructed or whether it was clear—in place of trusting to their memories as to the last signal which they had received or transmitted on their bells or gongs. The author stated, in fact, that he would be unable otherwise to recommend the Board of Trade to sanction the opening of the line. The talented electrical superintendent of that company accordingly contrived and provided, before the opening of the line, the miniature semaphore signals which are working in the cabins; and the safety of the line has been probably due in some respect to the "hint" on which the company thus acted. And this hint may further be supposed to have been considered valuable, inasmuch as the use of Mr. Walker's miniature semaphore has since been extended to all other portions of the South-Eastern Railway. But if any accident had occurred through the failure of, or in working those instruments, it would, of course, have been open to the chairman to attribute it to Board of Trade meddling, as he did, publicly, the collision which occurred on the Metropolitan Railway, between the Gloucester-road and the Kensington High-street stations, on the 29th of August last. In that case a disabled train proceeding from the Mansion-house Station to the Edgware-road Station came to a stand in a tunnel after passing

Gloucester-road; and the signalman at the High-street Station, when an unusual length of time had elapsed since he received notice of it, asked on his speaking trumpet, "Is train coming?" to which the Gloucester-road signalman replied, "I have not received line clear for last train." The signalman at the High-street, fancying he must have forgotten to give "line clear," did so, and a second train was thus allowed to enter the block length before the first train had passed out of it. Sir Edward Watkin remarked upon this at the half-yearly meeting of the Metropolitan Railway on the 22nd of January, 1874, as reported in the *Railway News* of the 24th January:—

"Now this accident, the first of the kind which has occurred, I think, during a period of twelve years' working, ought to be called—as many accidents ought to be called—a Board of Trade accident."

And he proceeded to argue that because the Board of Trade recommended in their general list of recommendations—for it was not an absolute requirement—speaking instruments as well as block instruments in the cabins, and because the signalman had, in calling attention and replying on the speaking instruments, committed this error, therefore the accident was, as he put it, "the consequence of the Board of Trade meddling." There was, however, another recommendation—that record-books should be kept also in the cabins; and this had not, it appeared, been complied with in the Gloucester-road cabin. Whenever an accident occurs at any place where every precaution has been taken to avoid it—and such accidents must be expected occasionally to occur—and where all the requirements and recommendations of the Board of Trade have been complied with, it will of course be open to any chairman of a company, so disposed, to attribute such accident to Board of Trade meddling, and to call it a Board of Trade accident. But in this particular instance the signalman might have committed the mistake in question without speaking instruments at all. The recommendation with regard to the adoption of speaking instruments in addition to block instruments is contained in clause 7, under the heading of "Precautions Recommended in the Working of Railways," and is as follows:—

"When a line is worked by telegraph, the telegraph huts should be commodious, and should be supplied with clocks, with record-books, with a separate needle for signalling the trains on each line of rails, and with an extra needle for other necessary communications between the signalmen."

It was adopted because signalmen had been found to be making private signals to one another on their block instruments or their bells, "shaking each other up," as they term it, by shaking the needles and so on. The recommendation has, in very many cases, not been complied with, and it will be an interesting subject for discussion whether and how far it should be acted on, as well as how far it may be considered desirable to depend upon bells alone without block instruments. Speaking instruments are, indeed, absolutely necessary in many cases, when it is considered requisite to afford information from distant stations of the running of fast non-stopping trains—whether they are keeping time, or whether and how much they are behind time. They are required in other cases for the transmission of messages on the company's service in regard to the working of the line in various respects. In the absence of them, the block regulations of some companies prescribe codes of signals by beats on the telegraph bells; and the number of beats required for such purposes mount up, as already stated, to 14 or 15. It is an important question to consider whether the signalmen may not make mistakes in counting so many beats on the bells more easily than in the use of speaking instruments. Sir Edward Watkin's proposal in the same speech was to send a man in place of using a speaking instrument, and was thus expressed:—

"The idea of the Board of Trade, no doubt, was this: that if anything took place in the way of blocking, the signalman should be able to ascertain what it was, instead of pursuing the old-fashioned plan, that when there was a block somebody should be sent to see what it was."

But no man would in this case have been sent running from the Gloucester-road signal cabin to the High-street signal cabin, even if there had been no speaking instruments in the cabins; and at all events the Board of Trade have never made any objection to Sir Edward Watkin's employing men in that capacity if he thinks proper, and finds it compatible with the working of the traffic on the Metropolitan Railway to do so. It is the more necessary to make the above observations because Mr. Forbes, the Chairman of the Metropolitan District Railway, is reported to have echoed in some degree the sentiments of Sir Edward Watkin in regard to the accident on their joint line. According to the *Railway Times* of the 14th of February, 1874, Mr. Forbes is reported to have said, at the half-yearly meeting, on the previous Tuesday, of the Metropolitan District Railway:—

"The item of compensation had been £5,000 extra in the half-year, with which they had really nothing to do. The accident was caused by one Metropolitan train running into another Metropolitan train, and they had to pay one-third of the cost under the agreement with that company. He complained that under the direction of the Board of Trade they were obliged to use apparatus that had caused accidents, and had entailed a loss of £18,000 in damages, which he thought very hard indeed."

It would be interesting to learn from the General Manager of the Metropolitan and the Manager of the District Railway, whether now, after the experience of that accident, they are prepared to remove the speaking instruments from all the signal cabins, and whether they could carry on the working of the line without them. Unless they can come forward and tell us that they are prepared to adopt this measure—which, if they consider it expedient, there is nothing to prevent them from doing—it must be admitted that the remarks of Sir Edward Watkin and Mr. Forbes on the subject were more ingenious than ingenuous; and the author contends that they were, in any case, in the highest degree unjustifiable.

Fully to expose the injustice and the nature of the accusation thus made by Sir Edward Watkin and Mr. Forbes against the Board of Trade for causing this accident by meddling, because one of their recommendations is that there shall be "an extra needle for other necessary communications between the signalmen," it is right, however, further to point out that the printed regulations for signalmen on the Metropolitan Railway provide for the use of speaking instruments, two in number at terminal, and three in number at inter-

mediate stations, that there are six in the cabin in which the mistake was made, and that the signalmen are directed to use these speaking instruments when the disc instruments are out of order, or the bells fail to ring.

The following are the regulations referred to, extracted from "The General Rules and Regulations to be observed by the officers and servants employed by the Metropolitan Railway Company:"—

"118. The station at each end of the line is provided with two train signalling instruments, one for the up-train service, and one for the down-train service, and a telegraph bell instrument; two speaking instruments are also provided, one to communicate only with the next station, and the other instrument for communication with all stations.

"119. The intermediate stations and junctions are each provided with four train-signalling instruments, one for up-trains and one for down-trains in one direction, and one for up-trains and one for down-trains in the opposite direction, with two bell instruments; three speaking instruments are also supplied, one for use to and from the station on either side, and the through instrument, by which each station is in communication with every other.

"131. Should the disc instrument be out of order, or the bells fail to ring, the speaking instrument must be used for the purpose of signalling the trains."

And the following is a regulation for signalmen, to a similar effect, from the printed book of rules for the Metropolitan District Railway:—

"90. Each station has an independent speaking instrument to the next station on either side. There is also a through speaking instrument, by which each station is in communication with every other."

The rule-books of these two companies thus provide for speaking instruments in the cabins, in excess of the Board of Trade recommendation; and it is due to the companies to suppose that they do not supply more instruments than they find in practice to be necessary. But it is anything but justifiable in the chairman to represent that an accident occurring in the use of instruments provided for their own purposes has resulted from their being forced to obey a Board of Trade recommendation, contrary to their own convictions; and especially when there are signal cabins on other lines where the recommendation in question is not complied with at all. The railway companies have not, indeed, always been in the habit of so implicitly carrying out the recommendations made to them by the Board of Trade as might be inferred from the accusation referred to.

Mr. Forbes, also at the half-yearly meeting of the London, Chatham, and Dover Railway Company—as reported in the *Railway Times* of the 14th February, 1874,

"Protested against the duplicate management which was being instituted by the Board of Trade, for it was this it amounted to, and the department was placing more faith in machinery than in men. This was really deteriorating the men, for they relaxed their watchfulness in the trust in machinery, and were trapped into a security which had led to two accidents on the line."

Mr. Forbes does not state what accidents he particularly refers to, or by what special machinery the men are trapped into security; and it is therefore impossible at present to reply in detail to his allegations; but if he will be more specific on these points it will add to the interest of the discussion, and his charges shall be fairly met. Meanwhile, the author is quite ready to admit, and has often stated, that there may be a tendency in the block system to engender confidence in engine-drivers, guards, and all connected with it, as regards the safety of these trains from collision; and that such confidence is justified by the results of its working. But while it is only natural that engine-drivers should have less apprehension of obstruction from trains, it must be remembered that there are still public road crossings, occupation crossings, the liability to find platelayers at work, or vehicles thrown from another line foul of that on which they are travelling, as well as other causes, requiring them to keep a look out. The experience of block working hitherto has not justified the apprehension which has, at times, been expressed of greater danger being incurred, and more serious accidents being caused, as the result of undue confidence thus engendered. Instances may, it is true, be adduced of engine-drivers running past signals, or of signalmen making mistakes, under the block system. But many more instances may be brought forward of similar causes of accident where the block system has not been in force. The great balance of actual experience, up to the present time has shown that there is more risk of inattention, mistakes, or neglect on the part of officers and servants in railway working when they are constantly compelled to work with insufficient appliances and accommodation, and are thus trained, so to speak, to dangerous practices, than when they are provided with the means of carrying on their work in a safe and proper manner; and good discipline which is, after all, and in any case, a most important element, can then be better maintained. And the memorial and opinions already referred to of the engine-drivers on the North-Eastern and London and North-Western Railways are illustrations of the natural desire which these men must, more than any others, feel to be afforded the means of carrying on their daily work under safe conditions, with sufficient warnings of obstructions, and ample means of obeying signals.

As an illustration of the necessity for block working combined with more accommodation for the conduct of traffic, and of the working of railway traffic under difficulties, the author cannot do better than refer to the circumstances of a collision that occurred on the 13th December last, near Bolton, on the Lancashire and Yorkshire Railway. On that occasion, a down passenger train from Manchester to Fleetwood overtook, whilst running, and came into collision with, an empty waggon train, in a misty state of atmosphere, a mile and a quarter after leaving Bolton; and a portion of the wreck having been thrown upon the other—the up line—it was immediately afterwards run into by an up passenger train from Southport for Manchester. In this double collision, 42 passengers and 6 servants of the company were injured or shaken. There are two signal cabins, 194 yards apart, called the Bullfield upper and lower cabins, on the further side of the Bullfield tunnel from Bolton; and the signalmen in those cabins, who had, as usual, exhibited caution signals only from their hand-lamps were dismissed from the company's service for not obeying the company's regulations, which required them to show a danger signal for five minutes and a caution signal for five minutes longer after the passage of the empty waggon train to any following down passenger or other train. But it turned out, on inquiry, that it

had not been the practice at those cabins, at all events for eight years, to obey those regulations—that the signalmen did just what they were in the habit of doing and what other signalmen working in those cabins would have done; and that the traffic could not have been carried on in conformity with such regulations. One of the signalmen further pointed out that he could not be expected to keep the trains five minutes apart when they timed to start from Bolton within two and three minutes of one another. A relieving signalman, not concerned in the accident, stated that he would have worked in the same manner, and himself have been dismissed from the service of the company, if the accident had happened an hour later; and he further stated that when he left his cabin to give his evidence, there were five engines—which turned out on enumeration to be six—on one main line, and three on the other main line, of which one was shunting in and out of the sidings at each side, and the others were waiting to shunt or to pass. The engine-driver of the passenger train, who had complained before leaving Bolton of the empty waggon train having been sent away in front of him, was told in reply that it could not be helped. Now there were no "new-fangled things" at these cabins. They were stated to be twenty years old, with such apparatus as they contained; and there was certainly nothing in their appearance to lead to a contrary opinion. The author ventured to think that less confusion and more simplicity in dealing with the traffic might be obtained by the addition of extra lines and sidings, and by the construction of improved cabins with modern apparatus in connection with them, and also by the extension of the block system (at present in force for the Bullfield tunnel only) to the portion of the line on which the collision occurred. The caution, the presence of mind, and the self-reliance of the officers and servants of the company must, certainly, have been developed to the utmost in the working of this traffic; but not with a satisfactory result, either to the passengers and servants of the company who were injured, or to the two signalmen—of good previous character—who lost their situations for doing their duty to the best of their power, as they had been trained to do it, as they had always done it, and as they were compelled to do it. The neglect of fallible servants will, no doubt, be considered by some to be a cause of this accident; but it is not essential to railway working that frail human nature should be employed under such conditions; and the author would commend this case—one of the more recent which it has been his duty to investigate—to the serious consideration of those who, in opposing what are called "modern requirements" on railways, like Mr. Harrison and Sir Edward Watkin, are inclined to lay too much stress upon human frailty as the cause of accident, to decry the means and appliances by which that element of constant risk may be in a great measure neutralised, and to leave out of consideration the difficulties, the disadvantages, and the defective or insufficient arrangements under which the officers and servants of railway companies are frequently compelled to work. The opponents of modern improvements which are thus designated as "new fangled things" are, in fact, not now found so much amongst the officers and men who have the practical working of them. Such officers and men, on finding out the value of them for their own protection, and for real simplicity and safety in working the traffic, are only too glad to obtain them, and are only anxious that their operation should be extended. The opposition to them comes mainly from certain chairmen and general managers of railways and others whose practical experience was gained in former years, before many of the improvements now so successfully employed were available, and under different circumstances of traffic; and from gentlemen such as the President of the Institution of Civil Engineers, who having some time since retired, as he tells us in his address, from the active work of railways, has not yet realised the benefits which such improvements confer. Many who were once opponents have now become firm believers, and, sooner or later, the true difference in such matters between simplicity in construction and simplicity in working will, the author believes, be all but universally understood and admitted.

Since the above was written, another eminent and practical railway chairman has made use of arguments and expressions which can hardly, in such a paper, be passed over without notice.

Sir Daniel Gooch is reported in the *Railway Times* to have said, at the last half-yearly meeting of the Great Western Railway Company, on the 4th of March:—

> "We complain of the mechanical arrangements and contrivances, and different things that are forced upon railways contrary to the opinion of the railway engineers and officers who are responsible for working the railways, and who have had experience to enable them to judge of the efficiency or otherwise of these contrivances. Therefore, we say, and we say it very strongly—that the contrivances of the Board of Trade, to the extent to which they are forced upon us, are increasing the danger of our railways."

And, again:—

> "Undoubtedly, our mechanical contrivances are very ingenious and clever, but they are not equal to the mechanical contrivances and appliances provided by a higher power; therefore I have much more confidence in a well-trained pointsman at his post than in any mechanical appliances designed to take his place."

These quotations would seem to convey the ideas —(1) that railway companies ought to abolish locking apparatus and trust to Providence; (2) that the Board of Trade is seeking to supplant well-trained pointsmen, and to employ mechanical contrivances and appliances in place of them; (3) that the danger of railway working is being increased by a number of things—though it is not stated what things—which the Board of Trade are forcing upon railway companies. Sir Daniel Gooch no doubt honestly feels what he so pithily expresses; but he certainly exhibits an extraordinary misapprehension of the principles by which all the action of the Board of Trade has been guided. And, indeed, Mr. Harrison made a complaint in the opposite direction, namely, that the requirements of the Board of Trade would necessitate the employment of a much greater number of signalmen, and thus lead to increased risk. Placing side by side the allegations of the four eminent gentlemen who are the chief complainants, it will be observed Sir Edward Watkin accuses the Board of Trade of two heresies—one, in considering the men infallible and the other in expecting too much from ma-

chinery; Mr. Forbes says that the Board of Trade mistake is in trusting to machinery rather than to men; Sir Daniel Gooch prefers to trust in well-trained pointsmen, which he looks upon as the better contrivances of a higher power; and Mr. Harrison complains—with special reference to the block system—that too many of these men are required. The truth of the matter is that the Board of Trade desires, not only to see well-trained signalmen employed, but also that they shall be provided with apparatus that shall enable them to work with the utmost possible simplicity, and shall neutralise as far as possible the mistakes that otherwise the best of men are liable—nay, are almost certain, sooner or later, in the course of years of working, to commit; and wishes, further, to see their numbers increased only so far as is necessary for the proper performance of their duties, for affording due warning to the engine-drivers, and for enabling the traffic to be worked in the simplest, best, and safest manner.

But the present is an admirable opportunity for these, or any other gentlemen, to come forward, and to state specifically what mechanical contrivances ought, as they think, to be dispensed with, and what are in their opinion admissible. If the Board of Trade is proceeding on a wrong basis, in whole or in part, let them point out precisely what are its errors. The only object is to increase the safety and efficiency of railway working; and that object may, apparently, best be secured by more simplicity and less confusion in working, on the principles stated in the present paper. There has been ample experience as to the causes by which railway accidents have been produced, as to the defects which they have disclosed in construction and working, and as to the remedies by which they may be and have been avoided. The author has laboured anxiously and earnestly, by analysing from year to year the results of that experience, to afford the best means of judging,—to anyone who will take the trouble to study those results,—not of the working of any one line, but of all the railways of the United Kingdom; and he will feel deeply grateful to any one who will correct him in any of the conclusions at which he has arrived, or point out to him any other mode by which the safety and efficiency of railway working may be better secured. Under no system can perfect safety be obtained—as he is too well aware—but confidence in a Higher Power, as it is expressed by Sir Daniel Gooch, can only with propriety be entertained after all reasonable means have been exhausted.

To sum up the whole case, it is necessary, in railway working, to deal with men and mechanism. Men are fallible, and mechanism may fail. The complications of railway construction and traffic have increased enormously, and are still increasing. At some points the lines, the sidings, and the crossings, are so numerous, and the traffic is so constant, that the employment of the best means and appliances is unavoidable. In other localities, of severe gradients or obstructed view, or when greater danger is otherwise incurred, similar means and appliances are also indispensable. These points and localities become more and more numerous, and ample experience has now been obtained as to the most efficient modes of working. The result of that experience has plainly demonstrated that mistakes and accidents may best be avoided, and efficiency of working may best be obtained:—1. By judicious selection, and careful training of the men employed, and especially—in a safety point of view—of engine-drivers and signalmen. 2. By providing those men with reasonable and necessary apparatus and accommodation for the proper performance of their duties. 3. By maintaining good discipline amongst them, which is only feasible when proper means and accommodation are provided, when proper modes of working are adopted, and when it is possible for them to carry out in practice the rules and regulations furnished for their guidance.

These three desiderata include the provision of fixed signals in sufficient number to enable the signalmen to afford due warning in each case in which warning is required to the engine-drivers, and to enable the engine-drivers clearly to understand the warnings so given to them. They include the supply of locking and other apparatus, which has been proved to act efficiently in preventing or neutralising the mistakes, in the working of points and signals, which the best of men are otherwise, sooner or later, almost certain to commit. They include the addition of sufficient lines and sidings to enable the traffic to be properly worked—without goods or mineral trains constantly obstructing the passenger lines—without the main lines being blocked when fast through trains are due or may be expected—without excessive delay to slow or goods trains in waiting for fast or passenger trains to pass—without stopping trains being shunted from one main line to another, to allow fast trains to pass them—without habitual unpunctuality. They include the necessary apparatus for enabling intervals of space to be preserved between running trains, and the proper arrangement and working of such apparatus, with the careful adaptation of it to local circumstances. They include the provision of ample retarding power in the trains, applicable at the will of the engine-driver, to enable him to obey the signals which he receives, and to bring his train to a stand within a reasonable distance. They include, in fine, all those things which contribute to simplicity, and which tend to the avoidance of that great cause of extravagance, inefficiency, and danger—confusion in railway working.

The Chairman—Ladies and Gentlemen, it is impossible to overrate the importance of this subject, for it is one in which every inhabitant of this country has a great interest. Captain Tyler has rendered a great service to the public in preparing this valuable paper, in which he has given us the results of his great knowledge and experience on this most important question. Our time for these meetings is drawing to a close, and as this paper contains such a large scope for discussion it is impossible to do it justice by entering upon it this evening; and I believe also it is generally expected that another evening will be devoted for the discussion of this paper. Under these circumstances therefore it is my duty to inform you that this meeting will be adjourned to this day week for the purpose of discussing this very important subject. At the same time, before we depart, although we must regret the absence of Captain Tyler, I am quire sure you will agree with me that he could not have selected a more able representative to read his paper than Colonel Yolland, and that we cannot do otherwise than give to

Colonel Yolland our best thanks for the very able way in which he has performed his laborious task.

The resolution was then put and carried.

Several models of improved railway apparatus were exhibited. Amongst them some rocking points (facing or trailing) by Messrs. Burn and Son, of Epsom; some self-regulating and adjusting apparatus for taking up the slack and allowing for the contraction of distant signal-wires, by Mr. G. W. Beynon, Great Western Railway Engineering Department, Reading; and Mr. R. Luke's patent facing-point lock, intended to be employed in connection with Saxby and Farmer's point and signal interlocking gear, by which the point of the switch rail is secured and held against the permanent rail, during the approach and passage of a train.

CONFERENCE ON MUSEUMS AND PUBLIC GALLERIES.

A Conference on this subject was held on Wednesday last, the 20th inst., the Right Hon. Lord HAMPTON, G.C.B., F.R.S., in the chair. The following gentlemen were present, as representing the various localities named. Numerous letters have also been received from representatives of other localities, who were unable to be present, expressing sympathy with the movement:—

Mr. J. Chamberlain (*Mayor*), Mr. Jesse Collings, Mr. J. T. Bunce (Birmingham); Mr. Elijah Walton (Bromsgrove); Rev. R. P. Walter (Bromley); Mr. R. M. Hands (Coventry); Mr. J. Yeaman, M.P., Mr. E. Jenkins, M.P. (Dundee); Mr. J. Brooke (Dunstable); Dr. Jamieson, Mr. A. Laughlen, Mr. J. Leitch (Glasgow); Mr. J. Whitwell, M.P. (Kendal); Dr. Barrington Chevallier (*Mayor*), Mr. E. Packard (Ipswich); Mr. S. Leigh Gregson, Mr. P. H. Rathbone, Mr. J. Armstrong (Liverpool); Sir J. Heron, Mr. Malcolm Ross (Manchester); Capt. T. R. Starey, Mr. S. G. Johnson, Mr. M. O. Tarbotton (Nottingham); Mr. J. L. Edwards (*Mayor*) (Rochester); Mr. R. Harwood (*Mayor*), Mr. E. Andrew, Mr. Alderman T. Davies (Salford); Right Hon. W. Cowper-Temple, M.P., Mr. T. W. Shore (Southampton); Mr. A. J. Mundella, M.P. (Sheffield); Mr. E. Bowles, M.P., Mr. R. Cameron (Sunderland); Mr. H. Deacon (Widnes).

Also the following:—

Mr. A. Cassels, Dr. Archibald Campbell, Mr. Hyde Clarke, Mr. Henry Cole, C.B., Dr. C. Dresser, Mr. I. Gerstenberg, Mr. J. Hinde Palmer, Q.C., Mr. R. M. Lawes, Rev. G. Moon, Admiral the Right Hon. Lord Clarence Paget, K.C.B., Mr. Hodgson Pratt, Lieut.-Col. Strange, F.R.S., Mr. Warren De La Rue, D.C.L., F.R.S., Mr. T. Webster, Q.C., &c., &c.

The Chairman said the object of the meeting was to discuss the necessity on the part of Government to extend the usefulness of our public museums and galleries, and make them subservient to the technical instruction of the people. The reasons for this action were two-fold. It was desired to promote those instructive and important effects which result from the introduction of museums and objects of art into the crowded localities of this country; and secondly, the object was still more to facilitate, by the introduction of matters which bore upon that point, extension of technical education in the country, an object which all who had turned their attention to the subject knew to be of essential importance to the manufacturing interests of the country, and which had been rather too much neglected. One of the resolutions which would be submitted would point to the importance of assisting various museums and galleries of art in different localities by the loan of objects, which might be interesting to those localities. Mr. Tonks, of Birmingham, had written to him, under the impression that the Society contemplated only loans of objects of art, which might be gratifying to the taste of those who looked at them; but the object really was to promote the loan of objects which would be useful to the localities in which they were exhibited, by enabling them to encourage the trade and improve the manufactures in which they might be engaged. Another important subject alluded to in the resolutions to be submitted, was the placing of national museums and galleries under the authority of a Minister of the Crown. He most heartily concurred in what was desired in that respect, and for very many years he had endeavoured to the best of his power to point out the advantage of a regular minister of public instruction. He hoped within the next few days again to raise his voice on the subject in the House of Lords. That somewhat peculiar contrivance which went by the name of a Committee of Council could not be considered as satisfactorily solving the question of having a minister to superintend the educational interests of this country. He was fortified in this opinion by the Fourth Report of the Royal Commission on Scientific Instruction, which affirmed that our national museums should be placed under the control of a responsible Minister. Such a recommendation from such a quarter had very great weight with regard to this question. An attempt had been made to arrange a deputation to the Prime Minister to ask him to encourage and support the objects which this meeting had in view; but Mr. Disraeli had stated that in consequence of a pressure of public business he was unable to fix a day for receiving the deputation. Under these circumstances it would be proposed that he (Lord Hampton) should submit the resolutions of the meeting to the Prime Minister.

Mr. J. Chamberlain (Mayor of Birmingham) moved the first resolution, which was—

"That in the opinion of this meeting all Museums and Galleries supported or subsidised by Parliament should be made conducive to the advancement of Education and Technical Instruction to the fullest possible extent, and that special Parliamentary funds should be granted to assist Local and Provincial Museums in the acquisition and loan of objects, and with building grants, and thus extend their usefulness."

He said the Town Council of Birmingham had done a great deal in the promotion of the objects which were to be furthered by this meeting. They had expended from the rates sums considerably exceeding £50,000, and had just voted an additional sum of between £13,000 and £14,000 for the provision of a suitable art gallery. They were expending annually the whole of the produce of the rate which they were allowed under the Free Libraries Act for the maintenance and promotion of museums and libraries. They were supported in their proceedings by the public feeling in the borough. During the last year a quarter of a million persons visited the art gallery in the centre of the town —about two out of every three of the population, men, women, and children. The number that visited the second museum in Birmingham during the same period was over 600,000. The total was two visits for every head of the population. The Birmingham and Midland Institute had now something like 2,000 students in daily attendance. It had raised by private subscription £20,000 for its buildings and apparatus, and it was now seeking to raise a further sum of £30,000, of which about £20,000 was already subscribed. In the metropolis, crowded as it was with visitors from all parts of the country, it might be supposed that the attendance at the national museums would be very much greater in proportion than the attendance in provincial towns,

but such was not the case. The people of Birmingham felt that they were entitled to demand that they should have their fair share in the distribution of the national funds. They had done much for themselves unaided, and were willing to do still more; but they claimed a fair share of Government assistance. They did not grudge anything to the metropolis, but they urged that something might very fairly be done to assist local efforts. The local efforts might be proportionately met by help from the Consolidated Fund, in the same way as help was given to education. Those whom he represented felt strongly that the help should take the form either of money or of objects for permanent exhibition. They were not prepared to be satisfied with loans. They wanted articles specially suited to the manufactures of their own districts. The chief jewellery trade, for instance, was at Birmingham, and yet the chief collection of jewels had been deposited in the British Museum. If such a collection was permanently established at Birmingham, it would have a most material influence upon the artistic character of the productions of the town. The collection at the South Kensington exhibition also would be more useful at Birmingham. The loan even of such an exhibition would be a small benefit to them, as they wanted not only one generation but succeeding generations to have the best specimens set before them as examples. The collection of carpets now in the Indian Museum would be much more useful if established at Kidderminster. Each trade and home of industry should have its special museum, to which it should contribute from the local funds, but which should also be assisted by the Government.

Mr. Philip H. Rathbone (Liverpool) seconded the resolution. He said that the Town Council of Liverpool had been doing something, and the people had shown that they would have supported the council, even if they had gone farther. The museum had had 428,000 visitors during the last year. The town council had done what, so far as he was aware, had not been done by any other municipal body, for it had taken charge of the annual collection of pictures by modern artists, and the profits of the exhibition, which amounted to about £400 or £500, had been expended in pictures for the town. When a town was doing thus, it had a right to ask for some assistance from the Government. He differed a little from the Mayor of Birmingham with regard to loans. He looked upon the loans as extremely important, for when a museum was perfectly stationary, the people got tired of going to see it, but something new each year created a fresh interest in it. If there was a good series of loan collections, each collection forming a history of a certain branch of art, more would be done towards educating the people than by any amount of merely miscellaneous museums. He was glad to see that the resolution carefully guarded against the idea that local museums should be placed under the control of a Minister of State.

Mr. A. J. Mundella, M.P. (Sheffield), supported the resolution. He said that for three or four years past, when the British Museum vote had come before the House of Commons, he had always drawn attention to the propriety of the British Museum distributing its duplicates to the local museums of the country, but without success. The Commission on Scientific Instruction, which had been sitting under the presidency of the Duke of Devonshire, had recently made a report bearing especially upon museums, and he rejoiced to find that their recommendations were precisely of that character which the Society of Arts had been long desirous to promote, and were in accordance with a resolution which he had put on the notice-paper of the House of Commons. The Commission recommended that a Director of the National Collections should be appointed by the Crown, and should have the entire administration of the museums under he control of a Minister of State. It was in vain to attempt to deal with museums while they were under irresponsible boards of trustees who had more than enough to do in their other engagements. The statement of the Mayor of Birmingham showed the necessity which existed for the extension of museums in the provinces. For instance, in the town which he represented (Sheffield), containing a quarter of a million of inhabitants, there was not an object of beauty for the eye to rest upon; and yet the working classes were expected to be frugal and temperate, although there was no place of attraction and enjoyment to counteract the attractions of the public house. He rejoiced also to find that the Commission recommended the appointment of naturalists in connection with the science and art section of the education department, to point out and supply deficiencies in the collection, and that a systematic inspection of provincial museums should be organised. But the most important of all the recommendations was that courses of lectures should be delivered in connection with the local museums, so that technical instruction might be brought to bear upon all the manufactures of the country. English manufactures and English industry had nothing at all to fear from the muscle and labour and industry of other countries. The only source from which they had anything to apprehend was the higher education of Germany and Switzerland. We required that provincial museums should perform the part which was filled on the Continent by the polytechnic and other institutions. If it were known that specimens from abroad would be distributed through different parts of the country, Englishmen in Australia and elsewhere would send home specimens for distribution, and we might have a good museum in every large town. He should agree with the Mayor of Birmingham if the object of this Society was simply to obtain loan exhibitions, but the object was threefold. It was first to stimulate local effort by supplemental help from the Government; next to secure the distribution of duplicates existing in the central museums; and thirdly to promote loan exhibitions of national property. It might ultimately be expedient to alter the Free Libraries and Museums Act, so as to allow a three-halfpenny rate instead of a penny rate. Such a rate would go far to keep up public museums in large towns. He should feel very much supported in the House of Commons by the representations which had been made by this meeting. He hoped the present Government would be wise enough to profit by an opportunity, such as was not often presented to a Government, of doing a most valuable service for the country at a very small cost, and so acquiring for themselves a very large amount of popularity.

Dr. A. Campbell, having served a long time in India, wished to support the suggestion of the Mayor of Birmingham as to the distribution of the samples of the manufacture of India to different centres of industry in England where they would be useful. The carpets and shawls of India and Cashmere, the brocades of Benares, and articles of compound metals, and perhaps also the jewels of Delhi, ought to be loaned from the India Office, where scarcely anyone now ever saw them, to the places in which similar manufactures were carried on.

Mr. Alderman Thomas Davies (Salford) said in his borough they had a museum, a library, and a picture gallery. The Town Council were already extending the benefits of the museum to all parts of the borough. The number of the inhabitants was 130,000, and the penny rate was not sufficient. Three hundred thousand visited the museum and the picture gallery in twelve months. Salford would very heartily support the movement before the meeting.

The resolution was carried unanimously.

Capt. Starey (Nottingham) moved the second resolution—

"That in the opinion of this meeting, all National Museums and Galleries should be placed under the authority of a Minister of the Crown, with direct responsibility to Parliament; thereby rendering unnecessary for the purposes of executive administration all unpaid and irresponsible trustees, except those who are trustees under bequests or deeds, who might continue to have the full powers of their trust, but should not be charged with the expenditure of money voted by Parliament."

He said that Nottingham was the first town in England which had had a permanent museum in connection with the South Kensington Museum. In 1871, the School of Art at Nottingham was so fortunate as to stand first in the list of schools of art in the kingdom, and it was in consequence of that it obtained the museum in question. Nottingham had done even more than Birmingham, if judged by the attendances at the museum. The population of Nottingham and its suburbs might be reckoned at 130,000. The museum in its first year had 131,995 visitors, with an average weekly attendance of 2,538. During the second year the attendance was 139,967. There was reason to hope that the taste and mechanical spirit of the town had been fertilised by the museum. The designers had considerably improved in their designs for the manufacture of lace, which was the peculiar product of the town. The authorities of the International Exhibition wanted to borrow the collection of lace this year, but it could not be spared, as it was fulfilling a most useful work in the town by exciting invention and good taste. Classical music had been introduced in the museum, and was found to be very attractive. No complaint of damage done by visitors to the works of art had ever been made. The authorities of the South Kensington Museum were not allowed to assist museums, except in connection with schools of art, and hence their action was limited. The object of the present meeting was to demand of Government that grants should be made for the encouragement and support of museums, without their being connected with schools of art. The technical knowledge which the Society of Arts desired to promote could not be obtained by those who required it, unless it was brought to them in their own towns, and therefore museums were comparatively useless if they were all together in one great centre. A comparison of the number of persons visiting the International Exhibition and the London museums, with the number of those visiting local museums, would show that the distribution of art treasures and everything tending to art education must be a main feature of a useful scheme of technical education. In fact it was needful to take the education to the people, instead of requiring people to come a long way for the education. That was a very important matter. The South Kensington authorities had up to the present time supplied the country with objects of interest and art of an educational character, but it must be patent to everyone that they must come to an end of their collections. They had already begun to be very shy of lending their pictures. What was wanted was that some of the choicest works of art should be lent, under proper supervision. He did not see why that should not be a matter for an Act of Parliament. One of the means of accomplishing what was desired was to have a responsible officer to undertake the work, and that was what was provided for in the resolution.

Dr. Barrington Chevallier (Mayor of Ipswich) had much pleasure in seconding the resolution. There had existed in Ipswich for many years an excellent provincial museum. It was rich in collections of natural history, but deficient in many other respects; and for that reason, as far as Ipswich was concerned, he should differ in one respect from the Mayor of Birmingham. They would be thankful for any loans which any Government or museum would let them have. Of course donations would be preferable. The Ipswich Museum was much appreciated, and a number equal to something like one and a half times the population visited it during the past year. The population was about 45,000, and nearly 70,000 visitors went to the museum. It was of very great importance that all national museums and galleries should be placed under the authority of a Minister of the Crown, who should be responsible to Parliament for them. As to the rate, he thought that there would be a difficulty in raising 1½d. in the pound under the present circumstances in some boroughs. An instance of this had recently occurred in Ipswich, in reference to the purchase of certain buildings as a school of science and art. A difficulty which had been hitherto experienced with reference to the Ipswich School of Science was that they had not funds at their disposal to pay suitable lecturers and instructors. A 1d. rate would produce only £600 a year, and when a good curator and current expenses were paid out of that sum there would be very little to spare. This was really a question of imperial importance for the country, and he thought that it was very important in a matter which concerned the national interest that large subsidies should be given from the imperial resources to enable Englishmen to be educated so that they might be able to compete with the artisans of the Continent.

Mr. E. Jenkins, M.P. (Dundee), had much pleasure in supporting the resolution, as he understood that it was not intended to interfere in any way whatever with the administration of merely local institutions. It was only intended that the supervision of an institution should be in the hands of a crown minister when the institution had been assisted by a Parliamentary grant. That seemed to be a most reasonable proposition. The object was to secure thoroughly good technical education. There was one good reason why it was necessary that there should be some such action as that which was proposed as the result of this meeting. If we looked to America we should find that the very constitution of America tended to decentralisation. Each State had its own government, and that government was able to devote its attention to questions affecting its own locality. That was not the case in Great Britain, and therefore it would be seen that, to a certain extent, the movement which they were met to inaugurate had something of a decentralising character. The intention of the promoters was that, instead of everything being brought to a focus in London, the greatest possible amount of benefit should be dispersed throughout the provinces. He might allude to what he observed in Burslem two or three years ago. As a friend of his said, Burslem was a good place to go away from. In the streets there was little beauty to attract, and nearly all the people were dressed in homely dress; but there was one oasis, and that was the Wedgwood Institution. He had seen workmen taking their wives and daughters to that institution, and pointing out beauties of form and outline to them; and he felt that the institution was teaching a lesson of beauty to the people, and so far tending to refine and improve them. The collection at Burslem was almost entirely a permanent one, and the people seemed to take special interest in it because it was their own. He felt the force of what the Mayor of Birmingham had said about the importance of having objects of utility representing the subjects of the manufactures of a district permanently exhibited in that district; and he believed that it would be advantageous if some of the articles from South Kensington could be permanently transferred to the provinces. He regretted to hear that the Commissioners had determined to cease holding the yearly International Exhibitions in London. It appeared to him that, perhaps, those exhibitions might be continued with success, if they were held in various provincial towns, in the same way as the sessions of the peripatetic societies, like the Social Science Congress and the British Association.

Mr. J. Yeaman, M.P. (Dundee), said that he had the honour of representing Dundee, which was con-

sidered to be in advance of other towns in Scotland with regard to technical education and schools of science and art. A recent exhibition of paintings, articles of vertu, and mechanical inventions was attended with very great success. Some years ago Dundee erected a public institution, at an expense of nearly £40,000, all of which, except £10,000, was raised by voluntary subscriptions. Looking at the success which had attended the efforts to advance the culture of the young, he had no doubt that in a few years this matter would be taken greater advantage of than hitherto. The penny assessment had been of great value, and produced something like £2,000 a-year. The School of Art at Dundee was fortunate in possessing a master who stood second to none in the kingdom—Mr. Kennedy, and his pupils had filled very important offices throughout the country. We ought to look at this matter in an imperial point of view. The advancement of science and art to enable us to compete with our Continental neighbours was certainly of imperial importance. The sooner the Government took up the matter the better. He had much pleasure in supporting the resolution.

Mr. T. Webster, Q.C., said that the question of lecturers and curatorships was a matter which had been discussed in that room on several occasions, and some time ago he read a paper upon a similar subject. There were to be found in the different local manufactures experienced workmen who would make extremely good teachers of their own art. They might even be called lecturers, and they might be attached to the local museums. He knew from experience that they were men who were really experts, and could give admirable evidence before any tribunal as to their particular vocation. These would be natural teachers, and their services could be secured for even half the £600 a year which the Mayor of Ipswich had spoken of. In addition to these teachers distinguished men might be sent down from London or some central town to teach the principles of science to the local workmen. Of course such professed lecturers would have to be well paid.

Mr. H. Cole, C.B., said that a previous speaker had alluded to the stoppage of the International Exhibitions, the aim of which was to give technical instruction. He was sorry to say that technical instruction failed to pay, just in the same sense as the British Museum, the South Kensington Museum, and the National Gallery failed to pay. It was not unlikely that at the close of the Exhibition the Commissioners would have devoted something like three-halfpence a-head for the instruction of the visitors who had gone to the International Exhibition. The British Museum cost 3s. 3d. for every person that visited it, and the South Kensington Museum cost 1s. 5d. The last time he looked into the subject, he found that the Crystal Palace visitors cost more than 1s. a-piece, as regarded the cost of administration and the provision of attractions; and the profits which the shareholders of the Crystal Palace got were obtained from the refreshments and all kinds of incidental receipts. He sympathised with the notion of having special technical exhibitions in the different localities; and if the people were in earnest about it, it would be possible to have an administration which would provide for the erection of a temporary building from year to year in different places. That was an idea very well worth consideration.

Mr. J. T. Bunce (Birmingham) was sorry to differ from the opinion expressed both by Mr. Jenkins and Mr. Cole as to the possibility of continuing the Annual International Exhibitions by holding them in provincial towns. Coming from Birmingham, and knowing something of the management of exhibitions, he could undertake to say, without hesitation, on the part of Birmingham manufacturers, that there was no hope of repeating international exhibitions in the provincial towns. He believed that that was the sentiment of manufacturers in other places.

Mr. Cole said that that was not what he meant. There might be, for instance, all sorts of shows, such as a jewellery show.

Mr. Bunce said that they would be delighted to have such a show at Birmingham, if Government would only give them the means of having it. A strong point might be made as to the great exhibition of jewels, which was at the British Museum, and was practically inaccessible to the public. It could only be seen by special permission. He hoped that this Society would not commit itself to the idea of any exhibitions of the same kind or nature. As to international exhibitions being produced in commercial towns, manufacturers were entirely sick of getting up specimens, and the public were getting tired of going to see them. As to the resolution, a very good illustration of its necessity might be furnished by the fact of the labour which persons would have to undergo if they tried to get a loan exhibition in any provincial town. There were five or six different bodies of trustees who have to be all separately "moved," as it was called, and there was nothing more difficult under heaven than the moving of such bodies of men. The trustees of the National Gallery once lent the Birmingham and Midland Institute, which he represented, 60 or 70 of Turner's drawings, and just as the people had become interested in the drawings the trustees recalled them, and they had to be sent back. That was a very strong argument in favour of a permanent grant system. There was no reason in the world why some of the collections which were now exclusively in London should not be formed into separate collections and distributed among the large towns.

Lieut.-Colonel Strange, F.R.S., said that the resolution before the meeting involved the question of the scientific instruction of the country, and that was by far too large a subject to be treated of at the present meeting. The management of museums was only a very small part of the question of the administration of national scientific instruction. He doubted whether the necessity which certainly existed of placing these museums under a minister would justify the Government in creating a new minister for the purpose, but in conjunction with other branches of science the demand assumed an importance which could not now be resisted. The sixteen different scientific institutions supported by the State were placed under no less than seven departments, and therefore it was almost impossible to expect harmony in the treatment of this subject. The fact which the chairman had stated as to the Prime Minister's avocations preventing his receiving a deputation from this Society was of itself a strong illustration of the want of a minister to deal with public instruction; for if such a minister had existed, any refusal to receive the deputation would have been inadmissible. There was at present no channel by which the Society could impress its views on the Government of the country.

Mr. Cameron (Sunderland) said he was practically the curator of a museum in that borough. His experience was that the elementary scientific education of the country was so deficient that the crowd of visitors who came to the museum came out of curiosity. Last winter he gave a course of simple explanatory lectures on shells and fossils, and the moment the working men got a glimpse of the meaning of the things which were exhibited they took a great deal of interest in them. Until our elementary schools gave a groundwork of scientific knowledge, our museums would be comparatively little worth unless there were lecturers in connection with them to expound their contents. Foreign skill had to be imported into Sunderland in order to carry on its manufactures, as English workmen were deficient of the artistic and scientific training which would enable them to fulfil certain duties in connection with the manufactures. This was a dishonour to our country. He believed that loan exhibitions would be useful in some instances. To his

own mind an essential idea was that we should endeavour to graduate our national education, so that the Government would organise schools gradually rising from the elementary schools. Such schools existed in other countries. The higher branches of instruction ought not to be taught as it were accidentally, and too much on the voluntary system.

The resolution was unanimously agreed to.

The Right Hon. W. Cowper-Temple, M.P. (Southampton), said that it was a subject of regret that the Prime Minister had not been able to give the time and personal attention which would be required of him, in order to receive a deputation from this meeting; it therefore remained to the meeting to prepare a memorial which would bring before him and the rest of his Government the facts of the case. They wanted to show the Prime Minister the progress that had been made in England in providing museums. The facts which had been brought before the present meeting confirmed the impression that in those large towns of England in which there was moral and mental activity, amusements had been freely established and well supported, and that in other towns individual bounty had produced the same results, as was illustrated by the Hartley Institute at Southampton. We had now finished the first stage of progress, and we ought to be getting on to the second stage—that in which museums would cease to be accidental accumulations of objects which excited wonder and amusement, but would be systematised for the purpose of bearing directly and effectively upon the instruction of the people. This could only be done by means of the central action of a responsible Minister of State. While they wanted on the one hand local interest and local knowledge of the circumstances of the place, they also wanted the kind of direction which could only be given by a central authority. He concluded by moving the following resolution:—

"That the thanks of the meeting be given to the Chairman, Lord Hampton, and that he be requested to submit to the Prime Minister the foregoing resolutions, and press their importance on his attention."

Admiral The Right Hon. Lord Clarence Paget, K.C.B., seconded the resolution, and added that they must all feel grateful to Lord Hampton for occupying the chair. He had always been foremost in forwarding all questions of this kind. As they should not have an opportunity of expressing their views to the Prime Minister themselves, they would entrust his noble friend with the statements of their wishes.

The resolution was carried unanimously.

The Chairman, in reply, said that he most heartily acceded to the request of the meeting, and he would make it his duty to submit the matter to the Prime Minister in such a form as might be thought desirable, and to impress upon him the fact that the present resolutions were passed by a representative meeting at which there were deputies from all parts of the kingdom. As to the vote of thanks, he could only express his sense of the kindness with which it had been moved and seconded, and his sincere pleasure at taking part in a movement which he believed would have a most useful tendency.

The production of steel in the United States last year is computed at 168,000 tons. In this total Bessemer steel figured for 140,000 tons, and cast-steel for 28,000 tons. In 1872 the total was 142,500 tons, Bessemer steel 110,500, cast-steel 32,000. In 1871 the total was 82,000 tons, Bessemer steel 45,000. In 1870 the aggregate was 75,000 tons, of which 40,000 tons were Bessemer steel. In 1865 steel was made to the extent of 15,262 tons, in 1866 18,973, in 1867 19,000, in 1868 30,000, and in 1869 35,000.

The Grantham Steam Tramway Car was recently tried at West Brompton, and received the favourable opinion of the Railway Inspector of the Board of Trade, Captain Tyler, R.E.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

PICTURES AT THE INTERNATIONAL EXHIBITION.

By Bernard H. Becker.

(SECOND NOTICE.)

Among the foreign nations exhibiting this year Belgium takes a prominent position. She sends, it is true, no historical picture of equal merit with the "Counts Egmont and Horn after Execution," which excited a profound sensation in 1862, but, nevertheless, sufficient evidence is afforded that the higher works of art are not utterly neglected in favour of the more facile and lucrative departments of landscape and *genre*. Many tears and much ink have been spilt in bewailing the decline of academic art, and, it must be confessed, with considerable reason. The highest and noblest efforts of art, the superb creations of genius, aided by perfect manipulation, are unquestionably to be found in those works which reveal a profound study of the nude. Mediæval architecture, carefully studied costume, and intense local colouring, replace but imperfectly the effects produced without adventitious aid by that consummate delineator of the nude figure, who is endowed with the faculty of expressing both by form and feature the great dominating passions of mankind. Unfortunately, artists, like other men, cannot afford to set at defiance the laws of demand. During the glorious period of the *renaissance*—albeit the intensely devotional sentiment had become perceptibly weakened, and the rapt expression of entire and complete adoration no longer signalised the faces of saints and martyrs—there was sufficient demand for altar-pieces and other large works to stimulate to the utmost the study of the "noble and nude and antique," but in these latter days this demand has almost entirely ceased. Such devotional works as are required are preferred by purchasers when executed in the early style of Italian art, while the influence of the stiff and angular tradition of Byzantine limners was not yet shaken off. Now and then, for the decoration of a palace or a town-hall, a work of some importance is required, but, unhappily, it has to be performed by artists accustomed to dwarf their conceptions to the limit of a few square feet of canvas, and who consequently fail more or less completely when attempting higher and more sustained efforts. Modern pictures are required for the adornment of comparatively small houses. The age of *palazzi* is over, and the prosperous manufacturers and merchants, who are the chief patrons of modern art, naturally prefer pictures more suited to their own abodes.

A remarkable instance of this truth is found in the case of M. Van den Bussche, the professor of the Royal Academy of Antwerp, who, when springing at a bound from the insignificant "Marguerite after drowning her child" to the "Last of the Romans," finds himself unequal to the task of utilising his huge canvas. Still there is in this latter work evidence of dramatic power. A band of barbarians has burst upon the degenerate descendants of the conquerors of Carthage and surprised them in the midst of a banquet. The savage invaders are at the door of the hall, sword and torch in hand, while the Roman women vainly strive to urge their half-drunken lords to strike a blow in their defence. In the "Last of the Romans" are the materials for a great picture, and it is to be regretted that the subject, the scene, and the title alike recall to its disadvantage a comparison with the wonderful "Romains de la Décadence" with which every student of art is familiar.

M. Van Lerius, whose "Ophelia" and "Elaine" are probably fresh in the recollection of visitors to the International, sends three pictures. A rather stiff and artificial "Queen of the May," may be dismissed from consideration as unworthy of the artist's reputation, but "Rosamond" is well worthy of study, as exhibiting his strong and weak points in a powerful light. The face of the girl is admirable, and of a most excellent simplicity, while on the other hand her figure is unnaturally short, and the May bushes in the background also appear stunted. "Cinderella" is perhaps the best picture M. Van Lerius has sent to this country. The story is excellently told. The slipper is just fitted to the naked foot of the girl, while indignation and incredulity struggle for mastery in the faces of the haughty sisters. There is some wonderful texture-painting in this picture, and the general execution, like the composition, is exceptionally good. It is pleasing to find M. Van Lerius content to allow his figures to fall into natural and graceful attitudes utterly unlike that of the page in "Elaine" last year, whose uncomfortable *pose* completely marred an otherwise admirable picture.

Two historical scenes by M. Charles Soubre attract many gazers, who, after making the tour of the room, gravitate again towards the "Family of Nobles (gueux) before the Council of Blood," a picture recalling the period deeply stained with blood and tears, but enriched by many noble memories—when the reformers of the Low Countries first made a determined stand against the despotism of Spain. The subject is sufficiently described by the title. It may therefore suffice to say that the figure of the Duke of Alva indicates much careful study, and that the protestant clergyman throws into strong relief the vivid picture of the accusing monk—a veritable incarnation of the genius of fire and faggot. The second picture sent by M. Soubre is hardly so successful. The noble figure of Katharine of Aragon towers superbly over the wheedling Cardinal who is endeavouring to persuade the neglected queen to agree to a divorce. Looking scornfully down on Wolsey with the insulted majesty of a queen, and the indignation of an injured woman, Katharine looks every inch herself, but the insignificant being buried in his purple hardly answers to the idea of the haughty churchman who might bend upon occasions, but could never have put on the sneaking look of M. Soubre's Wolsey. Edmund Vanderhaegen's "Biblical Discussion in the Sixteenth Century" is in many respects a remarkable picture, full of vitality and expression; but many visitors will turn from all this class of work to linger over Ernest Slingeneyer's "Street Scene in Tunis," a study of a woman and a naked Arab boy, admirably executed, and a half-length of "Salome Watching the Decapitation of St. John the Baptist," a clever little picture by Polydore Beaufaux.

In landscape the Belgian school is especially strong this year. M. Bossuet exhibits a "View of Rome," showing the tomb of Hadrian, the castle of St. Angelo, and the basilica of St. Peter in the distance. This picture is so good as hardly to suffer by comparison with an admirable rendering of the same scene by David Roberts, exhibited in the English room. A "View of Naples" is also conspicuous by its high finish and effect of broad sunshine. In a couple of pictures M. Edmond de Schampheleer fully maintains if he do not add to his already high reputation. A view of the "Meuse between Dordrecht and Rotterdam" is an example of what may be made out of unpromising materials by skilful treatment, while a scene on the Amstel, near Amsterdam, gives a perfect idea of a delicious autumn day, with the bright sunlight playing on the dimpled surface of silvery water. Among those who aim at a broad, masterly style of work in landscape, M. Coosemans takes a high rank. The "Hollow Way"—end of winter—displays excellent handling and truthful colour, but this latter quality is made more distinctly prominent in the "Allée de Hêtres," an autumn scene rich with mellow tints and ruddy browns. Keenly contesting the pride of place with M. Cooseman's *chef-d'œuvre*, the two pictures of M. Van Luppen challenge notice. "Towards Evening," good as it is, hardly sustains comparison with "After Rain"—a view taken at Anseremme, near Dinant—one of the most truthful pieces of work exhibited in the Belgian or any other gallery. The scene is merely a bit of Flemish roadway. Brightened by the recent rain, the verdure is unusually vivid, but it is on the broken, chalky earth that the whole power of the artist is put forth. Every one will recollect the peculiar slippery, greasy effect produced by rain upon a chalky soil. This is rendered with a fidelity absolutely startling—the road is obviously muddy, and the realisation of a soddened landscape perfect. M. François Musin sends three pictures, among which the "Prawn Catchers" perhaps exhibits the greatest power. The fishers themselves are the least part of the scene—a mass of breakers tumbling on a beach under a grey threatening sky. In pictures of this kind there can be no mediocrity; they must either be completely uninteresting or, like the "Prawn Catchers," be invested with a peculiar fascination.

The Bavarian pictures of the present year, although noteworthy for a certain correctness of drawing and high finish, giving evidence of careful and systematic instruction, exhibit for the most part a painful dearth of originality. This combination of great technical skill and absence of inventive power is vividly manifested in Mr. Rudolf Kuppelmayr's *Kunst Medaille* picture the "Italian Concert." This is an imitation—admirable enough—of Giorgione in subject, treatment, and colour. As such it is entirely successful, but the really splendid work excites a pang of regret that it was not devoted to something more than a superb imitation. Franz Widnmann sends an excellent historical picture of the "Countess Catherine of Schwarzburg-Rudolstadt forcing the Duke of Alva to grant safety to her subjects oppressed by his soldiers." This tremendous title indicates a noble lady presenting a scroll for the signature of the grim duke, who albeit backed by the whole power of Spain, the Indies, and the Inquisition to boot, quails before the superb matron, who is evidently "giving him a piece of her mind." This and Mr. Ernst Meissel's "Last Meeting between Louis XVI. and his Family" are meritorious efforts in the right direction, but are somewhat overshadowed by Professor Alexander Wagner's "Roman Chariot Race in the time of the Emperor Domitian." This is a grand canvas, and redeems the whole Bavarian school from the dreadful charge of mediocrity. The arena rendered familiar to moderns by the pencil of Gérome is here depicted at the most exciting moment of the chariot race. Amid scattered wheels, overturned chariots, and fallen horses, the charioteer in the middle of the track whirls his whip, and, carried away by excitement, urges his triple team, already fully extended, to still greater efforts. Already in imagination he grasps the prize, but he heeds not the quiet rival who has secured the "inside track," and with horses well in hand seems quietly determined to hold his advantage. There is some wonderfully bold drawing in this picture. The horses are literally galloping out of the picture, and the contrast between the vain-glorious charioteer and the quiet man—who is sure to beat him at the finish—is dramatically strong. The Bavarian landscapes are mostly well executed, but it is unfortunate that painters, who have such a superb variety at their command, confine themselves mainly to one class of subjects. Mountains and lakes, pine forests and glaciers, are very well in their way, and would be interesting if all the artists did not select the same subject and treat it in the same way. Thus, the visitor sees first a "Sawmill in the Zillerthal," and then a sawmill in some other "Thal." He encounters the "Valley of the Inn," the "Via Mala," and the "Valley of the Adige," several views of the Obersee, and many of the "Lake of the Four Cantons." All these are pretty aspects of nature, well chosen and fairly executed, but a

dreadful sameness of handling pervades them all. As a guide-book to the mountain regions of Central Europe the Bavarian exhibition is admirable, but as an expression of a school of landscape painting it leaves almost everything except rare technical dexterity to be desired. Clearly distinguished, however, from the general run of landscapes is Mr. Louis Newbert's bold attempt to paint a "Sunrise on the Grossglockner." Perhaps the colour seems a little yellow for the "Alpenglüh," but travellers must not forget that pink and crimson precede the evening grey—the first gleam of morning sunshine is yellow before it deepens into salmon-pink.

Among the German pictures are a couple of capital "game pictures"—"After a Day's Sport," by Augustus Schepp, and the "Modern Diana," by Professor Ferdinand Keller, of Baden. Midway in the room Mr. August Hörter's "Falls of Reichenbach" catch the eye and rejoice it with a lovely prospect. Excellent as is the execution of this picture, it yet incites the spectator to regret that an artist of such undoubted ability should have chosen a drawing-room waterfall to expend his strength upon. These "pretty" cascades have been "done to death" on workboxes and "Spa ware," and it is wonderful that a painter of far more than average power should select such a worn-out subject. Mr. A. Normann's "Norwegian Landscape" is open to none of these objections. It presents the head of a fjord, with the cliffs sloping sharply down into it like the "Screes" at Wastwater, and is a very sound, truthful, and notable piece of work. The great drawback of all the German landscapes is a certain smoothness and want of original vigour and individuality of touch. Sound academical teaching has its advantages, but when it turns out a generation of artists who paint exactly in the same fashion, the conviction is forced upon the observer that academical shackles may occasionally prove unwholesomely strong.

After innumerable delays, the French Section is at last open, and supplied with a catalogue which appears to have required an immense amount of labour in its composition. As the Royal Academy to living English artists, so is the French "Salon" to their French brethren; and it is difficult to escape the conclusion that these great national exhibitions have militated seriously against the picture galleries at Kensington. Nevertheless, the French gallery is notable enough in its peculiar way. The followers of Paul Delaroche cannot be accused of neglecting the study of the nude. M. Antony Serres sends a well-drawn and richly-coloured recumbent female figure entitled "La Sieste." Directly opposite to this is another remarkable nude figure, by M. J. P. A. Antigna, called "Un Cauchemar," drawn with great boldness and exhibiting to perfection the accurate anatomical knowledge possessed by an artist who has enjoyed the advantage of complete training in the art of depicting the human form divine. The choice of subject is perhaps *bizarre*, and English visitors may marvel at the curious taste which selects a naked female in the agony of an unquiet dream as a fitting subject for delineation; but there can be no doubt of the masterly style in which the design is carried out. Equal praise can hardly be accorded to the immense canvas of M. Felix Jobbé-Duval. The "Mysteries of Bacchus" incline the spectator to desire that the mystery had been better preserved. In the midst of a crowd of sprawling Bacchantes sits the young god on a triumphal car, drawn, not by the traditional panthers, but by tigers—an innovation possibly to be referred to the boldness of original genius. Disreputable old Silenus brings up the rear. The Bacchantes—very Rubens-like in contour—have been thrown in at random, or perhaps with a cunning carelessness intended to display the artist's power of drawing plump female figures in every possible attitude and position. Spirited and bold in drawing as this picture undoubtedly is, it yet leaves much to be desired on the score of colour, and betrays many traces of hasty execution. Taken altogether, it can hardly be regarded as a very satisfactory specimen of the school to which it belongs.

The "Shadow Dance" of M. H. P. Picon is a small but vigorous specimen of the semi-nude, and with this is exhausted the list of noteworthy pictures in that peculiar style in which French artists excel. Many more of these pictures are in the collection, but the weak colouring of these pale nudities cancels the praise which might in some cases be accorded to correct drawing.

Three fine examples of Charles Landelle find place in the present collection. The fine Cassandra-like face of "Velleda" (exhibited by H.R.H. the Prince of Wales) at once catches the eye, and deflects it from the smaller but equally admirable "Ruth aux Champs" and "Rebecca à la Fontaine." M. Charles Landelle is the happy holder of innumerable medals, and in addition is a Chevalier de la Legion d'Honneur. Perhaps in time it may become the fashion to decorate English artists with the Order of the Bath.

M. Schopin sends an historical picture which might fairly have claimed more ample scope and verge. The subject is dwarfed by the small size of the canvas. It is entitled the "Vision of Cardinal Richelieu on his Deathbed." Now it is difficult to believe that the great cardinal was at any time troubled with visions. The founder of the French monarchy was not the man to feel regret or remorse for the many haughty and rebellious heads that, during his long lease of almost absolute power, he had consigned to the axe of the headsman. However, art has a certain license, and M. Schopin has chosen to represent Richelieu starting up in terror at a vision of skulls, overturning at the same time the desk on which is placed his portfolio, which Mazarin is hastily clutching. The worn but yet beautiful and finely-cut features of Armand Duplessis are admirably depicted, and the keen look of Mazarin is well rendered. The dull impassive king is perhaps a trifle too wooden, and the ladies in the background might have been more carefully painted, but, taken altogether, this picture inspires a regret that more time and space were not devoted to it.

A lady, Mdlle. Nélie Jacquemart, contributes several excellent portraits, thrown for the most part against a neutral back-ground, and divested of any adventitious aid. Among them a portrait of M. Duruy may be cited as altogether admirable, while that of Marshal Canrobert is almost as good, and the portrait of Mdme. Arlès-Dufour is a wonderful example of the power and beauty that may be found in grey locks and grandly-cut features.

French landscape is relieved from the charge of mediocrity by a fine picture of Charles François Daubigny. Occupying a large space, the "Lever de la Lune" is in every respect a magnificent study of moonlight under its most sober and truthful aspect. There is no attempt at the well-known flashy and tricky effects so common in this style of picture. The landscape is a simple and homely one—merely a field with loads of freshly-cut grass being taken into waggons by the pale rays of the rising moon. Weary workpeople and not less weary cattle are wending their way homewards through the long green grass of the meadows. The picture is intensely and truthfully green—not with the bright silvery hues of full moonlight, but dark and rich with heavy half-revealed tints.

It is to be regretted that the accurate modelling for which the French are justly celebrated is not more amply represented at the present exhibition. The collection of sculpture is meagre, but so far as it goes it is admirable. M. Dalou, whose contributions to the Exhibition of the Royal Academy have made him deservedly famous in this country, sends a single bronze, "La Brodeuse." M. Cavalier also sends a bronze statue of "Francois Premier," a work of rare excellence. Madame Bertaux is represented by a "Jeune fille au

Bain," a carefully executed bronze. Two remarkable instances of the effect to be got out of "bronze argenté" are also present. One of these is M. Barrias' "Fileuse de Mégare," a fine study, and the other an admirable representation of animal life by M. Emmanuel Frémiet. This is a "Cat-family;" a mother cat and her kits revealing in every line a careful and loving study of feline life. Visitors to the cat shows now so much in fashion will pause in wonder and delight before this piece of truthful work. The expression on the face of the cat-mother is completely beautiful, and the attitude marvellously natural and perfect. The French collection is rendered additionally attractive by many fine paintings on porcelain, by some admirable etchings, and by an interesting collection of architectural drawings and restorations of ancient châteaux. Many of these possess rare historical as well as artistic interest, and will afford a delightful study to those who love to trace by its architecture the history of a great nation.

An exhibition of the designs and works of the late Mr. Owen Jones will be held in June next at the International Exhibition. Proprietors of works willing to lend them are requested to give notice to the Hon. Sec., E. Pigott, Esq., 9, Argyll-place, Regent-street.

The following is the return of admissions for the sixth week, ending May 16th:—Season tickets, 1,469; payment, 10,901; total, 12,370.

EXHIBITIONS.

Philadelphia Exhibition.—The *Philadelphia Press* says it has heard of an enterprising citizen who has promised to build a ship capable of carrying ten thousand passengers in time for use at the International U.S. Exhibition, which is to combine a steam railway, a race course, theatre, shooting gallery, circus, and every imaginable modern attraction. He claims that his plan is complete, and has been approved by some of the ablest engineers. He proposes to moor it in the Delaware, and convey it at intervals to the different cities, ports and watering places of the Continent. This monster machine will make about six miles an hour, and will be three or four times larger than the *Great Eastern*.

YORKSHIRE COLLEGE OF SCIENCE.

The following is the constitution for the college recently agreed upon at a meeting of those interested in the scheme, at least in its material points:—"The name of the association shall be the 'Yorkshire College of Science.' The operations of the 'Yorkshire College of Science' shall be carried on in Leeds, and such other place or places as the board of governors shall from time to time determine. The objects for which the college is established are—1. The supply of instruction in those sciences which are applicable to the manufactures, engineering, mining, and agriculture of the county of York; also in such arts and languages as are cognate to the foregoing purposes. 2. The acquisition and maintenance of premises for the business of the college. 3. The doing of all such other things as are incidental or conducive to the attainment of the above objects. The government of the college shall be vested in a Board of Governors, consisting of—1. All donors of £250 and upwards at one time, who shall be life governors. 2. Twenty governors elected by the general body of donors and annual subscribers. 3. Six persons to be elected annually, one by each of the governing bodies of six of the endowed schools of Yorkshire, which are named in a schedule. 4. Ten persons to be elected annually, one by each of the councils of the societies, bodies, or other associations, wherever situated, which are named in a schedule. The governors shall not hold less than two meetings during each year. They shall elect annually the president and treasurer of the college; they shall appoint annually a professional accountant as auditor; shall receive the annual report from the council, and shall constitute a final court of appeal from the council, in any dispute that may arise in the council. The ordinary administration of the college shall be in the hands of a council, which shall consist of fifteen members, to be elected annually by the governors out of their own number. The council shall meet not less than eight times a year, and shall transact all the necessary business of the college. They shall elect, and may remove, the professors and other salaried officials engaged in carrying on the work of the college. There are to be twelve trustees of the college, in whose names investments shall be made.

CORRESPONDENCE.

ANNUAL INTERNATIONAL EXHIBITIONS.

Sir,—It is a matter for sincere congratulation that the Commissioners of 1851 have acted so promptly and decisively in closing the series of annual exhibitions. It was evident from the results of last year's exhibition that the scheme was not in itself a good one, and that, however pleasing it might be in theory, it could not be practically carried into effect. Various excuses have been offered for the failure. Perhaps that failure arose from one fact, and that was that the public were tired of exhibitions. In the absence of a large number of visitors, there was nothing to induce exhibitors to go to trouble and expense, and so the show became less attractive. These two causes threatened to act and re-act upon one another, until the whole thing was spoilt, but with wise foresight the Commissioners decided to cut short the list, instead of wasting money and time over an obviously impracticable idea. But to dwell upon the causes of failure is useless, except to help us to avoid failure in future. The question is how to fill up the place of the exhibition, or rather how to obtain successfully the object unsuccessfully sought by the promoters of exhibitions. That object is certainly the promotion of technical education, and it is to that one end that any schemes for using the existing resources at South Kensington ought to be, as indeed they almost certainly will be, directed.

In the recent discussions on the Patent-office Museum, many suggestions have been made as to the possibility of developing it into a real *Conservatoire des Arts et Métiers*. Whether such an institution could be founded on the narrow basis of the Museum of Patents, may be doubted, but at all events it is certain that the establishment of an English Conservatoire is the one thing most certainly required to prevent the technical skill of our artisans falling below the Continental level. The idea is now so obvious that it can hardly be doubted but that it will be brought fully before the notice of the Commissioners of 1851; but it is also to be desired that public attention should be directed to it, in order that help may be obtained from every source, and a united effort made by the numerous and varied classes interested.

What is wanted is just an institution which should do for technical science what the South Kensington Museum has done for art and design. There are no difficulties which should not be overcome by care and judgment, nor is there any reason to suppose that, were the project once decided on, the able originators and administrators who have made the Museum of Art what it is, would fail to establish in like manner a sister Museum of Science.

There is no need yet to suggest an elaborately detailed scheme; what is required is exemplified in numerous foreign polytechnic institutes and conservatoires; it is also set forth very clearly in the Fourth Report of the Commission on Scientific Instruction. The idea should be to establish a museum—open free daily perhaps—which should illustrate all our industries, as fully as possible, by models and specimens—show the various applications of science to the arts, and mark the progress made in them. This and much more it should do, and if the proper organisation of a strong educational staff might be deferred, that should only be in order that such a staff might be the abler and stronger for its slower growth, if collected and arranged gradually as experienced pointed out requirements. The scheme is a large—a noble one, and it must eventually be accomplished; when better than now, when the time is so ripe, and so many converging circumstances all tend to the same point. I am, &c.,

W. T. H.

PATENT OFFICE MUSEUM.

SIR,—I have always understood that one of the axioms of constitutional government was the amenability of all, even the departments, to laws framed by the Government. We all know that the Civil Service is the subject of such a code, and all entering its lists do so on the understanding that these laws will not be departed from except for a very evident cause, at all events not on an assumption; and further, the Commissioners, as in the present case, ought to have taken good care that the propriety of their choice put it beyond question.

To my mind, the truth of the proposition, "The wider the field of choice for such a post as the one under discussion, the more likely it is that a good man will be chosen" is very doubtful, especially when this post is not the head, but in all respects subject to superiors in the same department. By an under basis of choice an intellectually superior man may be got, supposing unbiassed choice, but the want of departmental knowledge in such person will soon equalise his utility to the department with that of a very ordinary clerk, leaving out of the question the undoubted moral claim of an old servant, and the risk implied in a change.

The trite story of the round and square holes seems to me to carry a contradiction in the face of it, for, as your correspondent admits, the perversity depends on "luck;" but from the fact of a special training in a department which is implied in "rotation," it follows that the chances of round to round or square to square are infinitely greater than round to square or square to round.

I quite agree with your correspondent on the immense value of administrative ability, especially in the case of the Patent-office Museum, where immense improvements have to be made before the establishment can be even presentable to the public. Though I did not express in my last note a preference either one way or other as to the attainments of the curator, your correspondent has done so for me. Previously I had no very decided preference for an engineer by education; his letter has considerably strengthened that view. It is to my mind "part of the curator's duty to manufacture his models" in so far as on him depends the selection and attaching the proper value to contrivances, involves taking them to pieces, mentally sometimes rather a puzzling task, where a sound practical knowledge of machinery is of great value. Telford gave a very long definition once of a civil engineer, but your correspondent has succeeded, while detailing the qualifications he thinks necessary for the appointment, in giving a much neater one; his words are:—"An educated man and a man with a good general knowledge of practical and technical science he must be." Quite true. Continuing—"The one special qualification that would be useful would be a knowledge of the history of invention." It is only reasonable to suppose that those whose duty it has been to see, to speak of, and arrange specifications of inventions and models, would have as good a general notion of the history and progress of inventions as an outsider.

My main objection, however, is that such a proceeding (as the present) without sufficient reason, affects the whole of the servants in the department, from the youngest to the oldest; and your correspondent must remember that now departmental discipline is not the mysterious agency it once was. Now all must bear daylight, for were one to get it, all would get a change of some sort; if none, all are dissatisfied, for it affects all.

Again, a man entering the Civil Service voluntarily obscures himself for the Government; his chances of becoming famous by individual exertions are infinitely less than those of an outsider, on accounnt of the necessary red-tapeism in all departments; in the same proportion ought leniency and all assumptions be thrown on the side of the civil servant instead of, as now, casting the fact of their being civil servants against them as an objection.

In the above, all I contend for is the superiority of a sound, thorough-going, healthy, Civil Service, in which all have a chance of sharing the comforts of the higher posts—thus inciting the whole—as against one, now almost gone, bristling with famous men, the results of which we know.—I am, &c.,

C. E.

Westminster, May 15th, 1874.

MAJOR-GENERAL SYNGE, R.E., ON THE DIFFUSION OF SANITARY KNOWLEDGE.

SIR,—Allow me to say that when I spoke of an annual average mortality of the metropolis as from 22 to 26 per 1,000, I meant the entire population, and not the worst parts, where the mortality is probably more than double the average, just as in the best parts it is not much more than half. Again, when I spoke of dirty water and foul rivers, I did not say that either was desirable, but I did say that the evaporation from dirty water and from open foul rivers did not produce the amount of diseaso the General inferred took place. I for one will not offer obstructions to the spread of sanitary knowledge, but, unfortunately, I cannot agree with the teachings of General Synge any more than he agrees with mine; we must therefore each work upon independent lines of action.—I am, &c.,

ROBERT RAWLINSON.

London, May 18th, 1874.

GENERAL NOTES.

Assimilated Patent Systems.—The assimilation of the patent laws of England and the United States was the object of a deputation from the Associated Chambers of Commerce which waited on Lord Derby last month. The Foreign Minister said the subject came before him as a novelty, and while he felt disposed to encourage the step contemplated, he doubted whether the Americans were willing to co-operate. It is now proposed to form a deputation of the Americans in London, representing patent interests, to wait on Lord Derby, to assure his Lordship of the interest felt in the United States in this movement. The definite shape of the proposition of the Chambers of Commerce was a convention between England and America. The London members of the Executive Committee of the Vienna Patent Congress have the matter in hand, and, it is understood, propose to press it to an early conclusion.

Annatto.—In the two French colonies of Martinique and Guiana, there are more than 6,000 acres under culture with annatto (*Bixa orellana*), the annual produce being 3,000,000 pounds. Although French Guiana has nearly five times the extent of land under culture with this plant that Guadaloupe has, it only produces about two-thirds of the whole quantity. The production of annatto now exceeds the demand, as no fresh uses have been found for this colouring substance.

Colonial Museums.—The Industrial and Technological Museum at Melbourne is now an established institution. At Cape Town there is a museum. At Otago a museum is being formed. Jamaica and British Guiana have museums formed by their several Societies of Arts. The museum at Calcutta cost £120,000. At Bombay they have one, and in Ceylon the Governor is commencing the erection of a building for a museum of natural history, antiquities, and industrial products, which is to cost over £8,000.

Chicory.—The use of chicory, either alone or mixed with coffee, has largely extended, not only in most of the European States and Great Britain, but even in Australia, where the culture and manufacture is extensively carried on. In Victoria alone one firm purchased, last season, 500 tons, and a great quantity is imported. Of the raw or kiln-dried root, England imported, in 1872, upwards of 90,000 cwt., besides 6,000 or 7,000 lbs. of roasted or ground. The whole was valued at about £75,200, and was nearly all imported from Belgium. Last year, 1873, the imports of foreign chicory into England were 116,492 cwt., valued at £84,169. This is besides a large quantity of home-grown chicory.

Technical Education in Ireland.—Mr. C. H. Brien, in a lecture read a short time since at a meeting of the Agricultural Association of Ireland, on Technical Education, advocated an annual series of lectures or demonstrations by the senior members of the profession and scientific and artistic men of position, to be open to the general public, including our senior pupils at our great schools and such thoughtful workmen as might be from time to time met with, or might be recommended by their masters, or who might be students of a school of design or anxious to compete in an examination to be held at the close of the series. The history of architectural forms, he contended, and their geographical distribution; decoration in sculpture, mosaic, and glass-painting—in fittings and furniture; sanitary and other arrangements for comfort, convenience, or necessity, in hospitals, schools, churches, dwellings for poor and rich, could not fail to attract the general public, who are constantly concerned with these very matters.

Sleeping Cars.—We understand, says the *Engineer*, it is expected that a Pullman train will begin running on the Midland Railway, between London and Leeds, on the 23rd inst. It will comprise the Pullman palace cars, and ordinary American passenger coaches, provided with the improved brakes and couplers. The time-table, we understand, is arranged so that the trains will leave London at about midnight, making the run to Leeds in a little less than four hours. The trains will be shunted at Leeds, to permit passengers to occupy their sleeping berths till a convenient hour in the morning. The trip from Leeds to London will be made by daylight, in "parlour" or day cars, departing at 10.30 a.m. Upon the completion, early in the summer, of the Midland Company's short line to Liverpool, by way of Woodleigh station, the Pullman cars are to be put on the Liverpool route also.

Utilisation of the Chrysalids of Silkworms.—Attempts have been occasionally made in France to use silkworm chrysalids, when they can be obtained in large quantities, in various ways. One application was as a nitrogenous manure. The process employed consisted of passing the chrysalids, half dried, under a crushing mill, which reduced them to a dusty substance resembling bran. There was also obtained from the mill a kind of coarse waste silk, which has some value. As the chrysalids contain a certain amount of fat, efforts have been made to utilise the fatty acids for the fabrication of soap. Not much, however, has yet been successfully done in this respect, because the dark colour and bad smell of the product prevent it being mixed with other oils, or being even used for the manufacture of inferior soap. In other quarters they have tried to convert these chrysalids into cakes, in order that they might be kept longer, and sent to places where they could be used for fertilising land.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

The following arrangements for next Wednesday evening have been made:—

MAY 27.—Adjourned discussion on Captain TYLER's paper on "Simplicity as the Essential Element of Safety and Efficiency in the Working of Railways."

CHEMICAL SECTION.

These meetings are arranged for Friday evenings at 8 o'clock, and the following arrangements have been made for the concluding meeting:—

MAY 22.—"On the Manufacture of Chlorine." By W. WELDON, Esq., F.C.S. On this evening Professor A. WILLIAMSON, F.R.S., will preside.

CANTOR LECTURES.

The third course is by Professor BARFF, M.A., "On Carbon and Certain Compounds of Carbon treated principally in reference to Heating and Illuminating Purposes."

LECTURE VII.—MAY 26.

Consideration of furnaces, stoves, lamps, &c., in which the principles stated in the former lectures will be applied.

N.B.—As May 25 is Whit-Monday, this lecture will be postponed till Tuesday, May 26.

All the above Meetings and Lectures are open to Members, each of whom has the privilege of introducing two friends.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

MON. ...Linnæan, Burlington House, W., 3 p.m.

TUES. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Professor Barff, M.A., "On Carbon and Certain Compounds of Carbon, treated principally in reference to Heating and Illuminating Purposes." (Lecture VII.)
Royal Institution, Albemarle-street, W., 3 p.m. Dr. W. H. Stone, "On the Theory of Musical Instruments, with Musical Illustrations."
Medical and Chirurgical, 53, Berners-street, Oxford-street, 8½ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m.
Anthropological Institute, 4, St. Martin's-place, W.C., 1. Sir John Lubbock, "Note on the Discovery of Stone Implements in Egypt." 2. Mr. Hyde Clarke, "On Researches in Pre-historic and Proto-historic Comparative Philology, Mythology, and Archæology, in connection with the Origin of Culture in America, and its Propagation by the Sumerian or Akkad Races."
Royal Colonial Institute At Pall-mall Restaurant, Waterloo-place, S.W., 8 p.m. Mr. Frederick Young, "On New Zealand, Past, Present, and Future."

WED... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m., Discussion on Captain Tyler's Paper "On Simplicity as the Essential Element of Safety and Efficiency in the Working of Railways."
Geological, Somerset House, W.C., 8 p.m.
Archæological Association, 32, Sackville-street, W., 8 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.

THUR....Royal Institution, Albemarle-street, W., 3 p.m. Mr. N. S. Maskelyne, "On Physical Symmetry in Crystals."

FRI.......Royal United Service Institution, Whitehall-yard, 8½ p.m., Captain Hugh McNeil Dyer, "On the Siege of Carthagena."
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. The Very Rev. the Dean of Westminster, "On the Roman Catacombs as illustrating the Belief of the Early Christians."
Royal Botanic, Inner Circle, Regent's-park, N.W., 8 p.m. Prof. Bentley, "On the Reproductive Organ of Plants." (Lecture III.)

SAT......Royal Institution, Albemarle-street, W., 3 p.m. Mr. R. A. Proctor, "On the Planetary System."

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FRIDAY, MAY 29, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

IMPROVED RAILWAY LAMP.

The Society's Gold Medal, or Twenty Guineas, is offered for an improved lamp or means of illumination, suitable for railway passenger-carriages, that shall produce a good, clear, steady, durable, and safe light.

It must be simple in construction, and capable of being readily cleaned and repaired.

In judging the merits, cost will be taken into consideration.

Specimens in a condition suitable for trial to be sent in to the Society's House not later than the 1st of November, 1874.

The Council reserve to themselves the right of withholding the medal or premium offered, if, in the opinion of the judges, none of the articles sent in competition are deserving of reward.

PROCEEDINGS OF THE SOCIETY.

CHEMICAL SECTION.

A meeting of this Section was held on Friday, the 22nd inst., Professor A. Williamson, F.R.S., in the chair.

The Chairman, in introducing Mr. Weldon, said it was probably known to all present that he was the inventor of a process which had of late years come into extensive use for recovering in a form available for repeated employment a material of considerable value, and of which the available supply on the surface of our planet was, unfortunately, limited. It had been customary amongst manufacturers of chlorine, until lately, to allow the manganese which had been used for the evolution of the gas to run off as a waste product, and this of course occasioned very considerable expense from the necessity of buying fresh manganese for each operation. Mr. Weldon had, however, introduced a practical process for recovering the manganese from this waste product, and he need not say that such a process was a matter of considerable industrial importance in this country, where so much bleaching powder was made, and not only so, but the scientific idea which Mr. Weldon had worked out presented many points of considerable interest well worthy of attention.

The paper read was—

ON THE MANUFACTURE OF CHLORINE.

By W. Weldon, F.C.S.

There are two kinds of research which contribute to the progress of the industrial arts—that which we call purely scientific, and which has for its sole object the extension of our knowledge of natural phenomena, and that which is directed to the end of what is termed invention, and which aims at increasing the material well-being of mankind, by providing new appliances for the comfort or convenience of life, by producing new commodities useful or pleasant to man, or by the cheaper or otherwise more advantageous production of commodities already known and used. The industry of chlorine differs from all the other great chemical industries, excepting only the most recent of them, that of the coal-tar dyes, in having sprung directly from the first of these two kinds of inquiry; and I could not speak to you on the subject of the chlorine manufacture, in this centenary year of the triple discovery to which that manufacture is entirely due—the discovery, namely, of the existence of the body called chlorine, of the most effective method yet known for obtaining it, and of that one of its properties for which it is now so largely employed in the service of man—without commencing by reminding you of how much of the difference between the England of to-day and the England of a century ago is due to this result of the earnest pursuit of pure scientific truth by that then assistant to a provincial Swedish apothecary who has rendered for ever illustrious the name of Scheele. Within the hundred years which have now elapsed since this discovery, the annual value of the cotton goods manufactured in Great Britain has risen from something less than two hundred thousand pounds to close upon one hundred millions sterling. To this stupendous growth of what is now our greatest industry, we owe, in very large part, the vast development of all other of our industries, and the enormous increase in the numbers, wealth, and comfort of our population, which has accompanied it; and although the largest part towards this result has no doubt been contributed by mechanical invention, not even the steam-engine, the carding-machine, the spinning-jenny, and the power-loom could have produced our modern Manchester, and all that it represents, without the aid of that discovery in pure science which rendered it possible to perform in a few hours, in a workshop in a town, at any season, and in any climate, that operation of bleaching which forms an essential part of the preparation for sale of most kinds of cotton goods, and which previously occupied at least four months, could be carried on only in the open country, could be well performed only at certain seasons, and could be best performed, for reasons of climate, only in certain countries, of which England is not one, and which moreover required an enormous expanse of green field, which it withdrew entirely from agricultural service. The discovery of chlorine, and of its property of destroying vegetable colours, is thus to be counted as not the least among the causes of the marvellous industrial progress of the last hundred years; and we have also to claim for it whatever influence upon the incalculably beneficent activity of the printing-

press may be due to our command of a practically unlimited supply of white paper. Notwithstanding the continually increasing production of bleached vegetable textile fabrics, and consequently of white rags, the demand for paper for printing has long outstripped the supply of it from that source; and if it were not for chlorine enabling us to make white paper, not only from coloured rags, but also from straw, Esparto grass, wood, refuse jute, and many—at first sight—still less promising materials, while it is perhaps conceivable—for my own part I cannot think it is—that books and newspapers would nevertheless have been as cheap and as abundant as they actually are, they must at least have been printed on a material which at best could have been only whitey-brown, and so must have been far inferior, both in convenience and in attractiveness, to the books and newspapers we actually have. They certainly could not have been such that those who ran might read them. The history of science abounds with instances of practical benefit to mankind resulting from single-minded inquiry into the facts of nature, by inquirers who neither sought or received any reward but the satisfaction of extending human knowledge of the phenomena of the marvellous universe amid which we are placed; but it seems to me that of all such instances which have yet arisen, by far the most striking and the most worthy to be held in remembrance—although it is certainly not the one which is most generally recognised—is that which is afforded by the results of the discovery upon which is founded the important industry of the latest phase of which it is my duty this evening to offer you some account.

This discovery Scheele arrived at in the course of a research with respect to the nature and properties of a black mineral substance, a sample of which you see on the table. This substance is now known commercially as "manganese," and contains a large proportion of the body which chemists call manganic peroxide. Scheele treated this substance with every reagent that was known to him. In the course of his investigation, he thus came to boil it with hydrochloric acid. We will repeat this experiment, in the hope of showing you, at least in substance, what Scheele then found to happen. In one of the flasks on the table below is some manganic peroxide, the essential constituent of the mineral upon which Scheele's experiments were made, and Mr. Bunker will pour upon it some hydrochloric acid, and then apply to the flask the heat of a gas-flame. As it will take him a minute or two to obtain our desired result, I will call your attention, in the meantime, to the commencement of another experiment, which it will require nearly an hour to complete, and which it is therefore desirable that we should commence as soon as possible. We have here three jars containing a pink solution, the nature of which I will explain to you by-and-bye. To the contents of one of the jars I add a certain quantity of milk of lime, to the contents of the second jar another quantity of milk of lime, and to those of the third jar an equivalent quantity of solution of caustic soda. In each of the three jars we have now a white precipitate, suspended in a colourless solution. We shall now begin to send a current of air through the contents of all the jars, and by-and-bye I shall have to call your attention to the results which I expect it will have produced. I will now only ask you to observe from time to time the changes which I expect will take place in the colour of the contents of the jars.

Coming back now to this experiment of Scheele's, he found that on boiling his mineral with hydrochloric acid, a gas was given off which had a green colour and a most penetrating odour, and which produced very painful effects when respired, powerfully attacked all the metals, and completely destroyed the colour alike of flowers and of green leaves. He called this gas "dephlogisticated muriatic acid;" but Sir Humphry Davy afterwards gave it the better name of chlorine. The two jars which we have connected with our flask are now pretty well filled with it, and by daylight you could have seen the green colour of the gas in them, but by gas-light I fear it will be barely, if at all, perceptible. Its odour, and its effect upon the organs of respiration, we hope to avoid giving you experience of. I can assure you, with some authority, that they are not agreeable. Mr. Bunker, however, will show you that he has chlorine in the jars, and at the same time illustrate that property of attacking the metals which Scheele observed, by admitting into one of them a little powdered antimony. The attack is so rapid and energetic that as the antimony falls through the chlorine contained in the jar you observe there is actual incandescence. Into the other jar containing chlorine I will ask Mr. Bunker to introduce a piece of dyed calico, and I think you will see that its colour will be immediately discharged.

The idea of the practical application of this bleaching property did not occur to Scheele himself, but was the result of Berthollet's repetition of Scheele's experiments, some ten or twelve years later. Berthollet was then director of the Gobelins, and in that capacity had charge of dyeing and bleaching operations; and having found that a solution of chlorine in water bleached as readily as the gas itself, it occurred to him that a brief immersion in such a solution might be substituted for that long exposure to sun and air which up to that time had been the only known means of bleaching vegetable textile fabrics. In each of these jars I have some solution of chlorine in water, and to show you Berthollet's method of bleaching, I will introduce into one of them a piece of brown calico, and into the other a piece of calico which has been dyed. After a little time both pieces of calico will have become perfectly white.

Curiously enough, considering how much assistance chlorine was destined to render in the development of the application of the steam-engine, this idea of Berthollet's was brought to this country by James Watt; and the first piece of goods ever bleached by chlorine in Great Britain was bleached under Watt's personal superintendence, at the bleach-field of his father-in-law, near Glasgow, in the year 1787, being the year of Scheele's death. The process soon spread into nearly all the bleach-works of Great Britain; but it was attended by two serious inconveniences. Owing to chlorine-water being practically incapable of transport, each bleacher had to manufacture his own chlorine; and owing to its tendency to give off its dissolved gas, its use was all but intolerable to the workmen. Many attempts

were made to remedy these disadvantages, and they finally resulted, in 1798, in the discovery, by Mr. Charles Tennant, of Glasgow, that dry slaked lime would absorb more than half its weight of chlorine gas, giving a product—since become so well known as "bleaching-powder," or chloride of lime—which could be stored and transported with the utmost facility, and which would yield, on treatment with water, a bleaching solution, having all the advantages of chlorine-water, without either of its disadvantages. I am not sure that our time will permit our doing so, but we propose to try to make a little of this product. At the bottom of the glass trough on the table there is some dry slaked lime, and Mr. Bunker will put a cover on the trough, and then send into it a little chlorine, which he will generate, this time by means of a product similar to that which we hope to produce in two of the jars into which we are blowing air. I will ask him, however, first to take out a little of the lime, in order that, if our time permits us to complete the experiment, you may see the difference between the body which we put into the trough and the product which we hope to take out of it.

When Mr. Tennant first manufactured bleaching-powder, he sold it at one and sixpence per pound. Its present price is about £10 per ton, or very little over one penny per pound. Of it, and its equivalent in chlorate of potash, we now make in Great Britain one hundred thousand tons per annum, so that the annual value of the British chlorine manufacture is just about a million sterling. We manufacture in Great Britain rather more than two-thirds of the total chlorine made in the world.

The ultimate raw material of this manufacture is the universally familiar substance, common salt. We are fortunate in possessing in Great Britain enormous mineral deposits of this substance, those in some parts of Cheshire, for example, being more than two hundred feet thick, and this over an area of many miles. The salt exists in these deposits as a compact crystalline rock, of a reddish colour, due to the presence in it of small quantities of oxide of iron. A sample of it lies upon the table. Comparatively little of it is brought to the surface in that state, the greater portion of our output of salt—which reaches the enormous amount of one and three-quarter millions of tons per annum—being pumped up in the state of "brine," formed by the action on the rock salt of the water which infilters down to it through the superincumbent soil, and this is pumped up by the landowners or their lessees, and supplied by them to the salt manufacturers at a price sometimes as low as twopence, and I believe never exceeding sixpence, not per quantity of brine containing a ton of salt, but, so as to allow for any amount of loss in the process, per ton of salt actually turned out by the manufacturer. All that the salt-manufacturer has to do is to concentrate the brine by evaporation, and fish out from time to time the crystals which then form, and which collect at the bottom of the evaporating pan. According to the temperature at which he performs this evaporation, he produces salt of such fine grain as we are familiar with in table salt, or such very coarse-grained salt as is used for curing fish, or salt in the state of those still larger and most exquisitely beautiful crystals known as "Diamond Bay salt," or salt in crystals of an intermediate size. Samples of all these kinds of salt, most courteously supplied to me by Messrs. Fletcher and Rigby, of Northwich, are upon the table. The intermediate grain being cheaper to produce than either the very small or the very large, is preferred for that reason by the manufacturers of alkali and chlorine; and salt of that grain is hence known in the trade as "chemical salt." To produce a ton of salt of this kind requires about half a ton of coal; but the manufacturer can nevertheless sell it, even with fuel at its present price, at twelve shillings per ton, and for the ten years preceding the recent rise in the price of coal its average selling price did not exceed seven and sixpence per ton. One of the causes of our pre-eminence in the chlorine manufacture is thus cheaper salt than is as yet at the command of any other people in the world.

It is remarkable that this substance, which forms so essential a constituent of the food of man and of all animals, is a compound of two bodies, either of which, in the free state, would prove utterly destructive to any animal organism: namely, chlorine, the most energetic of known gases, and the metal sodium, one of the most energetic of known solids. I have here a sample of the latter constituent of our salt. It is immersed in naphtha, to protect it from the atmosphere, from which it would instantly absorb oxygen, as indeed the lumps constituting our sample have already done on the surface; but if I take a piece of it out of the naphtha and cut it with a knife—it is nearly as soft as cheese—you will be able to see its metallic lustre, although only for a moment. It is a metal so light that it floats on water, and possessed of so much chemical energy that it instantly decomposes water, forming a solution of caustic soda and liberating hydrogen gas. Mr. Bunker will put a little piece of it into a dish of warm water under a bell-glass on the table below. The action, you see, is so violent, and produces so much heat, that both the hydrogen which it liberates, and a portion of the sodium itself, take fire.

The proportions in which the salt contains these constituents are those of thirty-five and a half parts by weight of chlorine to twenty-three parts by weight of sodium. Of the total weight of pure salt, therefore, between sixty and sixty-one per cent. consist of chlorine. A cubic foot of it contains a quantity of the metal which in the free state would occupy about five-sixths of a cubic foot, and, in addition, a quantity of the gas which would occupy, in the free state, at the average pressure of the atmosphere, not less that 450 cubic feet.

In the manufacture of chlorine as at present conducted, free chlorine is obtained from the salt, not directly, but by two successive operations, the first of which consists in the decomposition of the salt by sulphuric acid. We have some salt in a flask on the table, and if Mr. Bunker pours upon it some sulphuric acid, there will be given off an acid vapour, which I hope we shall be able to condense in this little glass tower. This tower is packed with small pieces of coke, down which water from the little cistern above is kept trickling, and if we are successful in our experiment, the acid vapour

given off from the flask and conveyed first through a cooling jar and then into our little tower, close to the bottom, will dissolve in the water with which the coke is kept moistened, and an aqueous solution of the acid vapour will eventually run from the bottom of the tower into the beaker which you see placed to receive it. In the beaker is a little solution of blue litmus, and you will see when an acid solution begins to run from the tower by the blue colour of the litmus being changed to red.

What takes place when salt is treated by sulphuric acid is represented by one of the diagrams on the wall. Chemists use for salt the symbol NaCl, Na representing twenty-three parts by weight of sodium, Cl thirty-five and a half parts by weight of chlorine, and NaCl a compound containing the two bodies in those portions. Sulphuric acid is similarly represented by H_2SO_4, H standing for one part by weight of hydrogen, and therefore H_2 for two parts by weight of that body, and SO_4 for ninety-six parts by weight of a certain compound of sulphur and oxygen. When two proportions of NaCl, or common salt, each containing twenty-three parts of sodium and thirty-five and a half of chlorine, are treated with one proportion of sulphuric acid, containing two parts of hydrogen and ninety-six of SO_4, the sodium of the salt leaves its chlorine and unites with the SO_4 of the sulphuric acid, taking the place of the hydrogen of that compound, and the hydrogen thus removed from the sulphuric acid unites with the chlorine of the salt, taking the place which the sodium has forsaken. The two original compounds cease to exist, and instead of them we get two new compounds. Instead of H_2SO_4 we get Na_2SO_4, and instead of 2NaCl we get 2HCl. Perhaps the middle part of the diagram, in which one of the constituents of the salt and one of the constituents of the sulphuric acid are marked in red letters, and the other constituent of each in black letters, will make these transpositions clearer. The constituents marked in red go together, and the constituents marked in black go together. The product marked in black, Na_2SO_4, or sodic sulphate, is what the manufacturers call "salt-cake." It contains all the sodium of the salt, and by fusion with limestone and coal is made to yield carbonate of soda. The product marked in red contains all the chlorine of the salt, and is the compound now known as hydrochloric acid, and formerly called muriatic acid, or "spirits of salt."

Of the apparatus employed for the decomposition of salt by sulphuric acid on the large scale, I have here a diagram. At one end of it is a shallow circular vessel, or "pot," as it is called, from seven to ten feet in diameter, and made of very thick cast-iron. This vessel has a fire under it, and is domed over with brick. The salt is put into this pot in charges of from five to ten hundred weight each, hot sulphuric acid is then poured in, the fire is kept up, and the charge is occasionally stirred by the workman with a long iron rabble. Now, although the ultimate result of the action of sulphuric acid upon salt is that represented by the equation—

$$2NaCl + H_2SO_4 = Na_2SO_4 + 2HCl,$$

this result has really to be attained by two stages, during the first of which, represented by

$$2NaCl + H_2SO_4 = NaHSO_4 + NaCl + HCl,$$

only half the salt is decomposed, the second half of the salt being afterwards decomposed in accordance with the equation

$$NaCl + NaHSO_4 = Na_2SO_4 + HCl.$$

The second stage of the reaction requires a temperature much higher than the first stage of it requires, and much higher than could be used with safety in the iron pot; therefore, as soon as the charge in the pot, which the sulphuric acid at first renders quite liquid, has become pasty, so that there is no risk of its running through a brick bed, which is usually at the end of a little less than an hour, the workman pushes it out of the pot, through an aperture arranged for the purpose, on to the bed of a furnace built of refractory brick, on which it is exposed to nearly a red-heat. Of the two successive reactions which have to be effected before the salt is completely decomposed, there takes place in the pot the whole of the first and so much of the second that about two-thirds of the salt is decomposed in the pot, the proportion which has to be decomposed in the furnace rarely exceeding one-third. The furnace shown in the diagram is a muffle-furnace, such as is used throughout the Lancashire district, and in Glasgow; but in the Newcastle-on-Tyne district reverberatory furnaces are usually employed. Where reverberatory furnaces are used, the condensing apparatus employed for the hydrochloric acid gas generated in the furnace is distinct from that employed for the hydrochloric gas generated in the pot; but where muffle-furnaces are employed, the gas from both pot and furnace go to the same condensing apparatus, as represented in the diagram. The gas is first conveyed either through cooling cisterns or through some arrangement of cooling pipes, and then enters a condensing tower, such as we have a model of now at work on the table below. These towers are usually about six feet square, and vary in height from thirty feet to sixty, seventy, or even a hundred feet. They are usually built of stone flags, clamped together by iron tie-rods, and are packed with small pieces of coke, down which water is kept trickling. The gas enters at the bottom, and in passing upwards through the interstices between the pieces of continually moistened coke comes into contact with an enormous surface of water; and as it is a gas which is extremely soluble in water, if the tower is properly constructed, and properly proportioned to the quantity of hydrochloric acid gas which it is to receive, none of the acid ever reaches the top of the tower, all that enters it at the bottom as gas becoming converted into aqueous solution before any of it can get to the top. It is common, however, to have a second tower so connected with the first that any gas which may escape condensation in the first tower shall pass from the top of it to the bottom of the second tower, and be condensed in that. I need hardly remind you that this method of condensing hydrochloric acid is one of the many important inventions of Mr. William Gossage.

The use of an iron vessel for an operation in which sulphuric acid is employed, and hydrochloric acid generated, at a high temperature, is so contrary to laboratory ideas, that it may be interesting to mention that when a "salt-cake pot" is per-

mitted to fairly wear out, and is not broken by sheer carelessness and neglect on the part of the workman, as is unhappily nowadays too often the case, as much as three thousand tons of salt may be decomposed in one. The average life of a salt-cake pot is barely fifteen hundred tons of salt decomposed in it; but this is because so many pots get broken, either by the workmen neglecting to properly stir the charges in them, or by their charging heated pots with too cold materials. The wear of the pot is chiefly due to the action of the hydrochloric acid generated in it, and this action is also one of the causes of the yellow colour of commercial hydrochloric acid. Pure aqueous hydrochloric acid is quite colourless, but commercial hydrochloric acid has the yellow colour you see in this sample of it, owing to the presence in it of a small quantity of ferric chloride, due partly to the action of the aqueous acid on the coke in the condensing towers, but partly also to the action of the acid gas on the inner surface of the salt-cake pot. A little ferric chloride is formed in the pot, and flies over with the hydrochloric acid gas, and is condensed with it.

Another interesting point about salt-cake pots is that, within certain limits, like certain other good things, the older they are the better they seem to be. There are some manufacturers who always keep their pots two or three years before using them, insisting that pots thus "seasoned," as they call it, are far less liable to breakage than pots more recently made. I believe it is really the fact that pots which have been long kept are much more durable in use than new pots; although, seeing that the pots are masses of cast iron, five or six inches thick at the bottom, tapering to one or two inches thick at the top, why this should be so is not at first blush quite intelligible.

The operation in which salt-cake pots are used, and which I have endeavoured to describe, being the first step, not only in the manufacture of chlorine, but also in a still more important manufacture, that of soda, it is one of such moment that I cannot pass without mention a most important attempt which is now in progress, and which bids fair to be most successfully realised, to perform this operation in another and a very much simpler manner. Before salt can be decomposed by the method at present in universal use, sulphuric acid has to be manufactured. This is done by burning off into sulphurous acid gas, or SO_2, the sulphur contained in that native compound of sulphur and iron which is known as pyrites, and of all the properties and uses of which Dr. Wright gave us in this room so extremely clear and complete an account a month ago, and then sending this SO_2, mixed with air, steam, and vapour of nitrous acid, into vast leaden chambers, in which, by the aid of the carrying action of the nitrous acid, the SO_2, unites with a third equivalent of oxygen, derived from the air which enters the chamber with it, and thus becomes converted into SO_3, which unites with the steam present to form sulphuric acid, or H_2SO_4. This H_2SO_4 collects at the bottom of the chamber, diluted with a considerable quantity of water, and before it can be used for the decomposition of salt much of this surplus water has to be evaporated off from it. To produce the quantity of sulphuric acid required to decompose 100 tons of salt per week, requires leaden chambers of the enormous capacity of somewhere about 160,000 cubic feet. My friend Mr. James Hargreaves, working in conjunction with Mr. Thomas Robinson of Widnes, has for some years been sedulously endeavouring to realise the idea of avoiding the necessity for this preliminary manufacture of sulphuric acid, and of obtaining salt-cake on the one hand, and hydrochloric acid on the other, by the direct reaction upon salt of a mixture of suphurous acid gas, air, and steam, being the same mixture that at present goes into the sulphuric acid chambers, except that it does not contain that very costly element of the latter mixture, nitrous acid. To illustrate his mode of proceeding, Mr. Hargreaves has been so good as to supply me with some samples. His first step is to moisten his salt with water, and spread it upon iron plates, heated from below, but only to a low temperature, so as to dry the moistened salt very slowly. He thus obtains the salt in hard but very porous masses, a piece of one of which lies on the table. He breaks these up by machinery into smaller pieces of uniform size, and these he charges into vertical cast-iron cylinders, from ten to fifteen feet in diameter and from ten to twelve feet high. Arrangements are made for applying heat to the cylinders externally, and when the salt in them has attained a temperature of about 800° Fahr. he sends into the cylinders the gases from pyrites burners, mixed with air and steam. He employs a series of from six to ten cylinders, and so arranges them that the gases pass in at the top of the first cylinder, then pass from the bottom of the first cylinder to the top of the second cylinder, then down through the contents of the second cylinder, out at the bottom of it, and in at the top of the third cylinder, and so on. The mixture of gases will not act on the salt below a temperature of about 800° Fahr., but when that has been attained by the salt the external heating is discontinued, the heat of the gases themselves, together with that generated by the reaction upon the salt, being afterwards quite sufficient to keep up the required temperature. When the salt in the first cylinder is completely converted into salt-cake, the charge is withdrawn from it, fresh salt is put in, and what was the second cylinder of the series now becomes the first, while that which was the first, and is now newly charged with salt, becomes the last of the series. It takes from a fortnight to three weeks to completely convert the salt into salt-cake, but after that period from the commencement of the process has once elapsed, a cylinder, containing from fifteen to forty tons of salt-cake, becomes ready to be discharged every day, or every few days, according to the number of cylinders employed. The reaction which goes on in the cylinders may be represented by the equation—

$$2NaCl + SO_2 + O \text{ (from the air)} + H_2O = Na_2SO_4 + 2HCl.$$

The hydrochloric acid passes off as gas, and is condensed in coke towers in the usual way, and the salt-cake comes out of the cylinders in the state in which you see it in the sample on the table, in exactly such lumps as the salt went into them. For nearly a year past Mr. Hargreaves has been making from thirty to forty tons of salt-cake per

week by this process, with such success that five large manufacturers are now building plant for it on a very extensive scale; and there seems every reason to expect that by-and-bye Mr. Hargreaves will find himself rewarded for many years of most patient and persevering labour on this process by seeing it, if not universally adopted, which can hardly be hoped for in a single lifetime, at least invariably preferred to the process in use now whenever new plant has to be erected or old plant to be replaced. He will thus have been the first to effect any important change in what is unquestionably the most important of all the operations conducted by industrial chemists.

The chlorine of our salt having been driven off from it as hydrochloric acid gas, and this gas having been dissolved in water, the next step in the manufacture of chlorine is to treat this aqueous hydrochloric acid with manganic peroxide. The reaction which then takes place is that represented by the equation:

$$4HCl + MnO_2 = MnCl_2 + 2H_2O + 2Cl.$$

The manganic peroxide, or MnO_2, is a compound of the metal manganese with two equivalents of oxygen, and its oxygen combining with the hydrogen of the hydrochloric acid to form water, one half of the chlorine of the hydrochloric acid —say the part which is represented on the diagram on the wall in red letters—combining with the manganese to form $MnCl_2$, or manganous chloride, and the other half—represented on the diagram in blue letters—being set free. Six years ago, all the chlorine made in the world, except a certain portion of that manufactured at Glasgow, by Messrs. Charles Tennant and Co., the firm founded by the inventor of bleaching-powder, was obtained by digesting hydrochloric acid with native manganese ore: by exactly the method, in fact, by which chlorine was originally obtained by Scheele. In this country, the process was performed in square or oblong stills, built of silicious flags, and each provided with a false bottom, also of flags. One of these stills is shown in section on one of our diagrams. The manganese ore having been charged in lumps on the false bottom, through a man-hole in the top, hydrochloric acid was admitted, and then, the man-hole having been first closed, steam was injected by means of a tube made by boring a hole through a block of stone. Chlorine went off slowly, the operation usually lasting from forty-eight to ninety-six hours; and there at length remained in the still only the silicious and other insoluble portions of the manganese ore, and a liquid residue familiar to the manufacturers as "still-liquor."

Now, if manganese ores consisted solely of MnO_2, and if it were possible to make an equivalent of MnO_2 react on four equivalents of hydrochloric acid without using an excess of the acid, the liquid residue of this operation would have been simply a solution in water of manganous chloride: the only products of the reaction upon each other of MnO_2 and HCl being, as shown on our diagram, free chlorine, water, and manganous chloride, or $MnCl_2$. To utilise all the MnO_2, however, in a substance so hard and compact as manganese ore requires a very large excess of hydrochloric acid; and these ores moreover contain many bodies besides MnO_2, and especially considerable quantities of peroxide of iron. Instead, therefore, of being a practically neutral, wholly inodorous, and bright pink solution of manganous chloride, such as that of which I have a sample here, the residue of the treatment together of hydrochloric acid and manganese ores is a strongly acid, dark yellow, ill smelling liquid, containing a large quantity of that strongly acid salt, ferric chloride, and a still larger quantity of free hydrochloric acid. Of the total chlorine in it, one half is very frequently in the state of free HCl. Except in Messrs. Tennant's case, this product, down to six years ago, was simply poured into the nearest stream; and a product more unfit to go into an inland river it would be difficult to conceive. It is utterly destructive to fish, rapidly injures both the iron-work and the masonry of bridges and the like, and renders the water of the river poisonous to the land when carried on to it by floods, and entirely unfit for either manufacturing or domestic use. Being produced only in districts in which soda is manufactured, it had the still worse fault of being a prime agent of atmospheric contamination, seeing that it encountered in the streams the drainings from the tank-waste heaps, and reacted upon them with evolution of enormous volumes of sulphuretted hydrogen.

At the time I speak of, the extremely offensive nature of this product had already led to countless attempts to dispose of it otherwise than by sending it into the water-courses; and the fact that native manganese is not an abundant substance, and is therefore a costly one, had caused nearly all these attempts to take the direction of the regeneration from this product of manganic peroxide, for use over again. Of all the processes proposed to this end, the only one which had attained practical success was one which was invented by the late Mr. Charles Dunlop, of Glasgow, and the successive operations of which are represented on another of our diagrams. In Mr. Dunlop's process, the still-liquor is first treated with carbonate of lime, to neutralise its free acid and decompose its ferric chloride; the resulting ferric oxide is then separated by subsidence and decantation; and the clear liquor is then a second time treated with carbonate of lime, this time at a high temperature and under considerable pressure. In the first treatment with carbonate of lime, the manganous chloride in the liquor was not in the least acted upon; but in this second treatment with carbonate of lime, in closed boilers, under a pressure of several atmospheres, and at the temperature corresponding to the pressure employed, the manganous chloride is entirely decomposed; and whereas what went into the boilers was solid calcic carbonate suspended in solution of manganous chloride, what comes out of the boilers is solid manganous carbonate suspended in solution of calcic chloride. The manganous carbonate is then separated from the calcic chloride by subsidence, decantation, and thorough washing; and is then dried and charged into little waggons which are passed slowly through an oven in such wise as to expose the manganous carbonate for forty-eight hours to a current of hot air. The carbonic acid of the carbonate is thereby completely expelled, oxygen is absorbed, and the white carbonate is converted into a soot-like product, containing about 72 per cent. of

MnO_2. A sample of this product, and one of the carbonate from which it is made, you observe upon the table.

This very ingenious and extremely beautiful process was adopted in 1857, for the larger part of their enormous production of chlorine, by Messrs. Charles Tennant and Company, who have kindly supplied the samples I am enabled to show you, and who were not only the first, but have always been, and are still, the largest makers of bleaching-powder in the world; and hence the exception which I made a little time ago in saying that, six years since, all the chlorine manufactured, a portion of theirs only excepted, was obtained by means of native manganese. Mr. Dunlop's process, however, has never extended beyond Messrs. Tennant's great work at Glasgow; and although they are still using it there, Messrs. Tennant themselves, in their almost equally great new work near Newcastle-on-Tyne have adopted instead of it another process, which has now become nearly universal, which is known by the name of the present lecturer, and which I shall now proceed to describe to you as briefly as I can.

This process is performed in an apparatus of which we have here a diagram. The vessels comprised in it are arranged, you see, at five successive elevations. The lowest of them is a well, sunk in the ground, and furnished with a mechanical agitator. The residual product of the manufacture of chlorine by means of native manganese —such as you see it in this sample, only hot, and reeking with acid vapour—is run into this well, the agitator is put in motion, crushed limestone is thrown into the well, and in the course of half-an-hour the free acid at first contained in the liquor has become completely neutralised, and the ferric chloride which accompanied it completely decomposed. The liquor now consists of a perfectly neutral mixed solution of manganous chloride and calcic chloride, holding in suspension some ferric oxide, and, in smaller quantities, a few other solid bodies. This is pumped up into settling-tanks placed at the top of the apparatus; and here in a short time the suspended matters settle out, and we have above them a beautifully clear faintly rose-coloured solution, of which I have a sample in this beaker. This clear solution is run off into a tall cylindrical vessel, made of wrought-iron, and placed immediately below the vessels in which the liquor has settled. This vessel, called the "oxidiser," is usually eleven feet in diameter, and thirty feet deep. A pipe for conveying a current of air from a blowing engine, not shown on the diagram, goes down the centre of it, and terminates at the bottom in an arrangement of distributing pipes. The liquor from the settlers usually goes into the oxidiser at a temperature of about 140° F., and if it has fallen below that temperature it is heated up to it, in the oxidiser itself, by injection of steam. The liquor being or having been made hot enough, the injection of air is commenced, and there is then rapidly added, in the state of very fine milk, 1·6 times the quantity of lime equivalent to the manganese in the liquor. This converts the charge into a thin white mud, such as I produce by adding milk of lime to the sample of the liquor in this beaker. This thin white mud consists of solution of calcic chloride holding in suspension an oxide of manganese, known as manganous oxide, or MnO, which contains only half as much oxygen as is contained in manganic peroxide, or MnO_2, and also holding, partly in suspension, but partly in solution, six-tenths of an equivalent—reckoned on the manganese present—of free lime. When a little of this white mud is thrown on to a filter, the clear filtrate is naturally found, owing to the quantity of free lime present, and to the powerfully solvent action upon lime of hot solution of calcic chloride, to possess a strongly alkaline reaction. As the injection of air goes on, the mud becomes gradually darker and darker in colour, owing to the white hydrated MnO becoming converted into black MnO_2 by absorption of oxygen from the injected air, what was originally a thin white mud being at length converted into a thin black mud, such as we have a sample of in another of these beakers. During the progress of this conversion of the originally white mud into a black mud, it is found that the alkaline reaction of the filtrate from the mud gradually diminishes in intensity, until at length it entirely disappears; and it is also found that when this alkaline reaction ceases, the absorption of oxygen from the injected air ceases also. When this stage is reached, which is at the end of two, three, four, or five hours, according to the relation between the size of the oxidiser and the size of the blowing-engine employed, a little more liquor is run into the oxidiser from the settlers above, the injection of air is continued for a few minutes longer, and the charge is then run off from the oxidiser into one or other of a range of settlers placed below it. In these it separates, in the course of a few hours, into rather more than half perfectly clear solution of calcic chloride, of which we have here a sample, and a little less than half black mud of rather more than twice the density of that which left the oxidiser. The solution of calcic chloride is now decanted, and the settled mud is then ready for use for the liberation of chlorine from hydrochloric acid. To this end it is employed in stills which are very much larger than those used for the generation of chlorine by means of native manganese, but which are constructed of the same material, and in the same manner, as native manganese stills, except that they are usually octagonal, instead of square, like the latter; and instead of being charged, like native manganese stills, first with manganese and then with acid, the acid is put into them first, the mud being then run in upon the acid, through a luted opening, in a gentle stream, regulated at will by a cock. Steam being gently injected at the same time, the mud dissolves almost immediately on reaching the acid, and chlorine comes off in an even current, the force and flow of which can be regulated with the utmost nicety by regulating the admission of the mud. When all the acid has been decomposed and neutralised, except to the extent of from six to eight ounces of HCl per cubic foot, which at some works is at the end of two hours, and at others at the end of from four to six hours, the contents of the still are run off into the well placed below it, and there the round of operations which I have described is recommenced. Except to the extent of a certain mechanical loss, the

cause of which I fear I shall not have time to explain, the same manganese is thus made to serve for the generation of chlorine over and over again, being successively transformed from the state of MnO_2 to that of $MnCl_2$, from that of $MnCl_2$ to that of MnO, and from that of MnO again to that of MnO_2, time after time, indefinitely. The manganese in the black mud I exhibit has already undergone all these transformations, at least eight or nine successive times, in the course of practical operations, at the great works of the Newcastle Chemical Works Company, who make 230 tons of bleaching-powder per week by this process; the manganese in this white mud and in these liquors has done the same, at the works of Messrs. Hugh Lee Pattinson and Co.; and the manganese in all of them is capable of undergoing the same transformations again, any required number of times. At some works the entire stock of manganese undergoes all these transformations every twenty-four hours.

I will not occupy your time with any statement of those commercial advantages of this process, owing to which, of the 100,000 tons of bleaching-powder made annually in Great Britain, about 60,000 are now being made by it—we have not yet actually made 60,000 tons in any one year, but I believe that the production by it has now attained that rate—while plant for the greater portion of the remainder is now in course of construction; but for the information of any one who may be interested in that matter I have hung on the wall a tabular statement setting side by side the various items of the cost of a ton of bleaching-powder made by this process, and the corresponding items of cost of a ton of bleaching-powder made by means of native manganese. Those of its advantages which to myself individually afford the greatest satisfaction are: firstly, that it enables the manufacture of chlorine to be carried on entirely without offence to the neighbourhood, its only residual product—this perfectly clear, perfectly neutral, and indeed chemically pure, solution of calcic chloride—being one which is entirely innocuous, and which, to quote one of the Reports of the Rivers Pollution Commission, "can be sent into the rivers with no other effect than that of rendering the water a little harder;" secondly, that it does away to a very great extent with an operation which to the workmen employed on it was of a most offensive kind, that of charging and cleaning out native manganese stills; thirdly, that if it does not effect the proverbial benefit of making two blades of grass grow where only one blade grew before, it at least enables four tons of bleaching-powder to be made from the quantity of acid formerly employed, on an average, for three; and lastly, if I may be allowed to put the matter in the way in which the utilisation of previously waste substances always presents itself to my mind, by turning to continual account a valuable substance which was formerly used only once and then thrown away, it adds another to the instances, which of late years have begun to be so numerous, of industrial obedience to the Divine injunction: "Gather ye up the fragments, that nothing be lost."

I should much like to explain to you what takes place in the fundamental operation of this process, that which is performed in the oxidizer, because it results in the formation of compounds which were not known until they were produced in this process; but as I have already occupied you so long, the explanation must be a very brief one. We saw some time ago that when manganic peroxide, or MnO_2, is employed to liberate chlorine from HCl, the manganese of the manganic peroxide passes into the state of manganous chloride, or $MnCl_2$. By treating this manganous chloride with lime, we instantly transform it into manganous oxide, or MnO, in accordance with the equation:

$$MnCl_2 + CaO = CaCl_2 + MnO.$$

This MnO, however, cannot liberate chlorine from hydrochloric acid; its reaction with HCl,

$$MnO + 2HCl = MnCl_2 + H_2O,$$

simply reproducing manganous chloride, and producing water. A glance at one of the diagrams to which I have already drawn your attention will show that that part of the oxygen in MnO_2 which liberates chlorine from hydrochloric acid is in fact only the portion which it contains in excess of the quantity contained in MnO. Therefore, to get into the state in which it can be used again in the manufacture of chlorine, the manganese which was originally in the state of MnO_2, but which has been converted in the chlorine stills into $MnCl_2$, and then, by treatment of this compound with lime, has been made to pass into the state of MnO, we have to make this MnO absorb more oxygen. And for the process by which we do this to be practically available, it must be one which secures the absorption of a very large quantity of oxygen in a very little time.

Now, it is well known that hydrated MnO, such as you produce by adding lime to a solution of manganous chloride, absorbs oxygen, on exposure to the air, apparently with extreme readiness. On this filter, just before the commencement of the lecture, I placed some pure white hydrated MnO, and you see that on the surface it has already become of a deep brown colour, by absorption of oxygen from the atmosphere of this room. The action, however, has been confined to the thinnest possible film on the surface, and if I cut into it with a knife you will see that all below the immediate surface remains perfectly white. Nevertheless, the rapidity of the action on the surface would seem to suggest that if the oxide on the filter were suspended in water, and a current of air were passed through the resulting mixture, the conversion of all the MnO into the compound we have here on the surface would take place extremely rapidly. The actual fact, however, is altogether otherwise. This conversion takes place only extremely slowly, its completion requiring not less than several days at the rate of blowing at which, in the process I have described to you, the corresponding operation can be completed in one hour.

Moreover, the compound which has been formed on the surface of the MnO is not MnO_2, or manganic peroxide; it is simply manganic oxide, or Mn_2O_3. Instead of containing, as MnO_2 does, twice the quantity of oxygen contained in MnO, it contains only one-and-a-half times that quantity of oxygen; and the remarkable thing is that if hydrated MnO be exposed to air, in however intimate a manner, and for whatever length of time,

it never, even in the course of years, absorbs more oxygen than just half the quantity necessary to raise it from the state of MnO to that of MnO_2, the ultimate result being just the same as though one half of the MnO were converted into MnO_2 and the other half remained as MnO.

I have no doubt whatever that this is what actually happens, and that the Mn_2O_3 into which MnO is slowly converted by long exposure to the air is really a compound of MnO with MnO_2, exactly as manganous carbonate is a compound of MnO with CO_2, and manganous sulphite of MnO with SO_2. There seems no doubt that hydrated MnO_2, or H_2MnO_3, must be regarded as manganous acid, and that it reacts upon MnO in a manner exactly similar to that of the reaction upon MnO of carbonic and sulphurous acids. The reaction

$$H_2MnO_3 + MnO = H_2O + MnMnO_3$$

can be effected just as readily as the reaction

$$H_2CO_3 + MnO = H_2O + MnCO_3,$$

or the reaction

$$H_2SO_3 + MnO = H_2O + MnSO_3;$$

and you see that all three reactions are represented by precisely similar equations. And that the product of this reaction is really a salt, and not merely an oxide, is proved by its reacting with other salts, according to the manner in which salts ordinarily react on each other, as in the examples—

$$MnMnO_3 + CuSO_4 = MnSO_4 + CuMnO_3,$$

and

$$MnMnO_3 + FeSO_4 = MnSO_4 + FeMnO_3;$$

and moreover by the fact that hydrated MnO_2 reacts on other protoxides in a precisely similar way, giving products which are unquestionably salts. It does this especially with all the alkalies and alkaline earths, in accordance the equations, which you see written on our diagram*, the products all being Mn_2O_3, regarded as $MnMnO_3$, with its first Mn replaced by another metal. On another diagram† I have represented these compounds as produced by the direct union of MnO_2 with lime, strontia, baryta, soda, and potash respectively. It is on the existence of these and other compounds of MnO_2 with the alkalies and alkaline earths, and especially on that of compounds of MnO_2 with CaO, and on the fact that these compounds can be produced with much greater facility than the corresponding compounds of MnO_2 with MnO, that the process which I have described to you entirely depends.

I will now call your attention to what has taken place in the three jars into which, as long as we could endure the noise of it, we sent a current of air. At the commencement of the experiment, all the jars contained a solution of manganous chloride. To the contents of the jar at this end I added a quantity of lime in excess of the quanity required to decompose the manganous chloride in it; to the contents of the jar at the further end I added a quantity of caustic soda in excess of the quantity required to decompose the manganous chloride in it; but to the contents of the middle jar I added a quantity of milk of lime insufficient to completely decompose the manganous chloride in it. The colour of the contents of the jars is an index to the quantities of oxygen absorbed by them respectively; and you see that those of the jar in which at the commencement of the blowing we had manganous oxide in the presence of free soda are darkest in colour; that those of the jar in which we had manganous oxide in the presence of free lime are nearly as dark, but not quite; and that those of the middle jar, in which we had manganous oxide only, are darkened in a very much less degree. If we were to continue blowing into these jars until their contents would absorb no more oxygen, we should find at the end of the experiment that the whole of the manganese oxide originally contained in the furthest jar was converted into MnO_2, this MnO_2 being combined with soda; that the whole of the manganous oxide originally contained in the nearest jar was converted into MnO_2, this MnO_2 being combined with lime; but that of the manganous oxide originally contained in the middle jar only half was converted into MnO_2, the half thus converted into MnO_2 being combined with the half remaining as MnO. At the rate at which we injected air in carrying the experiment as far as we have done, the whole of the manganous oxide in the furthest jar would be converted into MnO_2 in about an hour, and the whole of that in the nearest jar in about an hour and a-half; while the conversion into MnO_2 of only half the manganous oxide originally contained in the middle jar would require between two and three days.

The fact seems to be that the production of MnO_2 by direct absorption of atmospheric oxygen by hydrated MnO absolutely requires the presence of some base with which the MnO_2 can combine as it forms. If the MnO has no other basic body in contact with it, a part of the MnO itself has to act as the required base, and only the other part of it can become peroxidised; but if any more powerfully basic body be present also, the MnO_2, as it is formed, combines with that, instead of with MnO, and so the whole of the MnO can become peroxidised. The more intimate the contact between the MnO which is to be converted into MnO_2 and the body with which the MnO_2 is to combine, the more rapid the absorption of oxygen by the MnO; and hence, owing to the extremely slight solubility of MnO in neutral menstrua, the extreme slowness of the absorption of oxygen when MnO alone is operated upon. Hence, also, owing to caustic soda being so much more soluble in water than lime is in cold solution of calcic chloride, the more rapid blackening of the contents of the jar in which we had free soda than of the contents of the jar in which we had free lime. When, however, as in working on the large scale, the solution of calcic chloride containing the MnO and free lime is at a temperature not below 140°F., owing to lime being so much more soluble in solution of

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$$\begin{aligned}
*H_2MnO_3 + CaO &= H_2O + CaMnO_3.\\
H_2MnO_3 + SrO &= H_2O + SrMnO_3.\\
H_2MnO_3 + BaO &= H_2O + BaMnO_3.\\
H_2MnO_3 + Na_2O &= H_2O + Na_2MnO_3.\\
H_2MnO_3 + K_2O &= H_2O + K_2MnO_2.
\end{aligned}$$

$$\begin{aligned}
†MnO_2 + MnO &= MnMnO_3 \text{ (or } Mn_2O_3).\\
MnO_2 + CaO &= CaMnO_3.\\
MnO_2 + SrO &= SrMnO_3.\\
MnO_2 + BaO_2 &= BaMnO_3.\\
MnO_2 + Na_2O &= Na_2MnO_3.\\
MnO_2 + K_2O &= K_2MnO_3.
\end{aligned}$$

calcic chloride hot than cold the operation goes on quite as rapidly as if soda were used. We are thus enabled to absorb and solidify, in practical operations, as much as two hundredweight of oxygen per hour.

One fact more, and I can pass from this process. When I first attempted to press this process upon the attention of the manufacturers, I was always met by the objection that as yet I had only performed it in the laboratory, and that many things are possible in the laboratory which on the large scale are utterly impracticable. No doubt that is so; but in this process we have an instance of results being readily obtainable on the large scale which cannot be obtained in the laboratory at all. I have never obtained in the laboratory, by this process, and for some time we never obtained in manufacturing operations, a product containing less than a full equivalent of basic oxide per equivalent of MnO_2 in it, being the product obtained, as represented on the upper part of our final diagram, according to the equation—

$$MnO + CaO + O = CaMnO_3\,;$$

but each time that the scale of our operations has been increased, the chemical quality of our product has improved, until we are now enabled to make regularly a product containing only one equivalent of base per two equivalents of MnO_2 in it, as represented on the lower part of the diagram:

$$2MnO + H_2O + CaO + 2O = CaH_2\,(MnO_3)_2.$$

The first product may be compared with calcic carbonate, $Ca\,CO_3$, and the second with hydrocalcic carbonate, $CaH_2\,(CO_3)_2$. The one is a normal manganite, and the other an acid manganite. The greater value of the latter than of the former is due, firstly, to its requiring less lime to produce it, and, secondly, to its liberating more chlorine from a given quantity of hydrochloric acid. The first yields an equivalent of chlorine per three equivalents of hydrochloric acid, and the second an equivalent of chlorine per two and a half equivalents of hydrochloric acid; the reactions being, respectively,—

$$CaMnO_3 + 6HCl = CaCl_2 + MnCl_2 + 3H_2O + 2Cl.$$

and

$$CaH_2\,(MnO_3) + 10HCl = CaCl_2 + 2MnCl_2 + 4Cl.$$

The conditions which determine the formation of this acid manganite are still somewhat obscure, and we have not time to discuss them; but I could not help suggesting to any chemical inventor here to whose proposals manufacturers may be raising the objection to which I have referred, the answer that there is at least one case of a new process in which the results regularly obtained in manufacturing operations are far superior to the very best that have yet been obtained with it in the laboratory.

I will now ask Mr. Bunker to take the lime out of our little bleaching-powder chamber on the table below, and to mix it with water, so that we may be able to see if it has absorbed any chlorine. While he is doing that, I will say a word upon a process for the manufacture of chlorine which the title of my lecture obliges me to mention, but which, for reasons which will be obvious, apart from that of my having already detained you so long, I shall touch upon only very briefly. I refer, of course, to the process which we know as Mr. Deacon's, and in connexion with which we ought not to forget the name of Dr. Ferdinand Hurter. In the year 1845, Mr. Robert Oxland, of Plymouth, patented the manufacture of chlorine by passing a mixture of hydrochloric acid gas and air through chambers filled with pieces of pumice-stone kept at a red heat. Mr. Deacon's process substitutes for the fragments of pumice-stone either fragments of fire-brick, or, preferably, clay marbles, steeped in solution of cupric sulphate, and then dried. A sample of the marbles which Mr. Deacon has latterly employed is in one of the bowls on the table below. Mr. Deacon originally supposed that the cupric sulphate on his fragments of fire-brick acted only catalytically, its mere presence causing a portion of the oxygen in the mixture of hydrochloric acid gas and air to react upon a portion of the hydrocloric acid in it, producing water and free chlorine, and the cupric sulphate itself remaining unchanged. That I should offer you any statement of how far this theory has been justified by the practical trials which have been made of the process, or of what have been otherwise the results of these trials, would be obviously improper. I will only say of the process that I am not in the least surprised at the great attention which it excited, nor at the extent to which most chemists fell in love with it forthwith, for a simpler process, theoretically, for obtaining chlorine from hydrochloric acid, is of course impossible, seeing that the process involves only one chemical reaction; while a more brilliant method of effecting that reaction has certainly never yet been suggested, and, indeed, probably never can be. For a considerable time I was obliged to anticipate, a little—or, rather, not a little—sadly, that it would render of no avail the results of the years of incessant labour, accompanied by the expenditure of large sums of other people's money, which I had devoted to the realisation of my own process; but what has actually happened is that Mr. Deacon's own firm have all along made the greater portion of their bleaching-powder by my process; and that there is now scarcely a manufacturer of chlorine in Great Britain, making any appreciable quantity of chlorine, who is not either actually making it by my process, or building plant to enable him to do so.

I must not occupy you further except just to say that the greater portion of the chlorine manufactured is sold as bleaching-powder, which is made by simply sending the chlorine gas into great chambers, sometimes constructed of lead, sometimes of stone, but now more frequently of cast-iron plates, upon the floor of which i spread a layer of slaked lime, from three inches to five or six inches thick. This lime remains in the chamber until the product contains from 35 per cent. to 38 per cent. of chlorine, which is at the end of from three days to a week, according to the thickness of the layer of lime, and other circumstances. About a tenth, however, of the total chlorine manufactured is not sold as such at all, but is employed in the manufacture of potassic chlorate, in which its function is simply to transfer oxygen from lime, employed as milk, to potassic chloride, in the manner represented by the equation:—

$$KCl + 3CaO + 6Cl = 3CaCl_2 + KClO_3.$$

The lime which we have exposed to the action of chlorine in the glass trough on the table below will hardly have absorbed as much chlorine as is contained in commercial bleaching-powder, which takes, as I have said, from three days to a week to make; but that it will at least have absorbed some chlorine I think I shall be able to show you. Mr. Bunker has mixed it with water in this beaker, and he has also mixed with water in this other beaker a portion of the lime as it was before it was exposed to the action of the chlorine. If I pour the latter mixture into a solution of manganous chloride, there is produced, as I have shown you before, a white precipitate of hydrated manganous oxide; but if I pour the other mixture into a similar solution we obtain, as you see, a dark brown precipitate, which consists essentially of manganic peroxide, formed by the reaction on the manganous chloride of the hypochlorite produced by the action of the chlorine on the lime.

We have now shown you, however imperfectly, all the operations involved in the commercial production of chlorine: the decomposition of salt by sulphuric acid, the decomposition of the resulting hydrochloric acid by manganic peroxide, the regeneration of manganic peroxide from the resulting manganous chloride, and the absorption of chlorine by lime. Here, then, I ought to cease to detain you; but if I might ask you to allow me just one minute more, I should like, with your permission, to conclude with a plea, founded on the existence, as a realised manufacturing operation, of the process with which I have occupied so much of your time, in favour of the policy of a patent law. I want to illustrate by it the proposition that, in many cases—I believe in most cases—without patents, inventions would be impossible. My illustration consists simply in the fact that the realisation of the process which has been the main subject of my lecture has required, not only years of incessant work, but a very large money expenditure, as utterly beyond my personal means as the payment of the National Debt; and that its existence as anything beyond a mere crude idea is therefore entirely owing to the operation of the patent laws. Those persons who propose that the patent system should be abolished and a system of state rewards to inventors substituted in its stead, certainly suggest that the inventor should be paid when he has done his work; but they propose no means of enabling him to do his work, and that, I take it, is the matter of most moment. It is not important, except to themselves personally, that inventors should make money, but it is important to the community that they should make inventions; and they who fancy that there would be as many inventions without patents as with them, fail to recognise that an industrial invention, instead of being a mere idea, demanding for its realisation nothing more than the effort which a poet expends in embodying his conceptions in verse, is a result which is usually only attainable by the expenditure upon an idea, or upon a set of ideas, not only of immense labour, but also of an amount of money frequently equal to the value of a very large real estate. Inventors are usually poor men, and I am not concerned that they should be enabled to clothe themselves in fine raiment and fare sumptuously every day; but it is surely of the utmost importance that there should continue to exist some means of enabling them to do their special work; and I feel certain that nothing which has as yet been proposed instead of it could be so effective to that end as the system which gives to the inventor a temporary property in his ideas, and thus enables him to tempt the capitalist to supply him with the means of endeavouring to carry them into practice. If the endeavour is successful, the capitalist of course takes the lion's share of that portion of the profits which ought to be the inventor's reward; but he at least enables the result to be achieved, and that is the main thing. In the case of a process like my own, too, even if it had been invented by a rich manufacturer, he would not have worked it out, if he could not have patented it; because by so doing he would simply have placed himself at a disadvantage as compared with his competitors in the trade, all of whom would have shared with him the advantages of his invention—seeing that he could not possibly have kept it secret—while the cost of its realisation would have had to be borne by himself alone. This illustration of the influence of the patent system in promoting industrial invention, seemed to arise so naturally out of the subject of this lecture, that I could not forbear submitting it to you; and I have now only to apologise for having occupied you so long, and to express my regret that I have not been able to make my subject as interesting to you as I know it could have been made in better hands.

DISCUSSION.

Mr. R. Calvert Clapham (Newcastle) said he did not recollect ever having seen so beautiful a set of diagrams to illustrate such a process as those which Mr. Weldon had placed round the room, or so complete a set of apparatus as that upon the table. For instance, he believed if Mr. Gossage, the inventor of the condenser, were present, he would be of opinion, on looking at the condenser standing on the table, that the process of condensation had arrived at great perfection. With respect to the difficulties which had been referred to in carrying out the process, he recollected very well trying some experiments in connection with it six or seven years ago, and the difficulties were exactly such as had been described. The first appeared to be that of getting regular and satisfactory results in the peroxidising of the manganese. He did not recollect whether Mr. Weldon, in describing the diagrams, had mentioned the very simple fact that the addition of a little excess of lime was found to overcome many of the difficulties which were at first encountered. In the first place, the idea was that the lime should be an exact equivalent to neutralise the acids in the manganese solutions, and this was an illustration of how important it was that new processes should not be hastily abandoned, because simply by adding an excess of lime many of these difficulties were overcome. He might perhaps be allowed to criticise the figures of cost given on one of the diagrams, which he thought might be a little increased; but he must congratulate Mr. Weldon on his perseverance and success. He had lately had an opportunity of looking through the large works at Newcastle to which reference had been made, and the manager of them had asked him to mention one or two of the results he had obtained, he being now one of the largest manufacturers by this process. In the first place, he was now able to oxidise the manganese up to

81 or 82 per cent., which was a much higher percentage than could be obtained in the native state. In the next place, in an oxidiser, such as Mr. Weldon had described, he was able to turn out rather better than two tons of pure MnO_2 in 4½ hours, which appeared a very marvellous result when he recollected the beginning of these experiments. There used to be some difficulty in getting the bleaching powder for commercial purposes of a uniform and sufficient strength, but that had now been overcome, and from a large number of analyses the result came out thoroughly successful, as an average of 35 to 36 per cent. of chlorine. The quantity of bleaching powder made from the salt was also much greater than was at first anticipated. These being thoroughly practical results from a manufactory which now turned out about 8,000 tons a year, were highly satisfactory, and lastly, the loss of manganese was not more than 10 or 11 per cent.

The Chairman said he must express the great pleasure with which he had heard the lucid and eloquent exposition by the discoverer himself of this exceedingly remarkable triumph of experience and well-directed skill. It was hardly possible for anyone, even after hearing such a description, to realise to his own mind the immense number of successive and well-directed efforts which had been needed to obtain such a result. When we constantly saw how many efforts were made to apply correctly known facts with regard to the properties of various materials, and to condense our knowledge into any useful improvement, and when we recollected how much money and time were often wasted by ill-directed efforts of that kind, we could appreciate as it deserved a result like that which had now been described. Perhaps there had been few cases in which a result had been worked out so well in accordance with truly correct scientific principles. To himself, as a chemist, it was exceedingly interesting to learn the fact that the presence of a strong alkali in the mixture should practically cause so much more rapid an absorption of oxygen than could be obtained without the alkali. Among chemical reactions there were various cases of differences of such a kind, but the application of it to this particular phenomenon was entirely new until worked out by Mr. Weldon. At the same time, if we saw the waste going on of natural products by ill-directed use, and then looked forward and considered that in later ages future generations would be wanting to make chlorine and many other things, while the men of the present day were in many cases wasting the materials which would serve for the purpose —not merely using them to produce the necessary results, but using a great deal more valuable capital than was necessary—it would be seen—not only in the present service rendered by the introduction of such an improvement, but also for the sake of posterity—an immense gain was effected in economising a material of which the accessible store was necessarily limited, and which would probably have come to an end only far too soon if not economised and more profitably employed.

Mr. Weldon said he might offer a word or two of explanation, which might perhaps be necessary to avoid any appearance of contradiction between his statement of the results which would have been obtained in those jars if the experiment had been finished, and one of the statements which Mr. Clapham had been so good as to make with respect to the results obtained at Newcastle. Mr. Clapham had said that in those works, which turned out 230 tons of bleaching powder per week, the manganese could be oxidised up to 81 or 82 per cent.; whereas he had stated that if the experiments were continued until the absorption of oxygen had entirely ceased, all the manganese would have been converted into MnO_2. The explanation was this, that in manufacturing operations it was necessary to keep the maximum proportion of total manganese converted into MnO_2, but, at the same time it was desirable to have the smallest possible proportion of base present. Now it was a curious fact, not yet fully understood, that if you oxidised the whole of the manganese so that the basic oxides present should be only lime or soda, without any MnO_2, you must oxidise less than 100 per cent. Mr. Clapham had also spoken of 35 or 36 per cent. of chlorine in bleaching powder being the standard. That was, no doubt, the standard of strength in the Newcastle district, but in Lancashire there was very little now packed under from 37 to 38. Mr. Wynne, the manager of the Runcorn works, told him he always made his of a strength of 37 per cent. The loss of manganese in the Newcastle district had also been referred to as being 10 to 11 per cent.; but that was a purely mechanical loss, due solely to the impurities in the hydrochloric acid employed. There was a considerable quantity of sulphuric acid in commercial hydrochloric acid, and the result was, that in the solution formed there was a quantity of calcic sulphate which settled down at the bottom of the vessel in a bulky state, and was obliged to be thrown away, and with it a considerable quantity of manganese. If pure hydrochloric acid could be obtained there need be no loss of manganese, and that was a difficulty he hoped soon to get over in another way. Mr. Clapham was the first practical manufacturer who made any experiments with this process, and when he criticised his statement of the cost it was touching rather a sore point. Still, he was quite right in so doing, but the figures he had given were based on the best results obtained in the Lancashire district. There were three great centres of the manufacture, Newcastle, Lancashire, and Glasgow, and somehow or other the Lancashire manufacturer carried out this process with not quite one-third the quantity of coal employed at Newcastle, and at a very much less expense for wages, and this accounted for the difference in the figures.

The Chairman then proposed a vote of thanks to Mr. Weldon, which was carried unanimously.

Mr. Wills then announced that the meeting concluded the present series of meetings of the Chemical Section, but he was glad to say that the Council considered the success which had attended them was sufficient to warrant them in establishing a chemical section as a permanent feature. A further series of meetings would therefore be arranged for the next session, and by the experience already gained, they would endeavour to make them even more successful. He should also be very happy, as secretary of the section, to receive any suggestions for making the work more valuable to the manufacturer on the one hand, and the scientific world on the other.

TWENTY-FOURTH ORDINARY MEETING.

Wednesday, May 27th, 1874; P. LE NEVE FOSTER, Esq., M.A., Secretary of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Birch, R. W. Peregrine, C.E., 5, Westminster-chambers, Victoria-street, S.W.
Bull, William, F.L.S., F.R.G.S., King's-road, Chelsea, S.W.
Cotton, Major-General F. C., R.E., Athenæum-club, Pall-mall, S.W.
Donkin, William F., 4, Museum-terrace, Oxford.
Liveing, G. D., M.A., Cambridge.
Oxland, Dr. Robert, 8, Portland-square, Plymouth.
Rolfe, Charles Spencer, C.E., 20, Highbury-place, N.
Thomson, Patrick J., 3 and 4, Great Winchester-street-buildings, E.C.
Walmisley, Arthur Thomas, C.E., 5, Westminster-chambers, Victoria-street, S.W.

The following candidates were balloted for and duly elected members of the Society:—

Allen, Franklin (secretary of Silk Association of America), 93, Duane-street, New York, U.S. America.
Anderson, J. R. W., Tallisker Distillery, Portree, Skye.
Burn, Dr. Alexander, 23, Marloes-road, Kensington, W.
Guerrico, Alberto A. De, 31, Sussex-square, Brighton.
Heron, Sir Joseph, Town-hall, Manchester.
Lansdell, Mark J., 38, Gracechurch-street, E.C.
Lockyer, William J., Pembroke-villa, Elgin-park, Redland, Bristol.
Sigismund, Dr. J. Mordaunt, 10, Weymouth-street, Portland-place, W.
Thicke, Frank E., 5, Great Queen-street, Westminster, S.W.
Townshend, Captain John, R.N., Lona, Weston-super-Mare.

The Chairman stated that it had been found necessary to postpone the discussion on Captain Tyler's paper owing to the unavoidable absence, on official duties, of Colonel Yolland and Colonel Hutchinson, one of whom would have represented Captain Tyler in his absence in America, and that Mr. Tussaud had kindly consented, on very short notice, to prepare a paper on his new method of treating furs and skins.

The Paper read was—

ON A METHOD OF TREATING FURS AND SKINS.

By Joseph Tussaud.

The invention to which I am about to call your attention and to explain this evening, has for its object the economising the furs and skins of commerce, by rendering them available under circumstances where they would otherwise have to be thrown away as useless, or by preserving the skins for leather, while the fur is equally retained for use as before. By means of my invention I strip the fur from the skin, and fix it to a prepared backing of calico, or any other material, and the skin thus separated is available for leather-making purposes.

My attention was first drawn to the invention in the course of my profession as modeller for the exhibition at 58, Baker-street, which now and has long enjoyed the generous patronage of my countrymen, and of many strangers who from time to time visit our shores.

It happened thus. I felt much annoyance that, owing to the eyebrows of my models being altered from time to time in the process of recolouring, the artist sometimes varied them in a manner which affected both the expression and the likeness, and I became anxious to have the hair inserted in such a way that it could be done under my own superintendence, and remain a fixture so long as the model lasted. In attempting this it was found that the operation was too delicate, and I was foiled, but the difficulty only made me more anxious than ever to succeed. In doing this, I little thought my search would lead me, step by step, to the discovery of a new trade.

I noticed by chance in passing a butcher's shop that the hair on a calf's head was particularly sleek, and I thought if I could take a piece of hair out bodily, with the roots attached, and place the roots in the wax, I should obtain the desired end; but how to do this was the puzzle; but the solution ultimately came. I noticed that the soap which dried on my razor after shaving held the stubble it had taken off somewhat firmly, and then it dawned on me that all I required was to place something on the hair which would imbed it with sufficient firmness to enable me to draw the hair out and expose the roots. I succeeded in finding a means which would hold the hair whilst I poured hot wax on the roots. I then dissolved off the medium in which the hair was embedded, and those pieces are now lying on the table for inspection, as the first specimens of hair transferred to a foreign substance, and yet held in its natural position.

My brother and co-inventor, Mr. Francis Tussaud, suggested indiarubber as a flexible means to hold the roots, and I then saw the advantage of using such a medium to hold the hair as would not injure the skin, and thus to obtain two articles from one, viz., the fur and the leather.

I showed the result to the late Mr. Nicholay. He very generously told me that I had opened a very wide door; but it has taken many years to find the cheapest means, as well as to simplify the process, and to make the material a lasting one.

The invention may be thus described. We introduce in a liquid form on the outside of the skin a solution of some matter adapted, when the solvent thereof has evaporated, or the matter employed has solidified, to form an artifical skin close upon the natural one, by which to hold the feathers, or hair, or other covering thereof at or near the roots, and in their desired relative position, in order that the skin may be removed without its necessarily being destroyed. We first lay the skin inside downwards upon a board or other suitable surface, and then apply thereon the solution of matter, which after the evaporation of the solvent, or the solidification of such matter, will, by acting as a temporary artificial skin, serve to hold the feathers, hair, or other covering in position during the removal of the natural skin, taking care that such matter is introduced among the feathers, hair, or other covering of the skin as near as possible to their roots. A solution of shellac in alcohol answers well for the production of the artificial skin. When the shellac has become dry by the evaporation of the solvent, the skin may be drawn off the inner ends of the feathers, hair, or other covering, leaving such held by the shellac. We then cleanse the projecting roots of any remaining fatty or animal matter, and apply upon such inner ends a coating or solution of indiarubber, or other suitable adhesive matter. A lining of any suitable fabric is then laid over the projecting roots, so as to occupy the place in which the pelt originally was. To facilitate the removal of the natural skin from the roots, we prefer to steep it for a time in lime water, as is practised by tanners. When shellac is used as the first holding medium, we remove the same again for re-use, or otherwise, by applying thereto a suitable solvent.

Subsequently we improved on this process, not finding the shellac solution to answer commercially, and we now use other means for acting first on the hair on the natural skin previous to the application of the temporary holding means, and use glue, size, or gelatine applied in solution, so as to form when cool a body to hold the hair or other covering in position during the removal therefrom of the natural skin and the application to the roots thereof of a substitute for such skin.

In carrying out our improvements we operate upon the hair or other covering and natural skin previous to the application of such temporary holding means, for the purpose of loosening the one from the other, by subjecting them to the action of lime-water or other suitable means, as practised by tanners. If desired the skins may then be washed in water to free them of the superabundant lime or other means by which the hair or other covering has been loosened from the skin, and then, when required, they may be hung up for a time to drain off excess of moisture. The glue, size, or gelatine is then applied to the hair or other material by pouring it thereon in a fluid or semi-fluid condition, and in sufficient quantity, or by immersion of the skin in a bath of such matter. When a sufficient coating of the glue, size, or gelatine has been applied to the skin to hold the hair or other such covering thereof in correct relative position during the removal of the natural skin, such skin with this temporary holding means applied is then laid so as to prevent the holding means from running off until it has become sufficiently cool or set to hold the hair or other such covering in position, when the natural skin may be pulled from the roots of the hair or other such covering, leaving the hair or other such covering held by the glue, size, or gelatine employed as the temporary holding means with the roots of hair or other such covering projecting therefrom. The matter or composition, with any suitable fabric to form the artificial skin, will then be applied in a liquid state to such roots of hair or other such covering whilst the hair or other such covering is being held by the glue, size, or gelatine.

The artificial skin may be formed of india-rubber, gutta-percha, or compounds thereof (vulcanised or otherwise prepared), boiled or other oils capable of being rendered suitably drying, or other suitable adhesive matters which may be strengthened if desired by woven fabrics.

When employing boiled linseed or other oil, its adhesiveness may be increased by the combination therewith of a small quantity of litharge or other suitable drying or adhesive matter.

In order to render the caoutchouc and gutta-percha more lasting and less affected by changes of temperature, we combine with them sulphur in any suitable manner capable of producing those results, preferring to apply to the artifical skins of caoutchouc or gutta-percha a solution of chloride or hypochloride of sulphur in bisulphuret of carbon (or other suitable solvent of caoutchouc or gutta-percha). When using bisulphuret of carbon, we take 40 parts thereof, and add to it one part of chloride or hypochloride of sulphur prepared as neutral as possible, and we allow the solution to remain in contact with the artificial skin of caoutchouc or gutta-percha a longer or shorter time, according to the thickness or substance of the article, but we find that for general purposes a thin sheet is generally sufficiently changed in less than a minute.

When the caoutchouc, gutta-percha, or compounds thereof, with the fabric or backing used to form the artificial skin, has become sufficiently set to hold the hair or other such covering firmly by the roots thereof, and the process of vulcanisation or preparing as above referred to has been effected, then the artificial skin with the hair or other such covering thereon is well washed in hot water, by which the glutinous or gelatinous matter which has been employed as the temporary holding medium may be readily removed, or the glutinous or gelatinous matter which has been employed as the temporary holding medium may be removed before the process of "vulcanisation" or "preparing" is effected. We, however, prefer that the fabric forming the artificial skin be well washed in water after the vulcanisation or preparing above referred to has been completed.

In some cases we employ carbonate, sulphate, sulphite, phosphate, acetate, or hyposulphite of soda as a substitute for the animal glue or gelatine. In such cases the salt is employed in a state of fusion or as a saturated solution, such that when cool it will set to a sufficient degree of solidity to hold the hair or other covering in correct relative position.

It is well known in the fur trade that large numbers of valuable furs are constantly lost by decay and decomposition of the skins, but by this invention all such may be preserved and utilised; besides this, the good pelts are thus rendered available for leather, whilst the fur is as useful as before. A good fleece, if such a term is allowable, may be made up by this means out of a number of imperfect ones; and there is a still further advantage, that the fur thus transferred to an artificial backing is moth and mildew proof, a matter of no small importance, as all fur dealers will admit. The result gives us a fur, without the hard and thick and heavy leather, placed upon a texture in its nature pliable and impervious to damp, mildew, and to moth; and with flannel or other warm material for a lining, a great convenience is attained.

Around the room will be seen a number of specimens, which, I trust, will interest the meeting. The bringing this invention to a successful issue has cost me much time and money, and has hitherto been a source of loss and disappointment. I trust, however, that now that the invention has been brought into a complete condition its merits will be ultimately appreciated.

[It was intended to have shown the process in action, but by some error the specimens were not prepared in time.]

DISCUSSION.

Mr. Campbell Johnstone inquired whether the process was applicable to general purposes, and whether it was more expensive than the ordinary process of preparing a skin. They knew that the india-rubber which was applied was somewhat expensive, and the question seemed to be would it pay.

Mr. Ince said there was no doubt about its being practicable, for it was done and done successfully, but it would only answer when applied to a cheap skin. Where the leather was valuable or it was a good skin it would not answer. Nature had provided animals with the best possible covering, and it was not likely that this would be an improvement on nature.

Mr. Stirke had worn a waistcoat of the material for two years, and it was as good now as when he first began to wear it. There were many advantages attached to the material. Moth would not get into it, and the disagreeable smell of the natural skin was got rid of.

Mr. Grazebrook did not agree with the last speaker about there being no smell, for he found a very disagreeable smell in one of the skins; nor did he think that a natural skin had a disagreeable smell. A lady's seal skin jacket and the Russia leather in use were rather pleasant smelling than otherwise, and a properly cured skin was not objectionable on that account. But he saw a worse objection than the smell from it. A skin has a certain amount of porosity about it which was lost in the prepared skins. From the commercial point of view it would certainly be a great advantage if it could be used for certain purposes, and if it could be made available for making a large fur out of several small ones. He was afraid, however, that any process by which the hide could be softened so as to enable the roots of the hair to be drawn, would result in an injury to tho hide.

Mr. Stirke, replying to the last speaker, said Mr. Tussaud was in possession of two certificates from some of the first tanners in Bermondsey as to the value of the process, and that it was a better plan altogether than that hitherto in use, and that they would be very willing to supply him with skins and let him have the fur without charge if he would give them the hide after he had treated it.

Mr. Trewby remarked that everything turned upon the cost of preparation. As to the remarks made about the value of the leather, the leather of fur animals was in most cases worthless. It was generally very thin in the case of seal skins and ladies' furs, and the hair was tho only valuable portion. When the last speaker said a tanner had offered to give the fur if he saved the skin, he thought it could only be a bullock's hide which was meant, and it certainly could not be the fur sold for ladies' wear.

Mr. Pearsall believed there were many cases where the use of the natural skin was really objectionable. Therefore if it were possible to get the warmth of the fur—the mere hair portion—with a proper backing as was proposed, a variety of articles might be made, all tending to comfort and utility. He understood that the tanner soaked the skin in such a way that it was nearly certain that any process founded upon this to get rid of the hair would produce a better skin, and it was therefore opening a splendid field for the production of a skin that would suit any market, as well as rendering available the use of the fur.

Mr. W. Smartt, judging from the scent, thought the rubber must be vulcanised, and he would suggest the use of mineralised rubber. The really important question had not yet been answered, for what purposes the process could be applied, and its cost. It was probable that the smaller skins could be prepared in this manner, but the cost would be more than the advantages found. In the case of sheep skins for mats and other purposes, the question arose whether the cost of transferring the wool from the skin to cloth would be greater than the value of the skin—whether the leather that would result from the separation would more than pay the cost of separation. Supposing the wool more than paid the cost, then the question arose whether the different skins could not be used for a greater number of purposes than they were now. He had seen caps made of fur, and if it were possible to transfer the hair and thus make caps it would be useful.

The Chairman asked the meeting to return its thanks to Mr. Tussaud for the valuable paper he had written on so short a notice—only since last Friday—and the very interesting discussion which had ensued thereon. He thought if the gentlemen present had had the opportunity, which he had enjoyed through Mr. Tussaud's kindness, of seeing the process carried out at his factory at Kew, they would not have had any difficulty in arriving at the conclusion that the process could not be otherwise than extremely cheap. The materials used were used over and over again. As to the solution used there was no great expense arising on that score; and with regard to that part of the process in which calico backing was used, it was very easy to judge what a slight cost that would be, and the india-rubber solution was not very dear material. Looking, therefore, at the whole process and the small skill apparently required—it was done so readily and cheaply—he thought it must be most successful. He regretted extremely that they had not had, from some accidental cause, the specimens to show how easily the fur was stripped from the skin and how easily the backing was applied to it. It had been said that there were furs where the leather was of very little value. No doubt that was so, but there were a large number of skins where the hair was not only of value for very many purposes, but the skin was of great value too. Here you might take the skin from a horse or a cow or a sheep, and then, when you had got the hair in the same state it was originally, but with an artificial backing to it, you could also have the benefit of the leather.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

BOOKBINDING IN THE EXHIBITION.

By H. T. Wood.

Among the various classes represented in this year's Exhibition there is none which seems to attract the visitors more than that devoted to bookbinding. It so happens that most of the other classes are of a very special character, and tend to attract rather those intimately connected with the subject treated than the general visitor. With bookbinding the case is different, and if in too many instances only a cursory glance is given to the cases in which lie, side by side for comparison, the laborious handiwork of past centuries and brilliant productions of modern machinery, there can be no doubt as to the interest shown by those who collect round the counters where the work of bookbinding itself is carried on.

Though an exhaustive history of the binder's art has yet to be published, still so much has been at divers times and in divers places written about it, that there can be no necessity here for giving any account of the ordinary methods employed. Nor can space be spared for any sketch, however brief, of the gradual rise and progress of the art. The subject is a tempting one, but as it cannot be treated at proper length, it is better not to touch upon it at all, but to devote this article to an account, incomplete indeed, but still as correct as may be, of the present condition of the art, endeavouring at the same time to indicate the progress that has been made during the two periods, 1851 to 1862, 1862 to 1874, since the first Great Exhibition.

In the Jury Reports on the Exhibition of 1851 several pages are devoted to bookbinding,* and there are also some remarks on the designs shown, in the "Supplementary Report on Design," by Mr. Richard Redgrave, R.A., which concludes the volume.† The account there given may serve to show with some exactness the state the art was then in, and the amount of progress that has since been made.

"Modern bookbinding is carried on in England on a scale of such magnitude as the binders of former times could scarcely have foreseen. The production of books greatly exceeds that of any former period, and has caused the application of so much machinery to bookbinding that it may fairly be said to have become a manufacturing business. Books, handsomely bound, gilt, lettered, embossed, and

* Jury Reports, p. 423.
† Ibid., p. 740.

otherwise ornamented, no longer depend upon individual skill, but are produced with extraordinary rapidity by the aid of machinery Mr. Burn, of Hatton-garden, first introduced rolling machines to supersede hammering; the iron printing-presses of Hopkinson and others were altered to form arming-presses by which block-gilding, blind-tooling, and embossing can be effected with accuracy and rapidity. Leather covers embossed in elaborate and beautiful patterns by means of powerful fly-presses, were introduced by M. Thouvenin in Paris about twenty-five years ago, and almost simultaneously in this country by Messrs. Remnant and Co., and by Mr. De la Rue, who were quickly followed by others. Embossed calico was also introduced about the same period by Mr. De la Rue; hydraulic presses, instead of the old wooden screw-presses; Wilson's cutting machines, which supersede the old plough; the cutting tables with shears, invented by Mr. Warren De la Rue, and now applied to squaring and cutting mill-boards for book covers; all these means and contrivances, indispensable to large establishments, prove that machinery is one of the elements necessary to enable a binder on a large scale to carry on that business successfully."

In the report on bookbinding in the Exhibition of 1862, the jurors state that they had given up as impracticable the attempt to form any detailed comparison between the exhibits of 1851 and 1862, because no one of the jurors had served for both exhibitions. The specimens shown in 1862 they divided into three classes. First, bindings of an elaborated character, jewelled, enriched with chasings of the precious metals, or with carvings of ivory, and enamelled. Second, elegant and solid bindings, showing high-class workmanship. Third, bindings of an ephemeral character, designed for popular works.

In all these classes they noted an improvement. In the first, extravagance had, they considered, to some extent given way to utility. In the second, there was more originality of design and greater care in the combination of colours. In the third, there was increased cheapness of production and a greater amount of artistic taste. A marked feature of the third class was also the very much greater rapidity with which the work could be accomplished.

In the present exhibition there is perhaps no division in which more decided progress has been made during the past ten years than in bookbinding. True, in the highest class of work there is little improvement, nor perhaps can much ever be made, but in the cheaper sort of bindings there has been a very marked change of recent years, both as regards the workmanship of the bindings, and still more as regards the methods by which they are produced.

For convenience sake it may be as well to accept the classification of the 1862 report, with some slight modifications, and to arrange the bindings as (1) fancy or very elaborate bindings, in which unusual or costly materials are used for the covers; (2) leather work; (3) cloth and paper bindings. To these may be added a class (4), bindings for ledgers, &c., of a purely useful character.*

Bindings of the first class are really separate works of art, and depend for their value on the skill of the artist who designs and the artist who executes the ornamentation, and not upon that of the bookbinder proper. They are *sui generis*, and, however beautiful or costly, can perhaps hardly be said to have much influence upon an art now practised on so large a scale as that of bookbinding. In the second class it can only be said that the extension of a truer artistic knowledge and more correct taste, which has been among the most valuable results of our exhibitions, has shown itself in bookbinding as in ornamentation of every sort. As the popular taste has become purer, it has also grown more exacting, and has produced a demand which has been fully met for more harmonious combinations of colour, more artistic and purer designs. Though a tendency to overload a costly binding with ornament is still occasionally visible, it is so to a less extent than formerly, and our most recent productions generally show a beauty of design that rivals the work of any preceding age, joined with an excellence of workmanship such as it may be doubted has ever before existed. Still it cannot be said that any considerable advance in this class has been made during the last decade beyond the regular and steady progress common to all arts of design during that period. As regards the method of production, that remains quite unchanged from what it has been for years. The work is all done by hand, at least all the highest class is so done; the hammer for backing and the hand-plough for cutting are still used as of old, and the process in all its details remain the same.

* Shown in the Stationery Class (C. xxviii.) in 1862.

It is in the third class, among the comparatively inexpensive bindings of cloth, that the chief improvements are to be noted. The immense multiplication of books has necessitated a correspondingly increasing cheapness in bindings. When books were few and libraries small, their possessors were able to expend considerable sums on the covering of a single volume, but to clothe an average modern library in leather is now a matter of no small cost, and the result has been that the principal energies of the trade have of late been directed towards the production of a handsome and durable substitute for morocco and calf. On the Continent and in America readers are still content with simple paper wrappers, but these are scarcely at all used in England for anything less ephemeral than a magazine. Even the paper-covered boards in which cheap novels are published have to a great extent been superseded by covers of cloth, often of a very neat and attractive character, and always a great improvement, both as regards appearance and durability, on the paper.

That this change has been effected as rapidly as it has is due to the introduction of machinery to accomplish nearly all the various processes required in bookbinding. This fact is noted in the paragraph above quoted from the reports in the 1851 exhibition, and the machinery therein alluded to has been most extensively developed both in power and in the variety of its application since that time. The presses mentioned have been improved and further developed, while several new machines have been introduced. Among the principal of these are "rounding" and "backing" machines, saw benches worked by steam power, and some improved trimming machines. All these have certainly come into use since the first Great Exhibition; machines for backing and finishing backs were shown in 1851 by Mr. Starr, of New York, but the jury were not able to see and report upon them.

To give an idea of the extent to which machinery is now applied, it may be worth while to give a brief sketch of the various processes which a book undergoes in being bound in cloth. The ordinary process of hand-binding has been so often described that there can be no necessity to refer further to it here, but as it seems probable that no description has ever been published of that of machine binding, no apology is needed for repeating much that is familiarly known to all specially concerned in this important business.

The sheets, which have been "gathered" at the printer's, are delivered to a girl, who folds each by hand. Machines have been invented for this work, and indeed are largely used for newspapers, but as yet they have not come into extensive use in binding books. The difficulty is that the machines fold by the edge of the paper, whereas for book-work the sheets have to be folded by the type. There are indeed machines which overcome this difficulty by means of register points like those used in printing presses, but these require that similar points should be set in the printing press, and except in houses where both printing and binding is done there is a difficulty about this. Still machines are used by many houses abroad, and some at home. In the *Graphic* office there is a machine which not only folds that journal, but "insets" the inside sheet within the outer one.

After being gathered and "collated" in the usual manner, the sheets are pressed between rollers, or in a hydraulic or screw press.

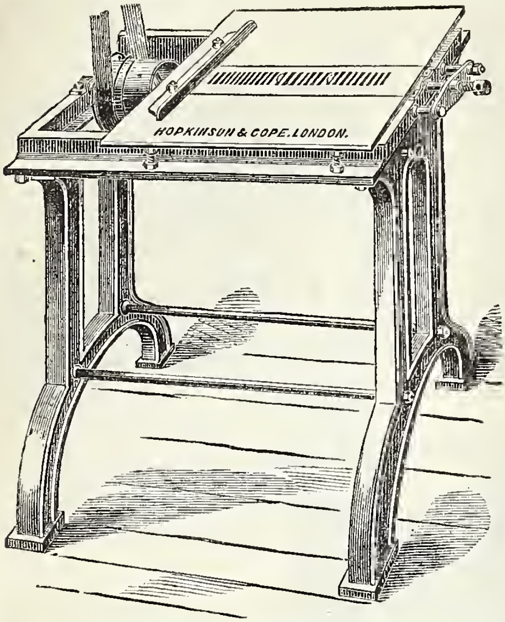

Fig. 1—Saw Bench.

The next thing is to saw the notches in the backs of the sheets in which the bands lie. This is still generally done by hand in the usual way, but in large establishments, and where a great number of the same book have to be bound up, machinery is used. A figure (Fig. 1) of the saw bench is given. Under the table is a spindle on which are fixed several circular saws, the edges of which protrude through slots in the table. The number and position of the saws are regulated according to the number of cuts required. After this the sheets pass to the hands of the sewer; and here there is no improvement in the old sewing press with the cords stretched across, to which a girl secures each sheet separately by a peculiar stitch. After being sewn, the sheets, now forming a book, are again placed in the hydraulic with boards between the books.

So far the work is now done mainly by hand, as it has been done for years. The next processes are those in which machinery comes principally into action. The first thing is to cut square the edges of the leaves. This of course was originally done by a hand-plough working over the edges of the book while it was screwed down in a vice, technically called a "laying press;" it is now done by one of several machines. These machines are of two classes, according as they are intended merely to trim off the rough edges, leaving as wide a margin as possible for the benefit of the future binder when the book is to be bound up in leather, or to cut the edges once for all as they are intended to remain. The former are known as "trimming machines," the latter as "cutting presses" or "guillotines." The latter have been in use for a considerably longer period than the former, and are now, of course, more extensively employed. To dispose of the trimming machines first. In the earliest of these a circular rotating cutter revolves

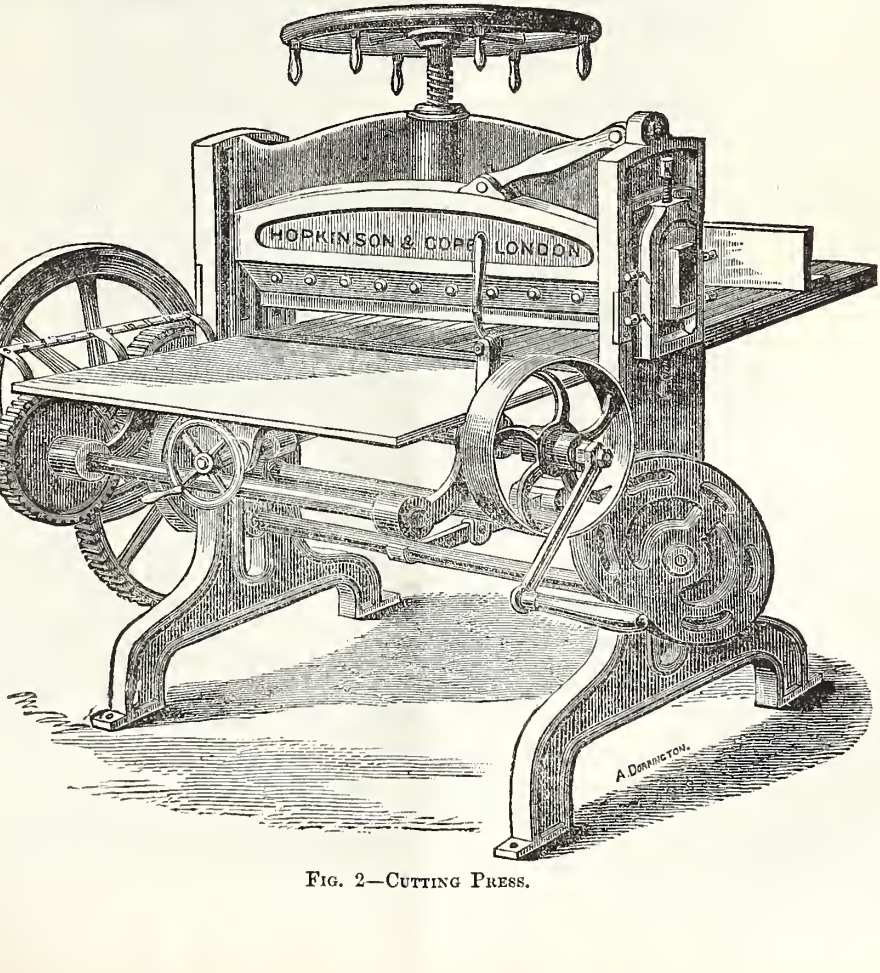

Fig. 2—Cutting Press.

by the side of a table having a to-and-fro motion. On this table the book is clamped so that its fore-edge is brought against the revolving cutter, and as the book is carried along, a cutting of the required breadth is taken therefrom. The bottom edge is then treated in the same way, the head being generally left uncut. This circular trimming machine is principally used for magazines and similar work. For book work a straight trimming machine is generally used. In this a rising and falling table is situated below a horizontal knife, to which a to-and-fro motion is given from a cam on a shaft at the side, at right angles to the knife. The book is placed on the table, where it is held down by a presser foot, against adjustable guides, and by the action of the table it is carried upwards against the knife edge, which, with a rapid saw-like motion, trims off the rough edges of the sheets. Of course, very little pressure is required, and the sheets are not squeezed together as in the machine next to be described.

The cutting press (Fig. 2) is, in the main, only a greatly improved form of the old hand-screw guillotine, which was the first improvement on the hand-plough. In it the book is placed against a guide on a fixed table, and held in position by a presser foot. A knife then descends between vertical guides with a slightly drawing motion combined with its vertical motion, and shears away the required amount from the sheets.

The next process is that of gilding. This is effected in the same way as formerly, except that a number of books are all treated at once. They are clamped down in a sort of vice, called a gilding press, the glaire brushed on, and the leaf applied and burnished in the usual way by hand. In the most recent description of press the frame in which the books are held is mounted in trunnions, so that it can be turned over, and both edges of the book be got at without removing it. After this they pass to the "rounding" machine (Fig. 3), where the round back and corresponding hollow fore-edge are given to them.

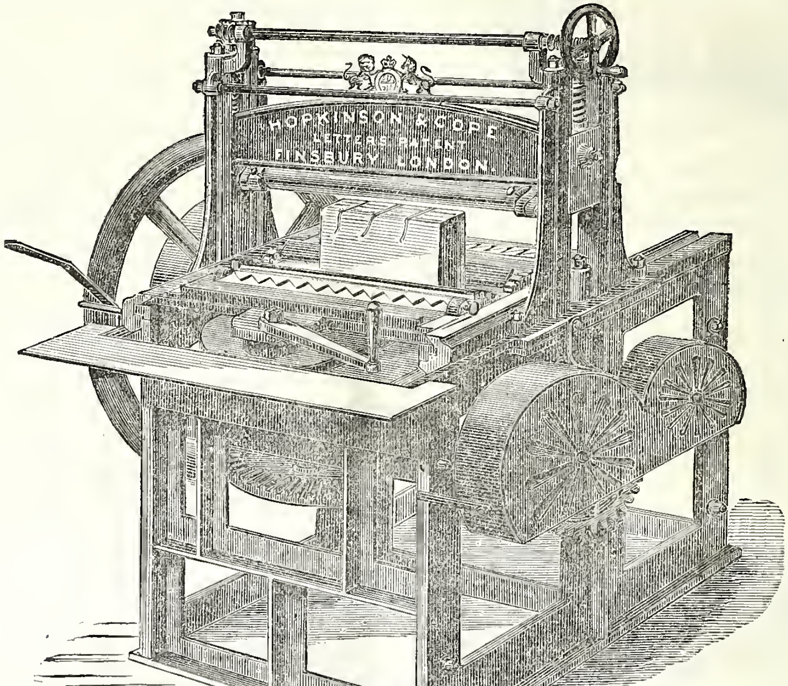

Fig. 3—Rounding Machine.

This process was till lately only to be accomplished by the hammer, though there have been several machines invented for the purpose. In 1868, Messrs. Cope and Bradbrooke brought out a machine, which is now in extensive use. In this the book is clamped with its back upwards between two horizontal cheeks on a traversing table which reciprocates backwards and forwards under a fixed roller, adjustable as to height, so that, as the book is carried under it, the roller is forcibly driven from side to side of the book, forcing the back over and causing it to assume the usual convex form.

Next the book passes to the "backing" machine (Fig. 4). This is a small hand-machine, instead of being like all the above, worked by power. Its object is to form the recess or groove along the side of the back in which the boards lie. Its operation is tolerably simple. The book is held in a vice, in which it is clamped by a lever worked by a treadle, the book being supported with its back just over the jaws of the vice, so that the backs of the outside sheets may be forced over to the proper shape. The roller shown is then brought down on the back, and passed backwards and forwards across it two or three times. The combined pressure of the roller and the jaws of the vice cause the book to assume the required form. This machine is the one exhibited, in its original form, at the 1851 Exhibition by Mr. Starr, of New York.

The sheets have now been brought to the proper shape, and only require to have a strip of canvas pasted over the back, for them to be ready for insertion into their covers. The preparation of these is another department, and must be described separately.

The first process is that of cutting the millboards into suitable shapes and sizes. This is effected by the apparatus shown as Fig. 5, in which a large knife with a curved blade works on a pivot at one end, against the edge of a table. The millboard is held by a bar pressed down on

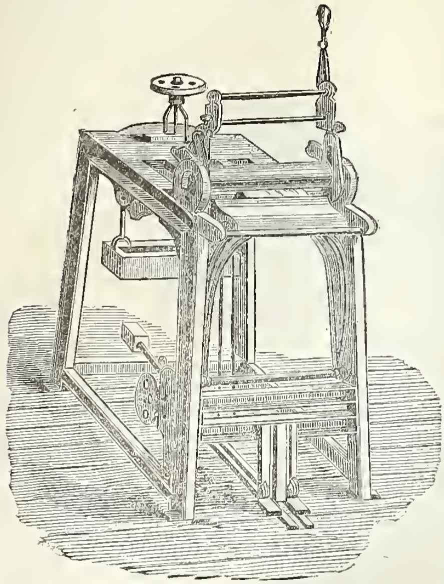

FIG. 4—BACKING MACHINE.

it by a treadle, and its edge comes against an adjustable guide, seen on the right of the figure, which is set according to the width of the cover required. If the edges are to be bevelled, this is done in another machine (Fig. 6). The board is laid on the table with a straight-edge over it, while a second straight-edge rises slightly above the edge of the table, and forms a projecting rim for the edge of the board to bear against. The straight-edges are set as required, to allow more or less of the corner to be cut away; and a knife passed along them, as shown, strips off the corner of the board, leaving a neat and bevelled edge. A recent improvement has been to fit to the machine a gouge, which slides in a carrier along guides by the side of the straight-edge, in place of the knife. By this a round bevel can be cut. The cloth covers are cut to the required size, and they are then glued, the boards laid on them with a strip of paper for the back, the corners of the cloth cut away, and the edges turned evenly in. The case, so far complete, is hung up to dry, and is then ready to receive whatever ornamentation may be considered proper.

Of this ornamentation the greater part is of three sorts, blind and black printing, and gilding. The machines used for all these processes are of the same character in the main. The blind printing and the printing in gold are done in the same press, the only difference being that when the work is gilt, leaf is applied to the parts required, in the usual manner, with glaire. The case, with or without the gold-leaf on it, is placed on the bed of the press, and a die is forced down on it from above, this die being heated by a gas jet or steam-pipe in a hollow box above it. For printing in black or other colour, another apparatus is used. This resembles in its main principles an ordinary printing-press, except that the printing surface is reversed, and acts downwards. The plate, on which lies the case to be printed, travels backwards and forwards automatically under the die, and has at one end an inking roller. The case is placed on this reciprocating bed, and it travels back under the die, the roller inking the die as it passes under it. The die is then forced down on it, the bed being held stationary below it. The die then rises, the bed moves forward again, and the case is removed to be replaced by another. This press is also equally applicable for blind work, the inking apparatus being detached, and the die being heated as before. By means of a recent improvement by Messrs. Hopkinson and Cope the same press can be used first for blocking, and immediately afterwards for printing, the heater-box being cooled by a jet of water. Two of these arming presses are shown, figs. 7 and 8.

Of course any or all these processes can be applied to each case, and the perfection to which the machinery has been brought enables this to be done with the greatest accuracy of register.

Another process commonly employed and capable of producing very pleasing effects, is that of "inlaying." In this a small piece of paper, of a different colour to the cloth, is pasted on the case, and the gilding and stamping effected over that. By this means the effect is frequently produced of lettering or devices in colour on a gilt ground, the cloth of the cover being of a different colour. Judiciously employed this device has very pretty results,

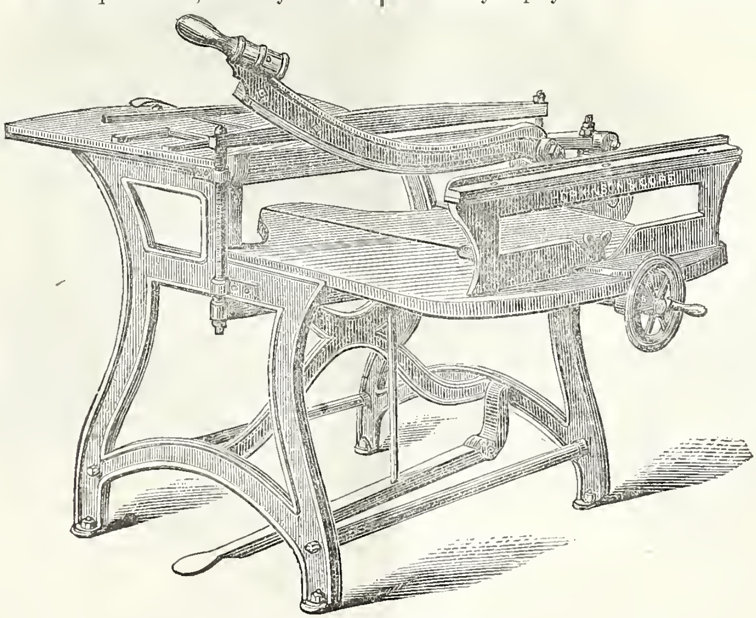

FIG. 5—MILLBOARD CUTTING MACHINE.

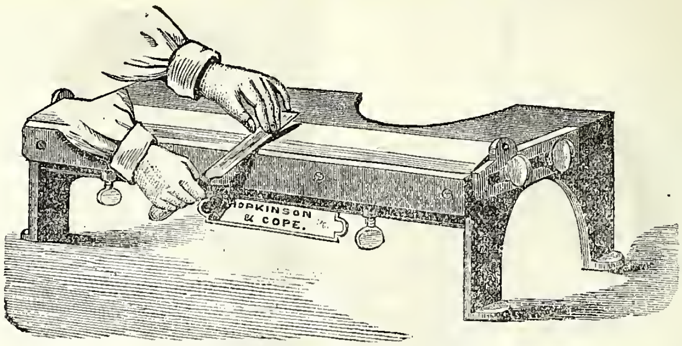

FIG. 6—BEVELLING MACHINE.

but sometimes—and this is often seen in German cloth binding—the patch-work appearance given by a mixture of several different colours is by no means pleasant or attractive. Perhaps the richest and best effects are produced by a mixture of black and gold printing. The ease with which the process is now carried out has made this style of work a very favourite one, and it is becoming the most usual way of getting up books which it is desired to render attractive at a moderate cost.

The book itself, and the case which is to hold it, having been thus separately prepared, it only remains to fasten the two together. This is rapidly done by hand, the canvas strips already glued on the back of the book with the fly leaves being then pasted down on to the cases. It is not usual to add head-bands to books in cloth, though in some highly finished examples this further finish is given to the book.

Such, in the barest possible outline, is the usual method employed in binding books on a large scale at the present day. So complete and rapid in their action are all the machines employed, that the bookbinder is able now to keep pace with the printer, and when once all the preliminary preparations have been gone through, the blocks made and mounted, the "making ready" finished, the process goes rapidly and steadily on, and the books are turned out a pace little short of marvellous.

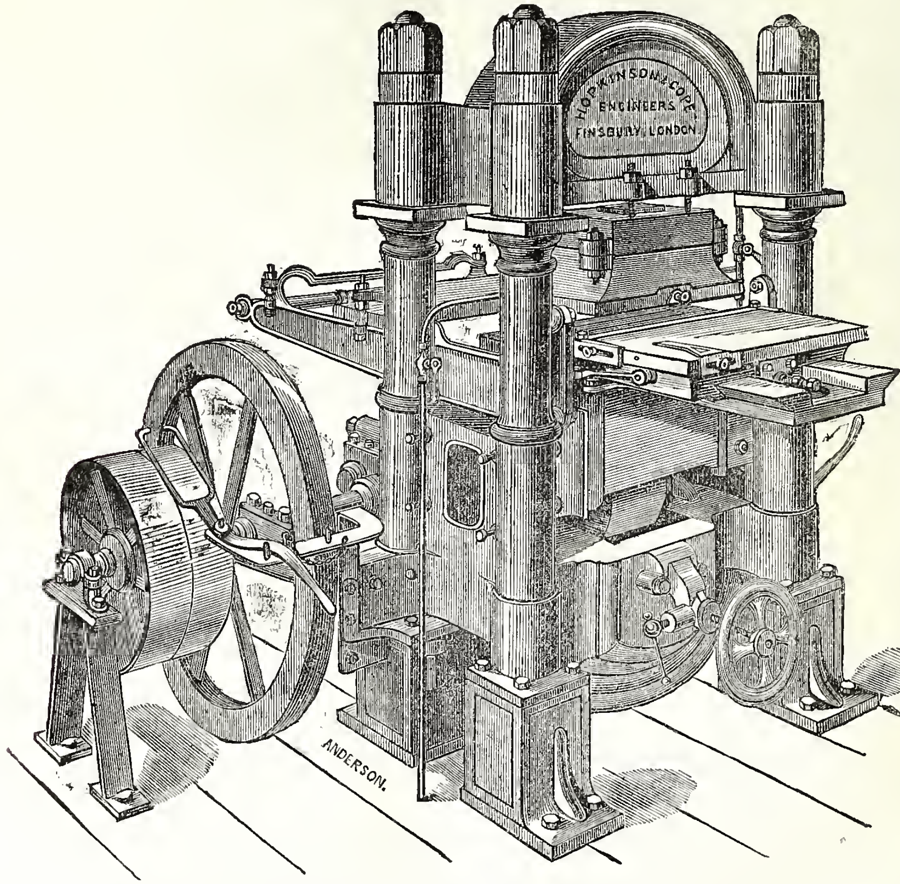

FIG. 7—ARMING PRESS. (HOPKINSON AND COPE'S).

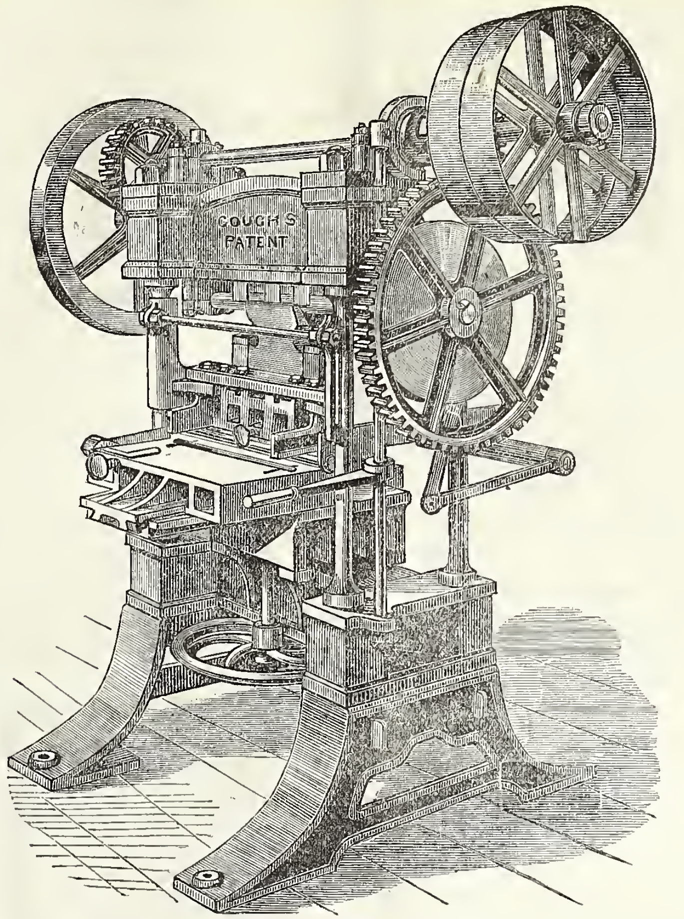

Fig. 8—Arming Press (Gough's).

Nor is mere rapidity of production the only, or the principal, gain. When a large number of books have to be bound it is almost as easy and cheap to produce an elaborate and handsome case as a plain and simple one. At all events, the slight additional cost of each volume is far more than repaid by the very great additional attractions it possesses.

The entire process as above described is shown by Messrs. Simpson and Renshaw, in Room I., among the machinery in motion, as is also the process of binding in leather. A variety of examples of modern library bookbinding in russia, calf, and morocco, bound in the Exhibition, is shown in their cases.

M. Zaehnsdorf also shows in Room XII. the process of binding by hand in leather, the whole work being in the latter case done by hand, in the old way.

In class 4, as above divided, viz., ledgers and account books, the chief advance made of late years has been in the direction of improved appearance. No longer satisfied with the old-fashioned rough calf, which soon gets soiled, our binders adapt to these purposes russia and morocco, and turn out volumes of a far more attractive character than of old.

Besides the introduction of machinery, and the improvement in taste, it is not easy to note any very great alteration of late years in the ancient art of bookbinding. The processes of binding in leather are now just what they have always been since the infancy of the art. The materials in use now for all sorts of bindings have undergone little change or improvement of late. They are, of course, as they have always been, most various; but it cannot be said there have been of late many introductions of importance. The use of ivory for bookbinding is well known, and a recent improvement in the method of cutting it, by which a continuous sheet is stripped from the circumference of the tusk, the whole tooth being thus formed into a single sheet, enables this material to be much more extensively and economically used than formerly. The process of india-rubber binding, patented many years ago by Mr. Hancock, is still used to a considerable extent. In it, as is well known, the sheets are all separate, and are united by a layer of india-rubber applied to their edges. The great advantage attaching to this method of binding is that the books can be opened out perfectly flat. For MS. books it is useful, but for account books a great drawback to it exists in the ease with which a leaf can be extracted and replaced.

A very fair idea of the existing state of the bookbinder's art may be obtained from a general view of the exhibits. There are examples of ancient bindings in sufficient number to illustrate the principal schools of bookbinding, while side by side with them are placed their modern imitations, as well as the more original work of our own age. To tell the truth, the style which is distinctly the product of our time compares but ill with the solid work of our fathers, and of those who still carry on similar work. However useful and valuable in their own way may be the bright cloth and gold bindings of a modern bookseller's shop, they seem tawdry and poor by the side of the massive tomes over which the ancient workmen lavished weeks and months of patient toil, or even the no less

laboured productions which are now sent out by our chief binders. Steam and iron can reproduce by the thousand objects of sufficient artistic merit and real beauty, but the unyielding force of the arming-press can never give us the free flowing lines that run from the tool of the skilful artist, nor can the rapid action of the other machines employed ever turn out the solid workmanship of the careful handicraftsman. Still there must always be abundance of room for the two sorts of work. The connoisseur of books will never be able to dispense with the one. The ever-growing public of book readers will provide an ample market for the other. Great as is the demand for cheap and quickly-made book covers, there is no falling off in the requirements for the highest class of bindings. Lovers of good books are as anxious as ever to lavish on their treasures all the adornment that the resources of the binder can supply, and it is satisfactory to note that these resources are as ample and as ready as of old.

With regard to the ancient bindings shown, it is obvious that only a sufficient number could be brought together to give specimens of the principal ancient schools. It is only in large and long-established libraries that the history of the art can be studied in its finest examples. Through the liberality of the owners, a select collection, sufficient for purposes of comparison, has been got together.

The following is a list of the exhibitors, with a brief notice of the principal specimens shown in each case. The exigencies of space prevent any extended account of many books well worth careful description, but it is hoped the short notices given may serve as a help to those anxious to examine this department of the Exhibition.

6552. Barker, Edward Matthew—Book bound in pigskin, printed a Wittenamberge in 1577.

6553. Barlow, Thomas O., A.R.A.—Choral Book, Figured Leather, with Brass Bosses; Church Casket, Figured Leather, Gilt, and Ironwork, 15th century; Casket in Black Figured Leather and Ironwork, 15th century.

6554. Bedford, Francis—Morocco and Calf Binding. This exhibitor shows a number of examples of the most highly finished modern workmanship in Leather Bindings. They comprise illustrations of most of the schools now generally in use. A noticeable feature is the tasteful and harmonious selection of colours in all the books, and the exquisite finish of the work. Amongst others—1. Some enamelled book-covers. 2. Book of Common Prayer, 1853; dark brown, richest Elizabethan style. 3. "Homeri Opera," two vols. Red morocco; Jansen style, quite plain. 4. "Reynard the Fox;" light brown morocco, elaborately ornamented in the richest English style. 5. "Cowper's Poems," 1841; rich English style; yellow morocco, inlaid in diaper pattern with green morocco. 6. "Rogers' Poems" and "Italy" (2 vols.); brown morocco, in richest Early English style, inlaid diaper pattern with red morocco, the inner covers correspondingly ornamented. 7. The same work (blue morocco) elaborately ornamented and inlaid in various coloured moroccos; inside covers equally richly ornamented and inlaid in imitation of a binding by Padaloup. 8. "Westwood's Anglo-Saxon Manuscripts; old red morocco. Design composed of Celtic ornaments. 9. "Destruction of Jerusalem;" red morocco; Grolier.

6555. Bell, Matthew—The chief exhibits are to illustrate a New Colour Process for Treating Cloth. The design is blocked on the cover with an adhesive varnish, and fine flock is then applied to the surface with a light brush. The superfluous flock is then brushed off, leaving a coloured surface adhering to the varnish. As far as the specimens in the Exhibition show, the colours are not sufficiently clear and strong to show well on the cloth, but the process, it is understood, is hardly yet fully developed, being quite new. There are also some cloth cases blocked in the usual way.

6556. Bemrose and Son—A special feature of these exhibits consists of some books with wood sides. The wood is introduced under several forms. Firstly, carved wood. As illustrations of this, several presentation addresses are shown. One is the address presented by the Derby Corporation to the Prince and Princess of Wales, and lent by their Royal Highnesses. The cover is of carved walnut. In the four corners are the Rose, Shamrock, Thistle, and Leek, while in the centre is the Prince of Wales's coat-of arms, illuminated on vellum and inlaid. The address is illuminated with vignettes in the borders and headings. Another application of wood is in the Masonic Address to Mr. C. R. Colvile. The corners are richly carved with oak, ivy leaves, &c., and in the centre is Mr. Colvile's coat-of-arms cut in box-wood. The address is on illuminated vellum. Another effect is obtained in the Address from Repton School. The walnut side is pierced, and a spray of carved ivy leaves is inserted on a gold ground; in the centre are carved the school arms. Another style of wood binding is shown in the copy of the "Book of Common Prayer." This is inlaid ivory and ebony of a delicate pattern let into a morocco binding. There are also other examples of marquetry and fret-cutting applied to binding. There are also three books in leather bindings:—1. "Moyen Age," bound in morocco, with sunk and inlaid panels of medallion heads, &c., painted on vellum. 2. "Macaulay's Lays," antique calf, hand-tooled. 3. "Wedgwood's Works," in red morocco, blind and gold hand-tooling. Some examples of account-books are also exhibited.

6557 Birdsall and Sons—Bookbinding; principally Hand-tooled Bindings in inlaid Moroccos, Russias, and Coloured Vellum. *Inter alia.*—1. "A Pedigree." In royal folio. Lent by the Marquis of Northampton; bound in black morocco, with inlaid and coloured vellum sides. The design is Italian in character, and consists of central arms inlaid and coloured and worked in gold and aluminium. They are surrounded by a diaper, in the alternate compartments of which are worked the various crests of the family, and small shields carrying the initial "C," also in gold and colours. The whole is contained within a flourished border, in which the heads of the supporters are introduced. The mounts are of *repoussee* metal gilt, with large onyx bosses. 2. An Album. Folio. In red morocco, decorated with a bold red pattern border, and powdered with gold flowers of the 15th century. 3. "Fasciculus Temporum" Small folio. Bound in crimson polished morocco, inlaid with a 15th century diaper in gold and colours. This design is adopted from contemporaneous painted decorations recently existing in some of the Norfolk churches. 4. "Dante's Vision of Hell." Folio. Black morocco sides, richly decorated with inlaid strap work and cartouches. The cartouches are alternately white and yellow, and carry the red lily of Florence, and black double-headed eagle of the Ghibellines. 5. "Le Temple de Jerusalem." De Vogue. Folio. Lent by C. T. Newton, Esq., of the British Museum. Red morocco, inlaid and decorated with a bold diaper pattern, within which are introduced the laburnum, golden candle-stick, and Jewish shekel—the former adapted and the three latter reproduced from early examples given in the work; the whole surrounded with a quotation from the Vulgate, Mark xiii., 1-2. 6. "Durer's Passion of our Lord." Small 8vo. Crimson inlaid morocco, with decorated leather linings. This design is adapted from a German Gothic diaper of about 1500, and is also repeated, with a somewhat different arrangement, in black and gold on vellum in the binding of a copy of "Berger's Early Printers' Marks." 7. "Clare's Poems," Lent by the Lady Marian Alford. White vellum, coloured diaper of marguerites, and border of marguerites and pearls. 8. "The Primer, 1545." Brown morocco, inlaid The design on this cover is adapted from some late examples of painted pannelled work on the roof of St. Alban's Abbey Church; the strap and metal fastenings from bindings of the date.

6558. Bowring, Edgar, A., C.B.—German Hymn-book, bound in velvet, with Metal Mount, after the design of the late Prince Consort.

6561. British and Foreign Stationery Company—Ledgers and Journals.

6562. Bruckmann, Frederick.—Bookbinding in Cloth. The books shown are examples of very highly finished cloth bindings. Many of them are deeply embossed. This is effected by thin board being subjected to strong pressure between dies, the hollows at the back being filled in afterwards, and the board being backed with a thicker layer behind it. The edges are generally bevelled, and the bevel impressed with a pattern. The illustrations (mostly photographs of a very high class) are mounted on linen guards, and all the work is finished in a way which until recently would never have been applied to any books not in leather. Although not quite connected with the present subject, it may be noticed that the books of this exhibit are valuable as showing how photography may be applied to book illustration.

6563. Buccleuch, Duke of—Ancient Bookbinding. King Charles' Bible, crimson velvet, with the royal arms, &c., and the letters "C R." embroidered in silver on the sides.

6564. Burn, James, and Co—112 cases for cloth-bound books. They show considerable variety of style and design, and the whole taken together offer an excellent view of the present state of bookbinders' art in this particular branch. Some of them go rather far in the attempt to make the outside indicate the contents of the book, thus a representation of the colours and lines of the spectrum is not quite suited for the ornament of a book cover, nor are landscapes, &c., either capable of such representation, or satisfactory when represented, but many of the bindings show much better taste, and in all the work is carefully finished. Some examples of white-cloth binding, closely imitating vellum, are specially noticeable.

6565. Cambridge University Library and Libraries of Trinity College and St. John's College.—A few specimens of Mediæval Bindings.

6566. Canterbury, Archbishop of—Ten Bookbindings of the 16th, 17th, and 18th centuries, from the Lambeth Palace Library. 1. Abbot, R., Sermons; 4to., London, 1623. 2 Brown, P., "Letter in answer to a book, 'Christianity not Mysterious;'"

8vo., Dublin, 1697. 3. "Catechismus Religionis Christianæ;" 8vo., Heidelburg, 1563; on cover is a head of Count Frederick Pfaltz. 4. Gander, J., "Glory of Queen Anne, &c ;" 4to., Lond., 1702. 5. Goodwin, W., Sermons; 4to.. Oxon., 1614. 6. Hooper, J., "Answer to Lord Winchester, &c.;" 4to., Zurich, 1547, and *ibid*, "Beginning and Ending of all Popery;" 4to., Lond., no date (bound together). 7. "Psalter in English Metre;' 4to., Lond., no date. 8. Rawlinson, J., Sermons; 4to., Oxon, 1623 (Archbishop Abbot's arms on cover). 9. Ross, A., "Virgilii Evangelisantis Christiados," Lib. xiii.; 8vo., Lond, 1638 (Archbishop Laud's arms on cover). 10. A Greek Book; 4to., Venetia, 1529.

6567. Clarke and Dunham—Mechanical Bookbinding. These exhibits include blocks for cases, and specimens of the cases blocked with them. Also some spring-cases for holding loose papers.

6568. Cope, Arthur—Ancient German Missal Manuscript of about 13th century, in Old Oak Board Binding; "Psalmorum Davidis Paraphrasis Stolhergensi," in original Binding, Stamped Vellum, Gilt and Tooled Edges, Heidelberg, 1596; "Le Nouveau Testament," printed at Charenton, 1668, by Estienne Lucas, in Grolier Binding.

6569. Courtier and Sons—Specimens of Ecclesiastical Bookbinding. The chief feature of these exhibits appears to be the designs with which they are ornamented, many of which are of great finish. Among the specimens may be noted a Bible, bound in calf, with bevelled boards; it is ornamented with light blind tooling, and has a rich gold centre, consisting of a quatrefoil border, with text surrounding an illuminated lettering, "Holy Bible;" also a Church Service in vellum, with I.H.S. in centre, and the symbols of the four Evangelists in the four corners. The latter design is by the late Mr. H. Rogers.

6571. Craig, J. Gibson—Four Ancient Bindings. 1. "Bartholomæi Camerarii, &c.;" in original binding, with emblems of Diane de Poitiers on the sides. 2. "Commentarii de M. Galeazzo Capella," from the library of the celebrated collector Demetrio Carevari, commonly called Mecenate, physician to Pope Urban in the 16th century. His device and motto are stamped on the sides, and represent Apollo driving his chariot across the waves towards a rock on which his winged Pegasus is pawing the ground. 3. "Chronique de Savoy," par Maistre Guillaume Paradius; Lyon, 1552. From the library of Mary Queen of Scots, in the original brown calf, with the arms of Scotland and the initial M. surmounted by a crown on the sides. 4. "L'Arismatique et Geometria de Maistre Estienne de la Roche;" Lyon, 1538. In the original brown calf, with blind and gilt panels, edges gilt and "gauffré." On the sides are stamped the arms of James Hepburn, Earl of Bothwell, third husband of Mary Queen of Scots.

6570. Cundall, Mrs.—Two Bookbindings of the 16th century.

6572. Cremers, V.—Marbled and other Papers for Bookbinding.

6573. Cunliffe, H.—1. Barne's "History of King Edward III.;" fol.; Cambridge, 1668. (Binder unknown.) 2. Book of Common Prayer; 8vo.; Cambridge, 1762. (Bound by Edwards, of Halifax.) 3. Ashmole's "The Way to Bliss;" 4to.; London, 1658. (Bound by Crawford.) 4. Form of Prayer and Thanksgiving after the Rebellion, 1715; 4to; London, 1716. (Binder unknown.) 5. "The Lady's Looking Glass," by M. B.; 8vo.; London, 1701. (Binder unknown.) 6. Sir Henry Wooton's "Reliquiæ Wottonianæ;" 12mo.; London, 1651. (Binder unknown.) 7. Robert Herrick's "Hesperides;" printed on vellum; 8vo.; London, 1846; two volumes. (Bound by Riviere.)

6574. Cole, Miss H. L.—"Albert Durer." Bound by Hayday, 1844. "Home Treasury." Bound by Hayday, 1844.

6575. Devonshire, Duke of—Specimens of Bookbinding, chiefly French and Italian, of the 16th and 17th centuries.

6576. De Lacy, George—Bookbinders' Tools. These include blocks (hand-cut), letters, and tools of all sort for binding in leather and stamps. There are also proof impressions of many blocks engraved by the exhibitor.

6577. Drewitt, F. Dawtrey—Two Ancient Bookbindings. 1. English Bible, 1682. 2. MS relating to the Charterhouse, 1619.

6578. Durham, Dean and Chapter of—MS. Biblia Sacra, Latina, *a*-ii.-I. Vol. iv.; Psalterium Glosator, *a*-iii.-7; MS. Ysazas Glosator, A-iii.-17; MS. Stephen Archip. Cant. Super. Eccles., A-iii.-28; MS. Excerpt. ca. opusc Gregoris, B-iii.-13; Hieronymus Opera, D vii.-4; Augustin Opera India, D-vii.-11; Augustin Opera India, 9-D-vii-20; Augustin Opera India, D vii-22; Gregoris decretal., G-iii.-6; Alex. Neckam, H-ii.-9; Vitruo a. Archited, H-ii.-22; Comment Budoe, L-v.-3; Rupertus in Ixou, P-v.-4; Albertus Magnus, P-v.-9; Diouysius, P-v. 5; Dionysius Pom., ii.-P-v.-8.

6579. Edwardes, Dyer—Examples of Ancient Bookbinding.

6580. Franks, Augustus W.—Six examples of Ancient Bindings, French, English, and Persian.

6580. Franks, Augustus W.—Six examples of Ancient Bindings, French, English, and Persian—1. Indo-Persian, 17th century, lacquered. 2. Arms of Pope Clement XII. (Corsini), 1730-40. 3. "Margarita Decreti," Paris, 1513; Old Stamped French Binding, André Bogle. 4. Official Dutch Almanack, 1722, in shagreen, silver clasp, and pencil 5. The same, 1760. 6. Panizzi, "Chi era Francesco da Bologna?" London, 1858, bound by Holloway, Grolier style.

6581. Gibbs, Henry H.—Twelve Ancient Bookbindings, chiefly French, Italian, and Spanish.

6582. Gerard, Miss—Ancient Bookbinding.

6583. Glaister, James—Two Specimens of Morocco Black Leather Frames, the pattern elaborately inlaid with various coloured moroccos, and richly gilt in the style of the ornamental leather work on the elegant and artistic book covers belonging to Diana of Poictiers, Grolier, and others of the 17th century. They are intended to hold miniatures, &c., in sunken compartments arranged in the design, and are shown as framing mirrors. They are curious, perhaps unique, specimens of the application of a description of leather-work, usually reserved for bookbinding, to a totally different purpose, and are perhaps remarkable rather for the ingenuity and skill displayed in their production than for the suitability of the material to its application.

6584. Gough, John—Printing and Arming or Blocking Presses, shown at work among the machinery in motion, in Room 1.

6585. Hamp and Co.—Bookbinders' Brass Blocks; "Gallery of Fine Art;" Album Blocks and Proofs.

6586. Harrington, J., and Co.—76 Modern Books, bound in an imitation of leather. The material closely resembles, in its varieties, the different sorts of leather used for binding. It is stated to be waterproof and supple, capable of being made of any colour, and of imitating any grain of leather; it is also said to receive the gold kindly, and to be suited for any usual kind of ornamentation.

6588. Hippesley, J. H.—Cloth Bindings.

6589. Hogg, S.—Ancient and Modern Styles of Bookbinding. Instances of modern workmanship in leather. Amongst others, "Birket Foster's Beauties of English Landscape" in blue morocco inlaid, and hand-tooled with a solid scroll pattern. "Christian Year" in white vellum with white watered silk lining. Also specimens of old walnut-tree calf and others.

6590. Jackson, Rev. John, M.A., F.R.A.S.—Holy Bible, John Field, Cambridge, 1660; 2 vols., folio; Luther's Bible, Nürnburg, 1716.

6591. Jeffrey, John, and Sons—Bookbinding and Restoring of Old Books. 1. "Bunyan's Pilgrim's Progress," &c. In the binding known as Harleian. 2. "Foxe's Books of Martyrs." In a style introduced about the time of Henry VIII., after the blind-tooling of the Monastic period. 3. "Gregoris Nazanzini," &c. Aldine style of about the 15th century. 4. "Carlo Quinto," &c. In one of the many varieties of old French bindings, designated tooled borders—the tools being worked singly. 5. "Constantine," &c. After an Italian design, for which the Society of Arts offered prizes. A specimen which gained the first prize in one of the competitions is in the South Kensington Museum. 6. "Ariosto." A design of the same character as the last, approaching the Grolier style. This was highly commended at the competition of the following year, but was precluded from taking a prize, the binder, Mr. Jeffrey, having taken the first prize in the previous year. 7. "Quintus Curtius." In calf binding of an Etruscan character.

6591*a*. Judd and Co.—Cloth Bindings.

6591*b*. Laehnik, Adolph (Austria)—Leather Mosaic Diploma Covers. inlaid in various colours, and specimens of Leather Bindings,

6592. Laing, David—Six Ancient Bookbindings. 1. "D. Hilarii Lucubrationes," &c., Erasmus. 2 vols. bound in 1; old calf, with initials J. S. C. S. A. (Jacobus Stewartus Commendatorio Sancti Andreæ) and Scottish Lion in shield, on sides; from the Library of the Regent Earl of Moray. 2. Beza, "Confession of the Christian Faith," Italian, 1560; in vellum; from the Library of Mary Queen of Scots. 3. Acts of Parliament of Scotland, 1621; from Library of James VI. (or I.); bound in olive morocco with the sides richly tooled. 4. Sequin, M., "Livre des Celebrants," &c.; Paris, 1730; 8vo., French red morocco; dedication copy to Cardinal de Fleury, with his arms. 5. Capt. T. Binnings, "Light to the Art of Gunnery;" Lond., 1676, 4to., in old English morocco, with monogram M. A. B., and ducal coronet on the sides. 6. Melancthon, "Examen," &c., 1565, 12mo.; old German binding, with medallion heads of Luther and Melancthon impressed on the sides, and the date 1566.

6593. Little, Philip Thomas—Plain strong Bindings in Cloth, Calf, and Half-calf. The speciality of these exhibits is their cheapness. No attempt has been made after beauty of design and costly workmanship, but the effort of the exhibitor has been to produce a strong, lasting binding that will stand wear and work.

6594. Littledale, Mrs.—1. "Book of Common Prayer," in Tortoise-shell sides with Medallions and Bosses, &c., 1704. 2. "The Whole Book of Psalmes," Bound by the Sisterhood of Little Gidding, 1635. 3. "The Book of Common Prayer," Old English Binding; Silver Medallions, &c., Silver Arms and Cypher, 1705. 4. "The Holy Bible," English Binding, 1681. 5. "The Spectator," French Binding, 1757. 6. Two Almanacks in Cases, 1782 and 1783. 7. "Les Souverains du Monde," French Binding, 1734. Various Volumes in English Bindings of 17th, 18th, and 19th centuries.

6595. Lothian, Marquis of—Seven examples of Ancient and Modern Bindings. 1. "L'amour de Cupido et de Psiche," Leonard Galtier; large paper; no date; modern morocco, with monogram of Marquis of Lothian. 2. "Boccaccio," Bruges, 1476; modern morocco, arms, monograms, and coronet as above. 3. "La Vie de Jules Agricola," &c., by Anga Cappel, 4to., 1574; in original binding; richly gilt; probably a presentation copy to Queen Elizabeth; it has royal arms inside of boards. 4. "Boccaccio" (French)

Paris, 1493; arms and monograms of Diane de Poitiers on sides. 5. "Epitome Historiarum et Chronicomus Mundi," per Achilles Gas-ams, 12mo., Lond., 1532; inlaid red and white "Jo. Maiolii et Amicorum." 6. "Historia Romaine," &c., on vellum; early part of 16th century; folio; inlaid old morocco binding. leather clasps, monograms of Diane de Poitiers. 6. Italian MS. on vellum; old morocco binding, stamped in silver.

6596. Machatschek, John (Austria)—Portfolio of Calves Leather. with wreath of flowers, painted and in sunken relief thereon; Album mounted with Sealskin.

6597. Maskell, W.—Specimen of Bookbinding in Needlework, 17th century.

6598. Mason, James—Ancient Manuscript Khoran in Arabic and Persian, 170 years old; original binding, with flaps.

6599. Moore, Samuel—Account Books. There are 19 samples, varying in size from foolscap to super-royal, all showing different styles of binding. The edges of the under-hands and boards are bevelled previous to covering, with the object of preventing any projecting corners, and thereby enabling the book to be handled with security. The workmanship of the whole appears strong and well finished.

6602. Orford, Earl of—Twenty-seven Ancient Bookbindings, chiefly French and Italian, of the 15th and 16th centuries.

6603. Palliser, Hugh C.—Specimens of the Binding of Books of H.R.H. the late Duchesse de Berry, mother of the Duc de Bordeaux, by Simier, of Paris.

6604. Pavy's Patent Company (Limited)—Specimens of a new material termed "Feltine," intended to be used in place of Cloth for Bookbinding. The following is a list of these exhibits:—Scrap Albums, common and medium; Sea-weed Album; Children's Scrap Book; Scrap Books, plain and miscellaneous; Newspaper Cuttings; Sketch Book; Album, rich; Common Photo-Album; Scrap, mosaique; imitations of Embossed Leathers.

6605. Paxon, Henry James—Ledgers, sup.-royal and medium; Cash Books, vellum and morocco. Among others a large ledger bound in russia, with tacketted under-bands also of russia, brass binding with rounded corners, patent spring clasp. Also, a square cash-book in morocco, with bramah lock let into boards and bound over so as to cover the lock and prevent its scratching the desk. All carefully and strongly finished.

6606. Ramage, John—Specimens of elaborate Calf and Morocco Binding, Inlaid Leather Work, and Tooling.

6609. Riviere, Robert—Morocco Binding, illustrating, by modern examples, the principal periods of the bookbinder's art. A "Dante" represents the Renaissance period, with its subdued but harmonious colouring and design. A "Doomsday Book" (folio) is a copy of a design made by the late Mr. Sykes for the binding of the original MS., now in the Record Office. The design represents William the Conqueror; the invasion of the Normans, and the enrolment. It was intended to be executed in enamel. It was, however, with many others (including one by the late Owen Jones) rejected by the late Master of the Rolls as too gaudy and elaborate for so venerable a document. The MS. was eventually bound by Mr. Riviere in plain black morocco, blind tooled, and with silver mounts. A "Fasciculus Temporum" is a small thin volume of the Maioli (Italian type). A "Milton" (quarto) is of the same school, interlaced and picked out in narrow dyed work. "Mœurs à l'Usage au Moyen Age" is of the Grolier school, as is also a volume of "Art Workmanship." "Thomas Aquinas," a folio in blue morocco of the Florentine school, modestly diapered. "Grafton's Chronicle" (folio) is an adaptation from a piece of quaint Tudor embroidery. "Hardyng's Chronicle" is an example of the Italian usually found on books in the possession of Cardinal Bonnelli. "Wordsworth" (two small volumes in light blue morocco), a reduced pattern from an Arabic MS. of the fourteenth century. "Guillim's Heraldry," a specimen of the English school, of the style known as "cottage binding" of 120 years ago. There are also some specimens of ordinary English bindings of the Harleian period.

6609*a*. Russian Artists, Society for the Encouragement of—Five Original Designs for Binding the Gospels, by Pupils of the Society's School.

6610. Shakespear, Rev. Wyndham A.—"Taylor's Holy Living": antique calf; bound by Parker and Co., Oxford; "Byron," in White Morocco, with foliated border.

6611. Simpson and Renshaw—Specimens of Modern Work in Cloth and Leather; amongst others a number of "Murray's Handbooks," in cloth, and some highly decorated children's books and novels. One of the most important books shown is the large folio volume on the Prince Consort's Memorial, in plain green morocco, with the arms of the Prince in gold on the sides. The firm also shows in operation the various processes of binding in cloth and leather as above described. Amongst the work at present in hand is a number of "Smith's Students' Manuals," for Mr. Murray's autumn sale.

6612. Spencer, Earl.—Thirty-one Bookbindings, chiefly French and Italian, of the 16th and 17th centuries.

6613. Spread, John W.—Dutch Bible, bound in Shell, Silver Mounted, by Jacob of Dort.

6614. Stevens, H.—Among the specimens shown are some in which a pattern on leather has been obtained by sprinkling with acetate of iron over a stencil plate, on the cover, bound in undyed leather. The book is then finished in any suitable manner. There are also specimens of tree marbling, in the border of one of which the pattern was first obtained in printers' ink, and then touched in with aniline colours; also examples of work done by stamping in varnish, and dusting over with a dry pigment.

6615. St. Paul's, Dean of—Manuscript, temp. Henry VII., belonging to the Library of St. Paul's Cathedral, bound in Velvet, enriched with Enamelled Silver Bosses and Clasps, and having Pendant Seals contained in Silver Boxes.

6616. Straker and Sons—Cloth Binding.

6617. Smith Brothers—Cloth Bindings of various sorts, one an imitation of Russia Leather. Two Modern Bookbindings. Albums bound in leather, with representation of flowers in Needlework let into side of cover.

6618. Tuckett, C.—Stained Leather Work for Bookbinding. Large Album for engravings, in stained russia.

6619. Tudor, Miss—Ancient Bookbinding. Two Prayer-books of the reigns of Queen Elizabeth and King Charles respectively.

6620. Turner, R. S.—Seventy-three Ancient and Modern Bookbindings.

6621. Vinter, Mrs. J. A.—Specimen of German Bookbinding, date 1619.

6622. Westmacott, Arthur, F.R.C.S.—Box richly bound in Green Morocco, and Writing Case in Red Leather.

6623. Zaehnsdorf, J.—Calf and Morocco Bindings of various styles:—1. Doré's "Bible" (2 vols. folio), in brown morocco is in a style imitated from a MS. of the 15th century; the ornamentation is floral in character, and is applied to the insides of the boards as well as the outside. The outside is inlaid with an illuminated cross, having a medallion in the centre, on which is figured a crown of thorns, and has a floral border round the edges. Inside is a monogram, I.H.S., interwoven, and a border similar in character to the outside. 2. Doré's "Dante" (folio), worked inside and outside the boards as the above; the outside is in red morocco, inlaid with a tesselated border and monogram in centre, surrounded by a wreath of flowers; the inside is in green morocco, inlaid with various colours in the Grolier style. 3. Doré's "Don Quixote" (folio), Maioli, inlaid. 4. "Recueil des Faiences Italiennes" (folio), light green morocco, fully gilt on side in modern English style. 5. "Etchings and Etchers," imperial 8vo., plain Grolier, with blind lines intersected. 6. "Jerusalem Explored," by Pierotti, imperial 4to, brown morocco, Monastic style. 7. "Voltaire," 8vo, red morocco, early Gascon style, the inside corresponding with the outside. 8. "Œuvres de Lovize Labé," 8vo, green morocco, Gascon inlaid. The remaining specimens are examples of ordinary English styles, tree calf, mottled calf, sprinkled calf, morocco, plain calf, &c. The process of binding by hand in leather is also shown in its entirety by M. Zaehnsdorf.

6650. Hopkinson and Cope—Bookbinding Machinery, consisting of Patent Printing and Embossing Press, Albion Arming Press, Patent Book Rounding Machine, Backing Machine, Hydraulic and Screw Press, Guillotine Cutting Machine, Millboard Cutting Machine, Saw Bench, &c. Shown in action among the machinery in motion in Room I.

NATIONAL TRAINING SCHOOL OF COOKERY.

The Duke of Westminster presided on Thursday, 21st May, at a meeting held in the great room of the Society of Arts, lent for the occasion, in support of the National Training School of Cookery. Amongst those present were Lord Granville, Lord Barrington, M.P., Right Hon. Cowper-Temple, M.P., Mr. A. J. Mundella, M.P., Lord Clarence Paget, the Hon. E. F. Leveson-Gower, M.P., Rear-Admiral Erasmus Ommanney, C.B., F.R.S., Lady Dorothy Nevill, the Misses Shaw Lefevre, Mrs. Scott, Lady Barker, Mr. H. Cole, C.B., Sir Daniel Cooper, Sir Walter Stirling, Mr. C. J. Freake, Lieutenant-Colonel Ducane, Mr. James Bateman, F.R.S., Captain Hans Busk, Mr. Scott Russell, Rev. Dr. Irons, Mr. T. Hughes, Q.C., Mr. Edward Wilson, Mr. Le Neve Foster, &c.

The Duke of Westminster read a letter from her Royal Highness Princess Louise, Marchioness of Lorne, who expressed her regret that she was unable to be present, having to visit her brother (Prince Leopold), who is ill at Oxford, and stated her intention to look after the interests of the school.

Letters of sympathy with the objects of the meeting were also read from the Archbishop of York, Lord Dartmouth, Lord Sidmouth, Sir J. M. Hogg, and others. It was announced that the following banks had consented to receive contributions in aid of the school:—in addition to the London and Westminster Banking Company, who are the regular bankers of the school, Messrs. Prescott, Grote and Co., Williams, Deacon and Co., Robarts, Lubbock and Co., Ransom, Bouverie and Co., Drummonds, Herries, Farquhar and Co., Cocks,

Biddulph and Co., Glyn and Co., Barnetts and Co., Fuller, Banbury and Co., H. S. King and Co., Hickie, Borman and Co.

The report of the Executive Commitee was then read by the Secretary; after which

The Duke of Westminster, in commencing his address, remarked that it seemed to be quite right and proper that a meeting of this sort should be held in the room of the Society of Arts, because cooking was unquestionably an art, and one, too, of very great importance. They were told that art was long and life was short, and he thought that there must be an intimate connection between the two, for if they wished to prolong their lives to the greatest degree, cookery was a highly essential matter for study; in fact, their lives might be lengthened or shortened in proportion as they cultivated the art or neglected it. There appeared to be some misapprehension as to the real work which the committee were doing. Some people supposed they had opened an office where cooks could be obtained, ready-made, on payment of a fee, or that it was a place where the best dinners could be had at the lowest price; and one lady, he believed, had even consulted Lady Barker as to the best means of getting a dairymaid. This was not the object of the promoters of the scheme, who sought to devise some means for improving the knowledge of cookery, which he was sorry to say was at a very low ebb in this country. The institution was established at a meeting held last year at Grosvenor-house, at which Mr. Leveson-Gower, Mr. Cole, and many ladies and gentlemen were present, and resulted in the maturing of the second branch of the scheme. A class of learners had been organised, and under the tuition of properly qualified cooks, its members had been taught to prepare simple dishes in the best possible manner. He had been present at one of the lessons when the cook was making lobster sauce, and he was struck with the attention that was paid to the remarks by the ladies present, who had their note-books in their hands, and who asked pertinent questions upon every point that seemed to require explanation. Those ladies paid fees for the privilege to attend, and after they had passed through a series of lectures they were supposed to know all that had been taught, and after passing an examination they got certificates, which no doubt were very valuable to them. The other branch of the undertaking was much more important, and would require a great deal more money, and for that reason the committee had not been able to undertake it at present. They propose to instruct a certain number of intelligent young women—who had the faculty of imparting knowledge to others—in the art of cooking; and as that would require either the hire or the purchase of a suitable building, they had determined to ask the public to support them in their endeavour. They conceived that after these young women had undergone a course of instruction, say for three or four months, they would be qualified to go into the country and instruct any classes that might be called together, or individuals who wished to be improved in the culinary art. Thus by degrees the operation of the society would be extended throughout the land. He thought the committee might fairly hope, if funds were forthcoming, to carry out, under the management of Mr. Leveson-Gower and Mr. Cole, who had effected so much for the advancement of art at South Kensington, a thorough revolution in the art of cookery, which he was sure was so desirable in this country. Then the people would be much more happy and agreeable on account of their digestions being improved. Englishmen, as a rule, were fond of grumbling; but he thought their tempers might be improved if their digestive powers were more looked after. Then there was the question of drink. If the wives of labouring men were enabled to give their husbands better dinners at less cost than at present, there would be less inducement for them to go to the public-house. The drink question, therefore, was not entirely separated from the scheme, but would play a most important part in it. It had been asked why they did not propose to teach the art to men and boys, and, in answer to that, all he could say was that at present the committee had enough on hand in teaching the weaker sex; but they would be glad, if funds were supplied, to extend their operations in any direction that might be of service to the community. The question, therefore, might develop itself at a later day.

The Hon. E. F. Leveson-Gower proposed the adoption of the report. The lectures, he said, were only preliminary to other operations, for nobody could learn to cook by listening to a lecture, but they had served to show the great amount of interest felt in the matter. The school had been a financial success. They began at Grosvenor-house with a subscription, to which their noble President responded with his accustomed liberality. The Duke of Westminster gave £100, but the whole of the subscriptions did not reach £400. He thought, however, that was due to the want of publicity and of canvassing. They had paid preliminary expenses out of the sum subscribed, and they hoped to repay them from the proceeds of the school as distinguished from the normal school. Doctors would tell them that ill-digested food, as much as the want of food, accounted for illness, and they hoped to introduce those modes of preparation which abounded in France. The Huguenots, as Mr. Helps had said, repaid us for our hospitality by teaching us to make soup of oxtails, and he hoped that they might, by their own similar efforts, increase the amount of food in the country. Some Englishmen had asked why they wished to be Sybarites, and to imitate the French—why not have economical fare? but his answer to them had been that no nation spent so much upon its food as the English nation, and no nation had so little in return. There was an enormous proportion of good food wasted in the cooking. The hon. gentleman's speech included a vigorous denunciation of the cooking in country houses and in the best hotels.

Lord Barrington seconded the resolution. He explained that the object of the committee was to obtain young women of good education and respectable position from every part of England to be trained in the school, and afterwards sent back to their own neighbourhoods to instil a knowledge of cookery into the inhabitants, through the medium of training schools and common schools. For this purpose the committee must buy or hire a building to accommodate fifteen or twenty of these young persons during their stay in London.

The resolution that the report of the executive be received and adopted, was then put and carried.

Earl Granville was then called upon to move "That an appeal be made to all corporations, benevolent and educational institutions, and the public generally, to place on a permanent foundation a National Training School of Cookery." His Lordship said that three principal causes brought him there—in the first place, his affection for his brother, the chairman of the Executive Committee (Mr. Leveson-Gower); secondly, his love of the fine arts, and, by implication, of that art without which none of the others could be exercised; and, in the third place, the importance of the work. He agreed with the noble duke in thinking that the art of cookery was a most useful and important one, and that it was sadly neglected and inefficiently carried out amongst all classes of society. A brilliant writer had asserted that the fate of a nation depended upon its diet. Now Englishmen were probably satisfied on the whole with the fate of Britain, and the British nation certainly had the best food; and there were many evils and imperfections in the method of cooking. Then, again, the richer classes oftentimes ate too much, for he was certain they had a great many more dishes than they could discuss, or than were good for their digestive powers. The lower classes, on the other hand, suffered from not having their food properly and sufficiently cooked, for their dishes were not made in the nourishing

or economical manner they might be if their wives and daughters really understood the culinary art. He thought the public were bound to show confidence in the plan that had been adopted by the committee to remedy these things, and more especially when they saw that a person of high literary attainments and very cultivated tastes like Lady Barker had turned her attention in a practical and business-like way to an art which might be thought vulgar, but which would contribute vastly to the happiness of the country. The committee had not incurred a debt and then appealed to be extricated from it, but they had shown by success that they were worthy of some confidence, and they desired to be put in a position to spread their teachers over all the country to give instructions in cookery for the advantage of every class.

Mr. Thomas Hughes, in seconding the resolution, said that the speciality of man was that he was a "cooking animal," and the more civilised the nation the better the cooks. He was afraid, however, England, which had the best material in the world, did not show that advantage by the use made of her succulent resources. He could not follow Mr. Leveson-Gower in thinking there was not enough good cookery among the upper classes. There was, in fact, too much. But he regretted the grievous waste which occured in the matter of cookery on the part of the best artisans.

Mr. Mundella supported the resolution, affirming the necessity of placing the school upon a permanent foundation, and regretted the little profit with which the present high wages of workmen were spent. After the Lancashire famine, a member of his family who visited his workpeople had said to him, "I don't know which is the worse, the famine they suffered from before or the cookery they are suffering from now." His wife found the women on returning from the factory "frizzling" good meat over the fire to a substance of the consistency of shoe leather. In three years an additional £13,000,000 was paid in England for meat. The greater part of that sum must have been applied for the consumption of the working classes, and he had no doubt that a very large proportion of it might have gone into the savings-banks instead if a smaller quantity of food had been bought, and that quantity well and economically treated.

The resolution was then put and carried.

Mr. Cowper-Temple proposed a list of vice-presidents for the ensuing year, which included the names of the Arrchbishop of York, the Duke of Sutherland, the Duke of Beaufort, the Marquis of Lorne, Lord Derby, Lord Spencer, Lord Granville, Lord Cowper, Lord Brownlow, Lord Dartmouth, Lord Carington, Lord Wharncliffe, Lord Barrington, Hon. E. F. Leveson-Gower, M.P., Sir D. Cooper, Mr. R. C. Browne Clayton, Mr. C. J. Freake, and Mr. Thomas Brassey, M.P. Mr. Cowper-Temple said that if he could only introduce among the working classes the use of such a cauldron as we see abroad always simmering upon the fire, we should add immensely to our people's means of nourishment.

Mr. Edward Wilson seconded the resolution, and referred to the agricultural labourer, saying it was a grievous thing to see an ill-fed man set to mind a well-fed animal. How could they expect to wean a man from his beer, or to receive from him a fair day's work, when he was not supported by wholesome and well-cooked food ?

Some further discussion took place, in which the present system of cooking in the army was commented on, and this caused the Duke of Westminster to suggest that the Duke of Cambridge should be added to the list of vice-presidents.

The resolution for the appointment of vice-presidents was duly carried.

Mr. J. Bateman, F.R.S., proposed a vote of thanks to the Chairman, and observed that as in the county of Stafford, where he resided, all the quails, ortolans, and turkeys were required for the miners and forgemen, it would be wise to organise a staff of ladies to teach their wives how to cook them.

Sir Daniel Cooper seconded the vote of thanks, which was carried by acclamation.

The Duke of Westminster briefly thanked the company, and the meeting broke up.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

MON. ... Royal Institution, Albemarle-street, W., 2 p.m. General Monthly Meeting.
Society of Engineers, 6, Westminster-chambers, 7½. Discussion on Mr. Suckling's paper "On Modern Systems of Generating Steam."
Institute of Surveyors, 12, Great George-street, S.W., 3 p.m. Annual Meeting.
Royal Geographical, 1, Savile-row, W., 1 p.m. Annual General Meetiog. 8 p.m., Dr. W. B. Carpenter, "Further Inquiries on Oceanic Circulation."
Social Science Association, 1, Adam-street, Adelphi, W.C. 8 p.m. Professor Leoni Levi, "On Imprisonment for Debt."
Entomological, 12, Bedford-row, W.C., 7 p.m.
British Architects, 9. Conduit-street, W., 8 p.m.

TUES. ...Royal Institution, Albemarle-street, W., 3 p.m. Dr. W. H. Stone, "On the Theory of Stringed Musical Instruments, with Musical Illustrations."
Photographic, 9, Conduit-street, W. 8 p.m.
Biblical Archæology, 9, Conduit-street, W., 8½ p.m. 1. Prof. W. Wright, "On the Phœnician Inscription, commonly called the Melitensis Quinta." 2. Mr. P. Le Page Renouf, "On an Egyption Calendar of Astronomical Observations of the XXth Dynasty." 3. Mr. Joseph Bonomi, "On the Cylindrical Monument of Nechtarheb (XXXth Dynasty), at Turin." 4. Dr. S. Birch, "On the Translation of the Text on the Monument of Nechtareb (*Nectanebos*)." 5. Mr. H. Fox Talbot, "On Assyrian Notes, No. 1, Use of the Papyrus in Assyria, Assyrian Books, &c."
Zoological, 11, Hanover-square, W., 8½ p.m.
Sculptors of England, 7, Gower-street, W.C., 7 p.m. Annual Meeting.

WED... Geological, Somerset House, W.C., 8 p.m. 1. Mr. T. F. Jamieson, "On the last stage of the Glacial Period in North Britain." 2. Rev. T. G. Bonny, "Notes on the Upper Engadine and the Italian Valleys of Monte Rosa, and their relation to the Glacier-erosion Theory of Lake-basins." 3. Mr. Thomas Belt, "The Steppes of Siberia." 4. Mr. D. Mackintosh, "Additional Remarks on Boulders, with a particular reference to a group of very large and far-travelled erratics in Llanarmon Parish, Denbighshire."
Microscopical, King's College, W.C., 8 p.m.
Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.

THUR....Antiquaries, Somerset House, W.C., 8½ p.m.
Linnæan, Burlington House, W., 3 p.m. Dr. M. T. Masters. "On the *Restiaceæ* of Thunberg's Herbarium." 2. Mr. J. Miers, "On *Napoleona*, *Omphalocarpum*, and *Asteranthos*." 3. Mr. H. Cunry, "On some Fungi collected by Dr. S. Kurz in Pegu."
Chemical, Burlington House, W., 8 p.m. 1. Mr. Huskisson Adrian, "On Dendritic Spots." 2. Mr. James Resch, "On the Acidity of Normal Urine." 3. Messrs. J. W. Russell and S. W. West, "On a simple form of Apparatus for estimating Urea in Urine." 4. Mr. M. M. Pattison Muir, "Note on Kauri Gum." 5. Mr. George S. Johnson, "On certain compounds of Albumen and Acids." 6. Messrs. E. Neison and James Bayne, "On Ipomacic Acid." 7. Mr. Watson Smith, "On the Action of Chlorine, Bromin, &c., on Isodiuaphyl." 8. Dr. Tommassi, "On Acetyl Sulphrite." 9. Dr. Tomassi, "On new product of Toluol."
Society for the Encouragement of Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. George Browning, "The Art Treasures of Italy, Rome, Naples, and Pompei."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. N. S. Maskelyne, "On Physical Symmetry in Crystals."
Royal Society Club, Willis's Rooms, St. James's, S.W. 6 p.m.

FRI.......Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Prof. Burdon Samuelson, "On Venus's Fly Trap (*Dionæa Muscipula*)."
Geologists' Association, University College, W.C., 8 p.m.
Philological, University College, W.C., 8 p.m.
Archæological Institution, 16, New Burlington-street, W., 4 p.m.
Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m. Prof. Bentley, "On the Reproductive Organs of Plants."

SAT......Royal Institution, Albemarle-street, W., 3 p.m. Mr. R. A. Proctor, "On the Planetary System."
Institute of Actuaries, 12, St. James's-square, S.W., 3 p.m Annual Meeting.

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No. 1,124. Vol. XXII.

FRIDAY, JUNE 5, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

CONVERSAZIONE.

The Annual Conversazione of the Society will be held on Friday, June 19, at the South Kensington Museum.

The issue of tickets is now proceeding, and members not receiving their tickets in good time are requested to communicate with the Secretary.

The following are the arrangements for the evening:—

1. A vocal concert, consisting of glees, by the London Glee and Madrigal Union, directed by Mr. Land, will be given from 9 to 11 o'clock, with intervals, in the Lecture Theatre; and the Council request that, as the theatre will only hold 700 persons, the audience will change at every interval, to enable the greatest number to have the pleasure of listening to the concert.

A promenade concert will also be given by the Band of the Grenadier Guards in the North Court.

2. Visitors will be able to make the tour of the Art Schools both on the first and second floors.

3. The Raphael Cartoons, the Sheepshanks and the National Gallery's Picture Galleries will be open.

4. The courts and corridors of the ground floor will be open. The reception will be held in the South Court by Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman, and other members of the Council.

5. The Art Library will be opened.

ECONOMICAL USE OF FUEL.

A meeting of this Committee was held at the Testing Houses, Western Annexe, International Exhibition, on Saturday, May 30th. Present—Mr. F. A. Abel, F.R.S. (in the chair), General Eliot, Capt. D. Galton, C.B., Dr. Mann, and Major Webber, R.E., with Mr. Le Neve Foster, Secretary, and Mr. S. W. Davies. The Committee took into consideration the arrangements and conditions for testing the gas cooking apparatus.

IMPROVED RAILWAY LAMP.

The Society's Gold Medal, or Twenty Guineas, is offered for an improved lamp or means of illumination, suitable for railway passenger-carriages, that shall produce a good, clear, steady, durable, and safe light.

It must be simple in construction, and capable of being readily cleaned and repaired.

In judging the merits, cost will be taken into consideration.

Specimens in a condition suitable for trial to be sent in to the Society's House not later than the 1st of November, 1874.

The Council reserve to themselves the right of withholding the medal or premium offered, if, in the opinion of the judges, none of the articles sent in competition are deserving of reward.

INTERNATIONAL EXHIBITION OF 1874.

The Council have resolved to offer the Society's Gold and Silver Medals in connection with the International Exhibition of 1874.

A gold and a silver medal is offered in each class, and these medals will be given for any object exhibited which, in the opinion of the Council, shows paramount or very great excellence, whether in respect of the final result, the machinery, method of production, or novelty.

CONFERENCE.

The Twenty-third Annual Conference between the Council of the Society and the representatives of Institutions in Union, will take place at the Society's House, on Friday, the 19th June. The chair will be taken at 12 o'clock, by Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman of Council.

Secretaries of Institutions and Local Boards are requested to send, *immediately*, the names of the Representatives appointed to attend the Conference; and early notice should be given of any subjects which Institutions or Local Boards may desire their representatives to introduce to the notice of the Conference.

ENDOWMENT FUND.

The following subscriptions have been received towards the establishment of an Endowment Fund for the Society:—

	£	s.	d.
G. T. Saul	5	0	0
W. R. Spicer	5	0	0
Colonel A. Angus Croll	20	0	0
G. W. Hart	2	2	0
Charles H. L. Woodd, F.G.S.	5	0	0
John E. Evans	2	2	0
Sir Walter E. Trevelyan	50	0	0
E. T. Blakely	1	1	0
W. R. Sandbach	50	0	0
Thomas Dixon	1	1	0
W. Atkinson	50	0	0
John Noble	20	0	0
James Bentley	20	0	0
J. Jonas	1	1	0
Samuel Jackson	5	5	0
Charles Goding	20	0	0
F. Mocatta	10	10	1
Jonah J. Wells	10	10	0
Charles Downes	2	2	0
G. T. Saul	2	2	0
Mrs. Charlotte Holmes	10	0	0
John Knowles	25	0	0
Sir John Le Couteur	1	0	0
John Peckover	5	5	0
Frederick Braby	2	2	0

PROCEEDINGS OF THE SOCIETY.

COMMITTEE ON THE MEANS OF PROTECTING THE METROPOLIS AGAINST CONFLAGRATION.

OPPOSITION BY VESTRIES TO THE CONSTANT SUPPLY OF WATER TO THE METROPOLIS.

Dr. Sutton, the medical officer of Shoreditch, in a recent report, recommended to the Vestry the application of the system of the constant supply of water to that parish, and that they should take steps for the purpose. He had written to the New River Company, who had informed him that they had made all the arrangements which are required in connection with their own works, for a constant supply of water to houses in the parish of Shoreditch.

In his report he gave a copy of the following letter from the New River Company, in answer to his application:—

"New River Office, 27th January, 1874.

"Dear Sir,—In reply to yours of this morning, I have to state that the New River Company have already made all the arrangements which are required, in connection with their own works, for a constant supply of water in the parish of Shoreditch.

"All that remains to be done in preparation for the supply, is the provision of appropriate 'fittings' by the owners of the houses, for which the said supply is desired.

"Although the company might select any portion of their district for constant supply, and insist upon a provision of the requisite fittings therein, my directors have felt that, as their so acting would unavoidably involve the owners of houses in a good deal of outlay, which they might be very unwilling to incur, it better becomes the local authority (as the guardians of the public health) than the company, to take the initiative in his matter. The company's requirements as to fittings are those which have been set forth in the regulations lately issued on this subject with the authority of the Board of Trade.

"I am, sir, yours truly,
"James Muir."

On the the 22d ult., the Vestry, by a majority of 34 to 15, rejected the recommendation of the officer of health and of the sanitary committee of the parish. They did so after much discussion, mainly in apprehension of the expense entailed by the alteration of the house services to meet the requirements sanctioned by the Board of Trade—an apprehension which the letter of the water company was calculated to confirm. The expense to be incurred was stated by the opponents of the measure to be £5 each for the lowest classes of houses, but it was not determined, nor, as the work would have to be done by each owner's own plumber, could it be. Other vestries have adopted the same course of opposition to the change proposed. In general, this course has excited much disappointment amongst the promoters of sanitary reform, and much displeasure against the vestries. The case is illustrative of the position of the water question for the metropolis at the present time, and requires explanation, from which it will be seen that the opposition is not without justification. In this instance of Shoreditch, as of the others, the majority of the opponents was composed largely of the owners, mostly the poorer owners of the poorest classes of property. Many of these owners, besides being poor, are only lessees of short unexpired terms, or of very limited interest in the property. Many of them are poor widows, and persons living on the collection of weekly rents, on whom the heavy immediate exaction for works of permanent benefit, in which they had only short interests, would operate as confiscations of their property.

A medical officer of health of Whitechapel, Mr. Liddle, in giving evidence before a recent Committee on the Improved Water Supply of the Metropolis, having described the sad condition of the tenements occupied by the poorer classes, was asked, "What is the class of owners of that kind of property of which you have been speaking?" "They vary a great deal, and, unfortunately, owing to the various sanitary requirements, persons who were formerly possessed of many of these houses are now disposing of them; persons who are incompetent to fulfil the duties of landlords, which is very often the case, now appeal, *ad misericordiam*, not to take proceedings against them." The officers having to make or to levy the charges speak in terms of compassion of the oppressive, immediate, undisturbed levies upon these classes of owners; and evidence was given before another committee that they almost amount to entire confiscation.

It was represented, in support of the measure, to the Vestry at Shoreditch that these charges would ultimately be repaid by the improvement which the alterations would make in the property, which is true if the charges were just, but a large proportion of the owners of this poorer property being only lessees on short terms, they are not in a position to partake of the ultimate benefits for which immediate payments are required.

Such are the conditions of the opposition which has been made in nearly all the vestries of the metropolis to the change of system required. It should be known that these conditions were inquired into and provided for by the Committee of the Society of Arts. Mr. Quick, the engineer of the Southwark and Vauxhall and the Grand Junction Companies, was asked—

"*Q.*—As the work to be done, besides being for the individual benefit, is also for the common or public benefit, would there not be an important equity in having it done from a common fund?

"*A.*—Certainly, particularly for the smaller class of house property in the poorer districts, because, as I have stated, so much of that property is in the hands of persons, lessees, who have only a short interest in the premises, and on whom the immediate outlay would operate often as a confiscation of their remainder rents. This is, indeed, the great source of the opposition to the constant supply."

The financial question, with a view to the obtainment of a common fund, has been closely examined, and it has been ascertained that a fund of a sufficient amount for the purpose, as also for the provision of hydrants for protection from fire, may be obtained by a consolidation of the eight separate companies, and placing the water under unity of management on a public footing, as recommended by several royal towns commissions.

Thus it is estimated that the charges for pumping may, by improved arrangements, be reduced upwards of £25,000 per annum;—that the charges of management may be greatly reduced, including upwards of £20,000 per annum for law and parliamentary expenses, £15,000 per annum to the directorates (after liberal payments of compensation to them, as well as other office-bearers), and various other items of expenditure may be reduced, amounting, on the whole, to between one and two hundred thousand pounds per annum. In these investigations, reference was again made to the condition of the poorer class tenements in the following question, put by the committee to Mr. Quick:—

"*Q.*—It has been stated that to obtain a constant supply, and to prevent even augmented waste, considerable alterations must be made in the water fittings and appliances, especially in the poorer class of houses. Do you not conceive that, if the saving to be obtained by consolidation, that is to say £100,000 per annum, be capitalised, it would suffice to defray the expenses of the change?

"*A.*—No doubt; and it would obviate the difficulties in making the necessary alterations now experienced by the owners of the poorest class of property, many of whom have very short interests in the premises, and to whom the immediate payments of the full amount of the outlay required might operate as a confiscation of their remainder rents. It may be a very great and just measure of relief."

Now, this just measure of relief, it should be known is fully provided for in the Bill now before Parliament The directorates of two of the companies have signified their acceptance, for themselves and the shareholders, of the terms of compensation proposed; but others of the directorates, it is stated, oppose the measure, in the interests of perpetuities to themselves and solicitors in the continuance of the present separate system, and to the exclusion of the saving derivable from consolidation; necessitating, if their opposition were to succeed,

either a perpetuation of the present system against repeated reports of Commissioners—or an immediate outlay of between one and two millions of money for putting the private-service apparatus in order to receive the constant supply, and for providing the hydrants requisite for fire-prevention.

It has been stated that the companies are preparing for the introduction of the constant supply, but that the public are very apathetic in receiving it. It should be understood that the maintenance of the constant supply in the street mains is only one—the first step—of little value in itself for domestic purposes unless the constant supply is maintained in all the house service pipes as well. The poorer classes of occupiers as a rule know nothing of the machinery of distribution. It has been proved practically that individual owners of the higher classes will not step forward individually to move the alteration of a great system of works. The source of the more than apathy—the hostility—of the owners of small tenements to the change of system is explained in the proceedings of the vestries, as above represented. Moreover, it has been carefully promulgated by several of the companies that an entire change of the present fittings, and the adoption of much stronger fittings for all houses, high as well as low, would be necessary to sustain the constant system of supply. The scale of charges for the works required, as stated before the Commission of the Board of Trade, ranged from £9 19s. to £63 10s. per house, or an estimated aggregate of nine millions for the 450,000 houses of the metropolis. On the inquiry of the Committee of the Society as to the actual results of changes from the intermittent system to the constant system of supply, especially in Manchester, where the change was made under much higher pressures and much greater difficulties than London, it was proved that no general change of fittings was required, and Mr. Berrey, the officer who conducted the change there, has assured the committee that the change may be effected in the metropolis at the same rate of expense as it was effected in Manchester, namely, at a rate of ten shillings per house, one with another over considerable numbers. Of immediate questions to be put are these. Are the opposition Directorates prepared to make the requisite adaptations of the house services gratis, as would be done under Colonel Beresford's Bill? And if they are, could they prevent waste, as has been done in Manchester, where the supplies are on a public footing? Are they prepared to extend supplies to the poorer class of new tenements at reduced rates, with the benefit of capital raised, on a public footing, at 3½ per cent., and at the cost of the service (as would be done under the proposed measure) and not at a trading profit? As respects the measures needed for fire prevention, are they prepared to place hydrants with hose in all the streets, so as everywhere to bring supplies to bear in little more than two minutes, and would they unite all their works for concentrating the supplies on any district in case of need, and to do all this gratis out of the saving derivable from consolidation, as it is proved may be done under the measure proposed? Moreover, are they prepared to supply water for street washing and road-watering, without any profit, and only at the cost of the service, at 2d., instead of 6d. and 1s. per 1,000 gallons, as would be done under the measure now before Parliament?

In the existing conditions of the separate trading companies such measures would be ruinous to the shareholders, and are out of the question. The conditions of those companies, heavily burthened with separate establishment charges, yet legitimately working for trading profit, are deemed to be conditions essentially antagonistic to the public, and impossible to be worked with economy and satisfaction, and that it is in the interests of the shareholders that they should be relieved from them without further delay.

The Bill now before Parliament, in removing the ground of the opposition of the small owners, and of owners of every class on the score of the expense of the change, places the responsibility on those of the directorates who oppose the measure, notwithstanding the liberal compensation proposed to them.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

The following is the return of admissions for the eighth week, ending May 30th:—Season tickets, 2,584; payment, 22,179; total, 24,763.

An exhibition of the designs and works of the late Mr. Owen Jones will be held during the present month at the International Exhibition. Proprietors of works willing to lend them are requested to give notice to the hon. secretary, E. Pigott, Esq., 9, Argyll-place, Regent-street. A movement is in progress to perpetuate the memory of the services rendered by Mr. Owen Jones to the Art of this country, and subscriptions are being collected for the purpose by an executive committee, of which Mr. Pigott is hon. secretary. The memorial will, in part, take the form of a mosaic potrait, which will be offered to the nation. The application of the remainder of the funds which may be obtained is not yet decided on.

ENGLAND AND CENTRAL ASIA.

Prospects of Trade with Eastern Turkestan.

The following despatch has been received by the Indian Government from Mr. Forsyth, together with the Yarkand Treaty:—

"In forwarding the Treaty of Commerce just concluded with his highness the Ameer of Kashgar and Yarkand, I wish to offer some remarks on the prospects of trade between India and Eastern Turkestan, regarding which very widely divergent opinions are held—one class holding the belief that the people of this country are much below the ordinary Hindoo in the scale of civilisation, and that the difficulties of the Himalayan route must ever prove a barrier to extensive trade; the other class going to the opposite extreme and encouraging the British manufacturers to believe that the conclusion of a treaty is only necessary to enable them to ship loads of bales consigned to the Yarkand and Kashgar markets.

"2. The truth lies in the mean between these two extremes; and while those who depreciate the importance of the trade are probably not thoroughly acquainted with the subject, on the other hand it would certainly save the more sanguine class from disappointment if before despatching their goods they weighed well the following facts.

"3. What strikes every Englishman who has visited the Ameer's dominions is the very comfortable condition of the people and the degree of civilisation they have attained, considering the entire want of contact hitherto with European nations. They are industrious, peaceful, and, as a rule, remarkably intelligent and very energetic, and would be quick to appreciate and adopt all the advantages offered by European science.

"4. Russian and English goods are eagerly sought, and though there are certain prejudices of religion against clothes figured with the resemblances of animal life, there are no such caste difficulties to be overcome as are to this day to be met with in India.

"5. The population is much scantier that we had been led to expect, and there is much more land available for cultivation and capable of irrigation by the numerous canals and streams than there are hands for; in fact, the prolific crops now raised would feed many more mouths than there are at present. Sheep and fowls are abundant, cows are not quite so plentiful. The disturbances of late years have, of course, much to do with the scantiness of the population, as may be seen in the undue proportion of females to males. This would prove an obstacle to a speedy development of trade on a large scale, but it is an evil which a few years of peace and good-will will soon remedy. Already the population in the cities of Yarkand and Kashgar is on the increase, and everywhere that we have travelled there is the appearance of a thriving people. The bazaars are well filled, trade is brisk, houses are springing up on all sides, and poverty is said to be on the decrease, so that on this head I can speak confidently.

"6. Time and peace only are necessary for the production of a large demand for necessaries and luxuries.

"7. The next great drawback is the want of proper currency, in consequence of which all commercial transactions have to be carried on more less by barter. It is the intention of the Ameer to introduce a silver coinage, and until this has been fully established merchants must content themselves with taking gold dust, felts, shawl, wool, churrus, carpets, &c., in exchange for their European goods. If very large consignments of British manufactures came over, the importer would perhaps find the market swamped by consignments from the Russian side, and they might have difficulty in getting loads in exchange which would fetch any fair price in the Indian markets.

"8. The next obstacle is the road over the Himalayas. At present mules and ponies are the only beasts of burden employed; and though the road by Kullu and the Bara Lacha has been rendered practicable for camels, it is exceedingly doubtful if Indian camels could stand the great cold of the higher Himalayas north of Ladakh.

"9. For mules and ponies the road between Leh and Yarkand passes for days over an inhospitable tract, where grass and grain are not to be found, and it would be necessary for traders to carry supplies with them or to lay them out at convenient distances. From the Yarkand side the difficulty of carriage can be met with more successfully, as the double-humped Bactrian camel is to be had in any numbers, and is bred in the Kogyar district. These animals are well adapted for crossing the high desert plains of the Karakorum, and if Mr. Johnson has been successful in finding a road down the Shyok practicable all the year round, there is no reason why camels should not go with their loads to Leh. They have already gone there with ease by the more circuitous Changchenmoo route.

"10. The Yarkandee ponies far surpass all other animals of their kind as beasts of burden, and, for all animals, the difficulties of the mountain route will be immediately reduced by the opening out of the Kogyar line, by which one low easy pass is substituted for the high and troublesome Suget and Sanju passes, and the journey will be shortened three days.

"11. The question of the best line throughout to be adopted must be reserved for discussion when all the information requisite for forming an opinion has been collected. But it may be assumed at once that the Kogyar route between Aktagh and Yarkand will certainly be adopted, and if so, then mules from the plains of the Punjab can without any great risk make the journey to Yarkand. Last year they came across the Suget Pass as far as Shahidulla or close to that place, so that they could certainly have crossed the easier pass to Kogyar, and then would have reached the plains of Yarkand.

"12. As regards the Ladakh and Cashmere ponies as a means of carriage, the stock is not nearly sufficient for the requirements of the trade as it is at present; and it is not likely that they will increase to any extent, and I look to Yarkand for the supply of carriage.

"13. Another supposed obstacle to our trade is the competition of Russia. Undoubtedly Russian goods have obtained the chief place in the bazaars of Eastern Turkestan, and the road between Kashgar and Russian territory offers none of the great difficulties to be met with on the Ladakh route; but it is, I believe, a fact that English goods can be conveyed at a cheaper rate through India and over the Karakorum than through Russia to Kashgar.

"English goods under Russian covers are sold here, which shows that our manufactures do somehow or other find their way into this country. Russian chintzes have a large sale here; but, comparing prices, I find that superior English chintzes could be sold at a much lower figure, and still leave the importer a handsome margin of profit.

"At present the few Indian traders who come over with ventures consider they have not done well if they do not clear 75 or 80 per cent. profit.

"Unless, then, the Russian merchants make the same rate of profit, it is clear that English goods ought to hold their own, to say the least, against all others.

. . . .

"23. It may perhaps appear at first sight that I have little faith in the elasticity of the trade which I am specially empowered to foster by treaties and other facilities. But this is very far from the fact, though I believe I am consulting the real interests of our British merchants and of Eastern Turkestan in putting all the circumstances of the case in a clear light.

"24. That the trade is capable of expansion experience has proved. When the subject was first brought to Lord Lawrence's notice in 1866 the total amount of annual exports and imports at Leh did not exceed one lakh (£10,000), and Wuzeer Goshaon, whose opinion was sought by the then viceroy, was considered to have overshot the mark when he suggested a possible increase to ten lakhs (£100,000) per annum. From the returns published by the Supreme Government we find that within five years fifteen lakhs (£150,000) have been passed, and as the obstacles to which I have alluded are gradually removed, the expansion of commerce in this direction may spread to a very large extent.

"25. But if British merchants try to act in defiance of all prudence, and without proper arrangements, they are sure to meet with disappointment, and will cause discouragement to others.

"26. I am led to offer these remarks by the receipt of a letter from a gentleman who signs himself as Director of a Company for trading with Eastern Turkestan, in which he informs me that he purposes leaving the Punjab on the 20th of May next with 600 loads of merchandise, valued at three lakhs of rupees, and he requests me to order supplies for his animals to be laid out on the road between Leh and Yarkand.

"27. It is not for me to offer him advice, and the idea of laying out supplies for him alone is of course not to be entertained; but as other merchants may be disposed to follow his example, I think they would do well to ponder over the facts I have put forth in this letter. There is wisdom in proceeding by degrees and not putting too great a strain on a growing structure.

"28. Experience tells me that to convey 300 loads from the Punjab to Yarkand requires an immense amount of forethought and arrangement, as well as a considerable expenditure, without which disaster would have been inevitable in crossing from Leh to Yarkand.

"29. Up to Leh the difficulties of supplies are far less and each year will decrease. In course of time I hope the Maharajah on his side, and the Ameer on the other, may be induced to arrange for supply-houses at convenient distances, and possibly, by judicious planting, grass and wood may be reared on some parts of the road; but till some such facilities are afforded, I should think small consignments would be more likely to be successful, and the establishment of a mark t at Leh will give probably a good impetus to the completion of the desired arrangements.

"30. To meet the wishes of the various Chambers of Commerce I am making as complete a collection as I can of samples and specimens of all goods in use in this country, which are capable of being manufactured profitably in England or India. The information regarding the travelling stages for merchants, &c., will be given when I submit my report on the various routes over the Himalayas. Meanwhile the following hints and facts may be considered useful.

"31. A mule or pony ought not to be compelled to carry more than 225lb., or 2 cwt., and spare animals in the proportion of five per cent. should be taken. The hire of a pony or mule from the Punjab to Yarkand is seventy rupees, or £7.

"32. Goods consigned from England for the Yarkand market should be packed in bales of 1 cwt. each, wrapped in skins or other stout material to resist damp, as well as the thorny bushes in the valleys, which are very destructive. Spare pony or mule shoes at the rate of three sets per animal should be taken, and it is advisable to have among one's followers one or more men who can do farrier's work.

"33. In selecting goods for the Yarkand market patterns with figures of birds or animals should be eschewed; stripes find more favour than checks: bright colours are much preferred by the people here; black is not at all approved; tweeds are not appreciated. Glacés, chintzes and all kinds of cotton goods are in great demand, though a common kind of cotton cloth is largely manufactured at Khoten, and is even exported to Kokand.

"34. All goods should be of the best quality, good prices being readily paid for fine cloth, whereas inferior clothes and sized piece goods though even low priced are not in favour.

"35. Having alluded to the fairs in Asia I may give facts as the result of my observation, which appear to account for their extensive use, and afford at the same time an insight into the character of the people.

"36. There are not many large towns in Eastern Turkestan, or villages of any size, such as are to be found in India, but the cultivated portion of the country is studded with separate farms and homesteads, many hundreds forming a kind of circle, or what in India would be called a pergunnah.

"37. As there is no village bazaar such as we understand in India in order to supply their wants, a custom has grown up of holding weekly markets at different spots in the pergunnah. Thus as we passed along from Sanju to Kashgar we came across many places called Ekshumba or Doshumba Bazaar, &c., held on Sunday or Monday, and so on. Here, for instance, within a radius of twenty-five miles, there is a bazaar held at one place or another every day in the week except Friday, to which the peasantry flock with their sheep, fowls, cotton clothes, boots, and other articles of daily consumption or requirement. Even in the large cities one day in the week is devoted to the bazaar, when the chief business seems to be transacted. Frequently when I have had occasion to send to the city of Kashgar for an article I have been told that it will not be procurable till Thursday, the market day. In this respect and in many others we may welcome a renewal in these parts of our recollections of old England.

"38. It is hardly necessary for me to do more than point to the peace and security to property which all this betokens; when a peasantry can live thus unprotected in solitary farms or in small hamlets, there must be little fear of robbers or of violent crime. No need here evidently for enclosing themselves within walled towns, or for the erection of forts for protection from internal commotions. Though there is no Arms Acts in the country, weapons are never carried by the people, and the appearance of arms is a sign that the wearer is employed on duty for the Government.

"39. Violent crime is almost unknown, and thefts are rare. The Ameer has acquired a character for excessive severity because he punished theft with death. He is no doubt dlya terror to evil-doers, but is acknowledged to be just in his punishments, and the result is a complete stoppage of crime. The peasantry are unmolested; and when peaceful industry is thus allowed to thrive we may with justice form high expectations of the advancement of the people, and be encouraged to aid in the work of improvement.

"40. The country is said to be rich in mines of copper, iron, lead, and coal, so that by the aid of European science and skill machinery of all kinds may be introduced, and would be quickly appreciated where the hands are so scarce. The habits of the people, too, are all favourable to industry. Instead of each man cooking his own food, and thus spending a valuable part of the day in culinary occupation, as is the case in India, there are innumerable restaurants and bakeries, and bread and meat pies are hawked about the streets, and a very cheap dinner is thus provided for the masses.

"41. In conclusion, there is one point on which any British trader or traveller purposing to visit this country ought to be

informed, and which he would do well to bear in mind. The people of Eastern Turkestan, though good-natured, friendly, and hospitable to Europeans, own to no inferiority of race, and will not submit to be roughly treated. They meet Europeans with perfect politeness, but on terms of equality, and any attempt at hauteur or domineering will be quickly and fiercely resented."

NOTES ON THE COLLECTION AND PREPARATION OF PARA INDIARUBBER.

By Bruce Warren.

Being stationed for a few weeks at Pará, after the laying of the Submarine Telegraph Cable from Pernambuco to Pará,* I was enabled through the kindness of Captain Ploem, of the Amazon Steam Navigation Company, to gather some information respecting indiarubber, which is worth putting on record, since little or nothing is to be met with in print that is authenticated upon the subject. Indiarubber, although it has been for some years past recognised as an article of commercial interest, is allowed to receive additional importance from its becoming extensively adopted as an insulating material for telegraph wires. It is well known that the indiarubber met with in commerce under the name of "Pará" or "Bottle" indiarubber, differs widely from all other kinds, both in form and purity.

Some few years ago, Pará indiarubber was met with in England in its native state, under a great variety of fanciful forms, borrowed principally from natural objects, or in the shape of some useful article or ornament. I have myself seen this class of indiarubber moulded into the forms of birds, rings, balls, shoes, bottles, &c., covered with tracings of some artistic design, which, although elementary, were sufficient to show an acquaintance with, or at least an appreciation of, ornamentative art. Considering the comparatively recent introduction of indiarubber as a branch of industry, it becomes almost impossible for us to imagine that this decorative taste could be coeval with its commercial birth. It is highly probable that the natives were impressed at a much earlier period with the many suitable applications of this product, which nature had so easily placed within their reach, and first dealing with it as an article of domestic utility, soon found out its suitability to receive the important position it might occupy as household ornaments, &c.

Although nothing, so far as I have been able to ascertain, remains to explain the object of this ornamentation, I think that the idea here indicated is confirmed by many facts which are of significant importance. The ornamentation, which consisted of designs traced in simple curvilinear lines or circles, must have taken a great deal of time to execute. At this time indiarubber was probably an article used in barter, although on a smaller scale by far than at present, for its demand must have been insignificant before the discovery of vulcanising was announced. The low price of the raw article would have been prohibitory for such a bestowal of time upon it, but as it rose considerably in price with its suddenly-increased demand, it is not improbable that the natives would be willing to convert such articles as they possessed of this material either into money, or to dispose of them eagerly in barter for what they might require.

Indiarubber is collected along the whole course of the Amazons, being brought down by the Amazon Company's steamers to Pará, where it is consigned to merchants, who effect the sale of it and return general merchandise in payment to the shippers. It is not sent into the market at fixed or regular times, many collectors keeping it by them for a long time, until either their household wants or those of their farms dictate to them the prudence of parting with it. The bottles are usually piled or strung together with lianas or thin branches of palms, or even the mid-rib of leaves of a species of palm. I have noticed at the wharves or warehouses bottles which must have been at least four or five years old, and approaching towards the top of the same bundle, bottles formed from the collection of each successive season, and finishing with the collection of the latest season. An experienced person could easily have told the age of each bottle.

The negrohead-rubber is usually sent down in open wicker baskets. It is produced by the same tree as the bottle indiarubber, and consists of the little pellets which coagulate or dry over the incision which is made in the tree, and this accounts for the fragments of bark and wood found mixed with it. The coagulated juice, produced by accident from long standing, or the portion adhering to the small clay cups used for collecting it, which is unfit for bottles, goes to make up the negrohead variety. This name, no doubt, arose from its great resemblance to the head of the negro. It is recognised by this name by the people of Pará.

Through the kindness of Senhor Picanco I was allowed to witness the tapping of an indiarubber tree at Arapiringia, an island about 30 miles from Pará. We met with a most cordial reception, and after partaking of an excellent lunch, we were escorted by an attendant through a partially cleared forest to the tree.

It must not be supposed that indiarubber is the sole produce of an estate; in most instances it forms but a casual or accidental tributary to the resources of its owner. At Arapiringia was an extensive plant for sugar manufacture, as well as a large tile and pottery works. There were also saw-mills and a distillery for the production of cashaca, or rum.

The tree yielding the Pará rubber is called by the people sivingia or syringe tree (*syphonia elastica*). The tree we visited stood upon a gently rising piece of ground forming a bank to a small stream or arm of the Pará River. A great number of such streams exist, winding through the denser portions of the islands, and are easily navigable in small canoes at high water.

The soil was a stiffish alluvial deposit containing much clay. The banks of the stream consisted of nearly all clay, from which the small cups to catch the juice were made. The cups are dried or baked by exposure to the sun for some days before they are wanted. They are formed by simply kneading a piece of clay in the hands, which, when fit, is pressed into a shallow and circular formed cup. By means of a sharp hatchet or knife a cut is made, in a slanting direction, in the bark of the tree, which instantly yields a trickling flow of its milky juice. The cups are attached to the tree immediately under the wound by sticking a piece of soft clay on to the tree, and then pressing the cup into it. The flow of juice was very slow, as a flow of about six ounces occupied nearly three days. This was, however, in very dry weather, about the end of September; but it is not at all improbable that during the rainy season, or immediately after, the flow of juice would be much greater and more copious. The proper time for gathering is during the months of January and February, but the tapping is frequently continued until the end of March, which is considered the rainy season in Pará, though it appears almost ludicrous to speak of a rainy season, when we consider that it rains once nearly every twenty-four hours all the year round.

The indiarubber tree no doubt attains its perfection in a rich humid situation. The forests are generally swampy, and exhale that peculiar odour met with in forcing-pits or houses. Hence it is that the collection of indiarubber is so injurious to the health of those engaged in it, ague being a most common complaint with them, and to it the natives easily succumb.

I have been informed that the collection of indiarubber, from the allurements it offers to the natives in the form of easy work and good remuneration, has a very disastrous effect upon the population, inasmuch as, being

* Pará is, properly speaking, the name of the province; the name of the city is Belem, which is the capital of the province; in the same way Recife, which is the capital of the province of Pernambuco, is frequently called Pernambuco.

naturally lazy, they earn in a few months during the season sufficient to enable them to bask in idleness for the greater portion of the year, and thus a barrier is raised alike to the introduction of fresh fields for labour, and the general exercise of energy.

This, however, may be due to a great extent to the combination of several temptations which an over-liberal nature has thrown in the way of the inhabitants of tropical climes. The requirements of the natives are very limited, for nature has provided a good supply of food, while demanding scarcely any exertion from them in procuring it.

The juice when fresh drawn has a creamy consistence and appearance, and possesses a strongly ammoniacal odour, which by exposure to the air rapidly disappears, while the indiarubber gradually separates on the top, leaving a yellowish turbid solution of its saline constituents at the bottom of the vessel. Previous to this change taking place, if the juice be confined in a close vessel, it exhales a strongly offensive odour, and assumes a strongly acid reaction.

There is no doubt but that free ammonia is the agent which effects the diffusion of the caoutchouc in the juice of the tree; the addition of solution of ammonia will protract its separation for a very long time. When coagulated it cannot again be made into an emulsion; on this account careful collectors are cautious in allowing the juice to stand as short a time as possible before using it up. One day's gathering should not be allowed to stand over the following day, but if possible, it should be used as collected. It is a curious fact that the addition of alcohol to the juice does not affect the separation of the caoutchouc, whereas if it be dissolved in ether or chloroform, a few drops of alcohol instantly separate it from the solvent.

The process of drying or preparing it in the bottle form consists in dipping clay moulds into the juice, or more generally in pouring it over these moulds.

The moulds which we saw in use at Arapiringia were in form oblate spheroids, measuring from eight to ten inches along the longer axis, and from three to four inches along the shorter axis. The clay was moulded on to a stout stick about 3 feet long, which served as a handle for turning the mould round, so as to ensure an even covering of juice, and for exposing it to the smoke or fire by which it is dried.

The substance used for burning in smoking or drying the indiarubber is the nut of a species of palm tree which grows plentifully in the equatorial portion of Brazil. It is called by the natives "urucuri." I was informed that the great difference between the indiarubber prepared at Pará and at Ceará is due to the latter province producing no urucuri palms, and that consequently they have no nuts for smoking the indiarubber. This, however, deserves confirmation, for should it be proved that such magical efforts are due to the urucuri nut, its introduction into the indiarubber-producing districts of the Asiatic and African continents might lead to the cruder kinds obtained from these sources becoming formidable rivals to the production of Pará. I have been confidently assured that the Ceará indiarubber is obtained from the *siphonia elastica*, the same source as the Pará indiarubber.

It is generally considered that the superior quality of the Pará indiarubber is due to the intelligence and care of the collectors compared with the savages who supply the more inferior kinds. I am unable to concede this point, at least so far as relates to the collectors at Pará and Ceará, and I think that any naturalist visiting Ceará would confer a great boon not only on the industry of Ceará but all other indiarubber-producing districts, by confirming this statement as to the urucuri. Of course it is possible that the tree growing on the favoured banks of the Amazons may not be indigenous to Ceará, but I see no reason why the *siphonia elastica* should not exist in some parts of Ceará, where its climatical and topographical advantages are so nearly allied to the country lying in the lower Amazon region. Some writers have stated that the black appearance of the bottle rubber is produced by its being held in smoke; this is sufficient to lead us to believe that the smoking process is only used on the complete bottle. This is not the case so far as I am aware, for the bottle is passed through the smoke after the addition of each covering or dipping. Oxidation produces this blackening effect. The smoke does not produce any darkening effect whatever; its colour is a pale blue, and it is perfectly free from soot. The heat, and probably also the carbonic acid from the fire, aid the solidification of the caoutchouc. From eight ounces of juice I obtained five and a quarter ounces of coagulated caoutchouc, which contained about 20 or 25 per cent. extraneous water. It is very difficult to keep the juice in its fluid form without the addition of ammonia.

I am unable to give any information as to the destruction or improper treatment of the trees, and I may add that my inquiries on this point were answered with no small an amount of indignant sentiment that such an idea should be entertained.

THE CONSERVATOIRE DES ARTS ET MÉTIERS.*

The Conservatoire des Arts et Métiers is the carrying out of an idea of the illustrious Descartes. It is not necessary to go into its earliest history. I may commence by stating that in 1775, Vaucanson formed at the Hôtel de Mortagne, Rue de Charonne, Faubourg St. Antoine, the first public collection of machines, instruments, and tools destined for the instruction of the working classes. At his death he left them to the Government of the King (Louis XVI.), and in this collection we have the germ of the Conservatoire. The legacy being accepted by the Government, the Hotel de Mortagne was also purchased, and a conservator was appointed to look after the collection. At the same time it was decided that all inventors who for the future might be recompensed by the nation should be expected to enrich the collection. M. de Vandermonde was chosen to be administrator and conservator of the new industrial museum; and from 1785 to 1792 he had enriched it by the acquisition of 500 new machines.

The Revolution, which destroyed so much in France, was of the greatest assistance to the Conservatoire. The Legislative Assembly had created a commission of monuments, which was appointed to look after everything relating to sciences, arts, and trades. This, however, they did not do. In 1793 the National Convention charged the Committee of Public Instruction to undertake the work thus neglected. A temporary Commission of Arts was appointed, composed of Vandermonde, Leroy, Conté, Beuvelot, and Molard. Afterwards the Abbé Grégoire, and the celebrated physicist, Charles, were members. More than 800 machines, instruments, and the like, were thus collected and placed in the Hotel d'Aiguillon, Rue de l'Université.

The already acknowledged utility of the collection founded by Vaucanson suggested that a similar destination should be given to the collection in the Hotel d'Aiguillon; and a decree of the Convention was obtained, which ruled that there should be formed at Paris, under the name of "Le Conservatoire des Arts et Métiers" a public collection of machines, models, tools, descriptions, and books of every description of art and trade, the construction and the employment of which were to be explained by three demonstrators attached to the establishment, and a draughtsman was also appointed. The Committee of Agriculture and Arts was charged to arrange with the Minister of Finance as to the locality of the new conservatoire.

* From the Appendix to the Fourth Report of the Royal Commission on Scientific Instruction. Account prepared by Mr. Norman Lockyer of the aid given by the State in France to Scientific Education.

The establishment of this new institution was, however, delayed for some time in spite of many reports urging the necessity for its completion, in one of which I find the enunciation of the principle, "*Il faut leur faire voir plus qu'il ne faut leur parler.*" The present locality, an ancient priory, was, however, at last chosen, and in the year 1808 all the models and machines belonging to the State, and existing in the various collections to which I have referred, were transferred to the new locality, in which they were arranged in order to realise the intention of founding a practical instruction based upon the actual seeing and explanation of the objects collected.

In 1806 M. de Champagny, the Minister of the Interior, raised in the Conservatoire a school for children, which soon became very flourishing. From 1810 to 1811 this school contained 300 students, who afterwards became sous officiers in the engineers, employés in the fortification branch of the army, students in the artillery school, constructors of works, chiefs of workshops, and the like. M. Schneider was one of these children.

In 1817 the Conservatoire was re-organised. A sub-director was appointed and a council was created, composed of scientific men and manufacturers, the function of which council was to advise the administration of the Conservatoire. The first catalogue of the Conservatoire was published by the advice of this council in 1818.

In 1819 a new line of usefulness was added; it was made a high school of application of scientific knowledge to commerce and industry, by means of free public instruction. Three chairs were appointed, of mechanics, chemistry, and industrial economy. In 1829 a chair of chemistry applied to the arts was added. In 1839 the number of chairs was increased to 10; the professors forming a council, one of them being chosen director under the title of "Professeur-Administrateur," on the model of the Natural History Museum.

This new organisation gave a strong impulse to the institution. The teaching of all the sciences applied to industry and the arts very rapidly took a high degree of development. Confided to scientific men of the first order, a great progress was soon observed in all branches of industry; but this was not without its drawbacks, for when the professors were appointed, the demonstrators were abolished, and the teaching *de visu* went with them. M. Morin informs me that, as a matter of fact, the services of the demonstrators were never required.

I think this hasty sketch will be sufficient to give a general idea of the growth of the institution until it came into the hands of its present distinguished director, General Morin, under whom it has become, as is universally acknowledged, one of the most important establishments to be found in France for spreading a knowledge of science amongst the working classes and others interested in the arts and manufactures.

The professors and the subjects at present taught in this establishment are as follows:—

Geometry applied to the Arts: Professor Colonel Laussedat, successor of the late M. le Baron Ch. Dupin.	
Descriptive Geometry	Prof. De la Gournerie.
Mechanics applied to the Arts	,, Tresca.
Civil Constructions	,, Emile Trélat.
Physics applied to the Arts ..	,, Edmond Becquerel.
General Chemistry, in its relations to industry	,, Eugène Péligot.
Industrial Chemistry	,, A. Girard.
Chemistry applied to dyeing, pottery, and glass	,, De Luynes.
Agricultural Chemistry and Chemical Analysis	,, Boussingault.
Agriculture	,, Moll.
Agricultural Works and Rural Engineering	,, Hervé Mangon.
Spinning and Weaving......	,, Alcan.
Political Economy and Industrial Legislation	,, Wolowski.
Industrial and Statistical Economy	Prof. Jules Burat.

Connected with the Conservatoire and the machines in movement is a *Galerie d'Experimentation*, in which various experiments are undertaken for the different departments of the Government, and also for individuals on machines of new construction which are required to be examined. Statements of the results of the experiments, made for the greater part in the presence of the inventors themselves, are at once printed and published. This branch of the usefulness of the Conservatoire is being rapidly expanded. Up to 1864 more than 200 investigations of this kind had been made for the Government and for individuals, and no objection had been taken to the results obtained in any case, which is held by the director very justly to prove the care and the impartiality with which they are conducted. I should add that in the case of experiments carried on for individuals the work is done gratuitously by the officers of the Conservatoire, excepting, of course, the necessary expenses incurred in setting up and dismantling the apparatus.

The Conservatoire is also the office for the French standards, and any experiments connected therewith are conducted gratuitously by the officers of the establishment.

It is found that no very great sum of money is requisite to feed the collections; the munificence of French and foreign manufacturers is perpetually creating an influx of new objects, which perhaps is not altogether disinterested.

As is the case with all the other scientific establishments of France, there is a special statement given of the work done every year. This publication is entitled "*Annales du Conservatoire*," and contains a statement of all the scientific and technical researches and operations conducted in the establishment.

THE REGENERATION OF STEEL.

A striking instance of the combined application of metallurgic science and delicate manipulation to the restoration of sword-blades apparently irremediably damaged by fire, may be gathered from a recent correspondence in the *Times*. A sufferer from the burning of the Pantechnicon, complaining of the state to which certain valuable sword-blades had been reduced by that disastrous fire, was encouraged by another correspondent, who told him that on the destruction, not long ago, by fire, of the house of a popular officer of high rank, several swords, valued not only for their workmanship and temper, but for the circumstances under which the owner had become possessed of them, had been reduced to the condition apparently of twisted pieces of hoop iron. They were sent to Birmingham, and some time afterwards returned in a condition "differing but little from what they had been before their fiery ordeal." Major-General M'Murdo, the officer in question, has since confirmed this statement. The swords had been hung upon the walls, and afterwards, when disinterred from the ruins, were "mere crumpled bits of burnt and rusty iron." "This 'triumph of art,'" General M'Murdo continues, "as the late Lord Ellenborough called their restoration, was the gift of the 1st Warwickshire Rifle Volunteers, and was executed by Mr. Charles Reeves, of the Toledo Works." Supplementing this statement, Messrs. Wilkinson, the sword manufacturers in Pall-mall, say that it is often of great importance that the outer scale left by the fire should not be removed, nor any attempt at cleaning the surface be made unless by experienced hands. In the case of sword-blades especially, they find that the minutest details of embossed ornament can generally be traced over the outer scale of burnt steel, and may be copied and restored unless obliterated by friction. Inlaid or damascened gold work on steel will stand a very high

degree of heat without being destroyed, and the figure of the genuine Damascus blades, being a part of the structure of the metal, can be restored as long as any of the steel remains.—*Iron.*

SERICICULTURE IN VICTORIA.

The labours of Mrs. Bladen Neill, says the *Warehouseman*, appear to be becoming very fruitful. We learn from a recent description of her establishment on the Murray, that she has now some 20,000 seedling mulberries, and almost as many rooted cuttings in her grounds; that she has a splendidly-constructed magnanerie, 138 feet long by 30 in breadth, easily capable of accommodating from 400,000 to 500,000 worms; and finally, that a number of young ladies are qualifying themselves under her tuition either to take charge of magnaneries of their own, or to act as instructresses to persons desirous of engaging in the industry in Victoria or one of the other colonies. The best source, however, we believe, from which to obtain information as to the success that has attended Mrs. Neill's exertions in the cause of silk-rearing, is the recently-issued report of the Victorian Ladies' Sericicultural Company. From this we gather that the Government have granted to the company 635 acres of land, which are to be turned to account forthwith in the raising of mulberries; that fresh grain has been got out from Europe in splendid condition, "educated" with a view to the production of eggs, which are to be distributed in such a way as to be most serviceable to the association; that the interest in Mrs. Neill's operations is expanding not merely in Victoria but also in Tasmania, New Zealand, and other of the Australian colonies; and that M. Roland, the distinguished patron of the movement, is to reach Australia some time in 1874. It is mentioned "that at no previous period in the history of the silk trade has the necessity been so clearly pointed out for efforts to be made in the New World to supply the wants of the Old World as at the present time." "We hear," it is added, "from trustworthy sources that the revenue of Italy has suffered during the years 1872-3 a deficiency of 12 millions in consequence of the disease which had proved so fatal to the silkworms now having attacked the mulberry trees also. An eminent English authority, writing on the silk-growing resources of the world, says:—'There are in the British colonies silk-producing capabilities equal in the aggregate to the present silk production of the world. It is to be regretted that colonists have not as yet thought it worth their while to cultivate silk, for the chief want of the silk trade will ere long be more severely felt than ever.'" Testimony of this kind is not new, but it is nevertheless of value as, says the *Argus*, showing that those who engage in sericiculture in Australia are not embarking in a hopeless venture. With an assured and practically unlimited market for the grain and cocoons, with facilities of production of a most encouraging character, there would be no disposition shown to pooh-pooh the industry, which may yet prove of great national importance. Mrs. Neill, it is mentioned, contemplates going home in January, and she is to take with her about 100 ounces of good grain as an evidence that progress has been made. It will be well, if sericiculture is to be carried on in Victoria in a systematic way, that communication should be opened up with the Ladies' Committee in Victoria, and that every care should be taken to obtain a healthy supply of eggs. A pursuit which can affect the revenue of a country to the extent of some millions sterling is not at all to be despised.

Plans have been prepared for a bridge to be thrown across the Murray River at Eelmea, so as to connect the colonies of Victoria and New South Wales. The estimated cost of the work is £60,000.

THE SILK INDUSTRY OF NORTHERN ITALY.

Silk is an article of the greatest importance to North Italy, and on it a large portion of the wealth and prosperity of that country depends. Mr. Colnaghi, the British Consul at Florence, states that the present condition of the silk trade between England, Lombardy, and Piedmont is rather unfavourable, owing to the limited consumption of raw Asiatic silk on the one hand, and the falling off in the consumption of raw Asiatic silk, imported through England, on the other. A great extension has of late years been given to the importation of Asiatic silk direct from China, Japan, and Bengal into France, and latterly also into Lombardy, in the shape of large deposits not subject to the heavy dock and other charges to which silk is liable in London. This fact is of considerable importance to the future prosperity of Milan, as the probable principal *entrepôt* of Asiatic raw silks on the direct route, through Italy, between England and India. The consumption of Italian silk in England has been gradually decreasing for several years past, owing chiefly to the high rates to which Italian produce had risen on account of the bad or inadequate silk crops in Italy. In 1870-71 the demand had somewhat improved, owing to the more moderate range of prices, but in 1872 the comparatively high standard of value tended again to curtail the consumption of Italian silk in England. The entire annual export of silk grown in Lombardy to foreign markets is calculated at about 1,980,000 lbs., equal, at the average price of £1 13s. 8d. per lb., to £3,233,000. These figures of cost are largely increased by silk reeled in Lombardy, and therefore considered as the produce of the region, although reeled from cocoons grown in other parts of Italy and in several other countries. No reliable estimates can, however, be formed on this head. The manufacture of plain silks at Como, which has lately taken a new and increasing growth, is deserving of mention. Como produces annually from £600,000 to £640,000 worth of manufactured silks, the greater portion of which is exported to Venice, the remainder being for home consumption. The silks manufactured, both black and coloured, are of excellent quality, certain kinds being quite equal to those of Lyons, and at lower prices. The velvets, *velluti moussellini* as they are technically called, both black and coloured, are rather largely manufactured at Milan. It has been found that both as regards quality and price the manufacture of velvets by expert weavers is carried on better in their own homes, or rather that they should work in limited numbers together. Thus, manufacturers at Milan engage the services of an experienced and reliable workman, to whom they confide a given quantity of silk, providing him at the same time with the necessary machinery, which, by periodical reductions in payments made to him, gradually becomes his own property. This workman, on his part, employs skilled weavers; and it is found that this more modest partition of labour gives the best results. The weavers generally live outside the town, where rent and provisions are cheaper, and the expense of renting spacious buildings is thus obviated. The velvets manufactured in Piedmont are also low in price and of excellent quality. The great drawback to trade in this class of goods is the small quantity produced, rendering it as yet not worth the while of English dealers to leave their old-established connections at Lyons for new ones in Italy.

There is an annual importation into Italy of Asiatic raw silk to the amount of 1,200,000 lbs., the largest portion of which enters Lombardy for conversion into brown silk to be again exported to the markets for consumption. Mr. Colnaghi further mentions that about one-third of the total of all articles imported into Italy from England are consumed in Piedmont and Lombardy. While, however, the value of our imports is continually on the increase, it should be borne in mind that several minor products, which were formerly brought from abroad, and especially from England, are now manufac-

tured in the country, such as various articles of hardware, old iron re-fused, &c. Even of first-class woollen goods the manufacture is increasing, and a considerable consumption of home produce takes place in Italy, the high rates of exchange on gold, owing to the forced paper currency, acting as a protection to native industry, which is, moreover, in possession of a large amount of water power. The opening of the Suez Canal, placing Italy in direct communication with India and the far East, enables products formerly imported from England to be received at once in Italy, and experiments are now being made to supersede our goods by those of Italy in the Eastern markets. Among the articles which are pointed out as likely of success are cotton, woollen, and silk stuffs, candles, wine, paper, soap, and perfumery, &c. In the midst of our wealth and prosperity it may be as well to look to possible rivals in the future, and to remember that the commercial prosperity of England is not based on an immutable decree of Providence, but that other nations, and among them the Italian, are quietly, if slowly, advancing on the path of manufacturing progress.

FRENCH GUIANA.

Very little is known of the interior of French Guiana, except to an average distance of twenty-five miles from the coast by water, travelling to any distance by land being totally impossible for man or horse. Dense, impenetrable, dark green forests, with tangled underwood and submerged marshes are the powerful preventatives. Only by means of the rivers and creeks can one penetrate, and that by slow and laborious means, for after ascending a few miles, and as the land gradually rises, formidable obstacles bar the way: there are concealed rocks to avoid and rapids to surmount, trying alike to the most courageous and most patient. It is said according to Vice-Consul Wooldridge, that there are eighty-five known varieties of wood in the forests, from a quality as hard as oak, used for building the craft of the colony, and for posts and beams in house-building, to the softest; and from the coarsest grained to the finest, some of which are most beautifully marked and most delicately tinted. Almost everything in nature grows there; gums, resins, balsams, and other oleaginous substances abound therein; in fact, French Guiana is the richest of lands in natural resources, and it is the most shunned and despised. There are a very few known aborigines inhabiting the interior, which may be attributed to the density of the vegetation, and the extravagance of its growth, to the unceasing drenching rains, encouraged by hundreds of square leagues of forests, and to the presence of wild beasts and venomous reptiles, and insects infesting them. Game, large and small, also abounds in the colony, and birds of the most gorgeous plumage exist in myriads. The cultivated part is that lying along the coast from the River Oyapock to the River Maroni, to the average distance inland as before mentioned. These coast lands are, however, interspersed by woods and marshes, and along the whole of the shore of the colony has sprung up an artificial rampart of vegetation, tall, slender trees, densely packed, called "palétuviers," nourished in an alluvial belt deposited by the great Guiana current which sweeps the coast in a N. N. W. direction from the mouths of the Amazon, whence the alluvium is brought. This tall brushwood ceases to grow beyond the alluvial district, and gives place to groups of larger trees, and as you proceed inland and the surface becomes more undulating, these groups join and form into one vast forest, intersected by ruins and a network of creeks. There are four large rivers, not including the Maroni, which separates French from Dutch Guiana, and the Oyapock which separates it from Brazil, and sixteen other smaller rivers, some with names and others nameless, running into the sea, having their sources, no doubt, from the vast savannahs swollen by incessant floods. The length of the coast line is about 340 miles, and is divided into thirteen quarters, in each of which is a bourg, or village, under the authority of a Commissaire Commandant and a Municipal Council. The soil is clayey and fertile, and produces manioc, coffee, cinnamon, sugar-cane, rice, corn, &c., the arnatto tree, whence "roucon" is manufactured, limes, and every class of tropical fruit and vegetables, such as yams, sweet potatoes, pumpkins, spinach, the egg plant, cucumbers, &c. In the hills and valleys of the interior the soil is argillaceous schist, abounding with quartz, containing quantities of gold, and some iron and lead.

Since the discovery of gold in 1855, the culture of the land has been gradually abandoned and the healthy vegetable industries have retrograded. The town of Cayenne, the largest in the colony, is the centre of all, and is a busy and apparently thriving place, occupying a surface of about seventy acres, and containing a population of about 7,000 persons. It has the credit of being the most expensive place in the world. The market could not be worse supplied, and everything in the shape of beef (mutton is never seen), poultry, pork, fish, and vegetables is dear, and of the worst description. Meat unfit for human food is sold daily at the exorbitant price of 24 sous a pound. Fish is tasteless and of inferior quality. Fruit, however, is excellent, but by no means cheap. Sometimes game appears in the market, such as the agouti, the tattoo (armadillo), and others, said to be very nutritious and good eating. Potatoes and onions, not being cultivated in the colony, are imported from France and the United States; and there is often a dearth in these necessary articles, as in many others. The only articles of consumption of moderate price are bread and French wine; all else is bad and dear, including articles of clothing. There are no hotels at Cayenne, and only a few indifferent cafés and lodging-houses; neither is there theatre, club, or any room or place of amusement.

CORRESPONDENCE.

PYRITES AS A SOURCE OF IRON, SULPHUR, AND COPPER.

Sir,—With reference to the quantities of pyrites imported into this country from various sources, Mr. Deacon has obligingly communicated to me the following figures, taken from the returns of the Board of Trade for the last ten years (1862 to 1872), the details for 1873 being not yet published:—

	Norway.	Holland.	Belgium.	Portugal.	Spain.	Italy.	Other Parts.	Total.
	Tons.	Tons.	Tons	Tons.	Tons.	Tons	Tons.	Tons.
1862	4,975	6,817	9,860	53,296	33,717	...	2,187	110,853
1863	6,736	15,40	12,059	109,180	33,213	...	2,628	179,225
1864	16,087	12,751	7,068	118,489	15,529	...	1,065	170,990
1865	22,229	14,727	2,121	1[illegible]7,78[illegible]	16,393	..	369	193,626
1866	38,262	21,57[illegible]	4,006	165,993	11,910	Sardinia 1,226	1,625	244,596
1867	77,895	34,592	2,299	105,556	50,222	...	2,134	27[illegible],698
1868	63,007	41,559	...	75,883	47,458	Sicily. 794	1,01[illegible]	229,720
1869	63.091	13.983	...	140,805	99,648	...	2,420	319,947
1870	67,467	14 914	...	174,458	150,996	...	3.676	411,512
1871	74,416	12,809	...	*120,573	242,163	...	4,581	454,5 2
1872	71,665	5,682	...	180,329	257,429	...	2,521	517,626

I am, &c., C. B. A. Wright.

Chemical Laboratory, St. Mary's Hospital, Paddington, W., May 21st, 1874.

* And Azores.

THE YARKUND MISSION.

Sir,—The dispatch of Mr. Forsyth to the Government of India with the Yarkund treaty is a document of the greatest value. Every line of it deserves and requires the most careful consideration of all persons interested in the trade between India and Eastern Turkestan. It is not too much to say that a disregard of Mr. Forsyth's advice in the matter of supplies and transport may lead to great disaster at the commencement of our trade with this new market; while attention to them may be the means of gradually forming a most important intercourse and trade with a very promising portion of Central Asia.

The present time seems to me appropriate for reverting to the efforts made by the Society about a year ago to direct the attention of the Secretary of State for India to the route by the Chitral valley as a preferable one from India to that now in use, *viâ* Ladak and the Karakoenn to Yarkund. In the memorial presented by the Society to the Duke of Argyll it was stated, "That, as an alternative to the at present difficult Ladak route, consideration be given to the route by the Chitral valley, in the hope that the efforts of the Indian Government may secure it as a commercial route in safety and under protection."

This portion of the memorial was not referred to by his Grace in his reply to the deputation, and as at that time the treaty now concluded with the Ataligh Ghazi was only in prospect, the omission was not to be wondered at. Now, however, matters are on a very different, and much more favourable footing, and it is in this view that I would suggest fresh attention to the subject, requesting particular attention to the following summary of our information.

1. Mr. Shaw says, "Eleven passes have to be crossed on the present route from India into Turkestan, and of these passes only two are lower than the summit of Mont Blanc."

2. Dr. Cayley says, "From Leh to Yarkund is 350 miles, or thirty marches, and the road goes over five passes, the lowest nearly 18,000 feet, three of them are covered with perpetual snow or glaciers, the road is so bad and difficult that twenty per cent. of the horses die on the journey; but these natural difficulties have no effect in checking the trade when it receives fair play and is not encumbered with excessive duties."

3. General Adye, in his paper read before the Royal Military Institute, noticed other routes believed to be easier, but there were still "passes of 17,000 to 19,000 feet to be surmounted."

4. Let us now contrast the physical obstacles to trade by the Karakoenn route with those by the Chitral valley. Speaking of the valley of the Chitral Mr. Shaw says, "It may be said to be the only valley leading from the level of the plains right up to the back bone of the great mountain system which forms the water shed between India and Central Asia. It is also the only route on which there is only one pass between these vast basins, and that a very easy pass."

5. The political obstacles to trade by the Karakoenn route being now happily removed by the Yarkund treaty, is a great encouragement to the friends of commerce to look for action by the Indian Government for their removal in Chitral, where the natural obstacles are, comparatively speaking, very small.

6. It appears that this valley is considered to be under the double sovereignty of the Ameer of Cabool and the Maharaja of Cashmeer, the former our subsidised ally to the tune of £120,000 a-year, and the other, our feudatory, who has recently helped us efficiently in getting one treaty with Yarkund. This state of things would surely admit of satisfactory results if the Secretary of State and the Governor-General of India would take the matter up with a good will in the interests of commerce, to which they are both well affected at the present time.

7. Chitral affords an easy access to Badakshan and Wakar; and, as the latter is now allowed by Russia and England to belong to Cabool, it is but reasonable to expect that in the interests of commerce with other portions of Central Asia, as well as with Kashgar, the three powers—England, Cabool, and Cashmeer—may combine to open out for trade the Chitral valley, now the hot bed of brigands and kidnappers under the chieftanship of Amani Moolk.

8. For details about Chitral see "A Havildar's Journey through Chitral to Farzabad," in the *Journal of the Royal Geographical Society*, and Dr. Leitner's addreses lately delivered in London. The former deals with the route from Peshawur, through Swat and Bagour; the latter by the Cabool River and the Roonur River which traverses the valley.—I am, &c., A. Campbell.

Denmark-house, Slough, Bucks.
May 29th, 1874.

ANTIQUITIES OF CAMBODIA.

Sir,—Without doubt many rejoiced to read in the proceedings of the Society that the antiquities of Cambodia will be further considered.

The points of resemblance, on the one hand, between the remains of ancient Akkad and those of Cambodia, and on the other, between the latter and those of the native Mexicans and Peruvians, undoubtedly are important and striking. When this branch of the subject is again entered upon, it may be interesting to consider how it is that, supposing these nations to have had a common origin, as suggested, there should be so notably absent, both from the sculptured records and the oral traditions of the Americans, all signs of knowledge or idea even of the horse. Any one examining the photographs of the Cambodian remains cannot help being struck by their character, so similar in the delineation of both human and equine life to those of Assyria, to which they have been compared. On a second comparison of the same photographs with sketches of American, there is much less resemblance, and the most manifest divergence is the absence of the horse. That the native mind would have been retentive of impressions of such a striking animal is proved, it may be considered, by the fact which rests on good authority, that for two hundred years the Indians of the inland lake city with great veneration preserved the remains, and even a carved figure, of Cortes' horse, which, the historian narrates, he had to abandon to their care during his famous expedition from Mexico to the borders of Yucatan.

Another point that might be dwelt upon is the want of knowledge among the Americans of navigation, for they looked upon the Spaniards' vessels with awe as winged monsters, and seemingly had no traditions, even the most scanty, of their remote immigration, as might have been looked for. On the contrary, the fact is often speculated upon, that the Mexicans and Peruvians had no intercourse or even knowledge of each other's existence.

It may be well then to await further information and discussion before putting down these nations as directly connected, as they were declared to be; indeed, it may appear to many, that it has too generally been assumed, as a necessary starting point, that all races of men have had one source. This seems generally taken for granted, whereas if it were considered as at least possible that more than one stock was created or developed side by side, many facts that are now irreconcilable would cease to be so.

As more and more information is gained regarding the earth's structure, the first existence of man is being referred back to a more and more remote antiquity; indeed, it is perhaps becoming a question, whether it may not be that great physical changes have occurred, like the deluge (was this limited or not to a certain locality?), during man's existence, and that the subsidence of con-

tinents, leaving but groups of islands here and there, may account for the seclusion for ages of these or other races. I am, &c.,

HAHNEMANN EPPS.

CHLORINE.

SIR,—The concluding paragraph of the very able and truly scientific paper upon this subject, read by Mr. Weldon, on Friday evening, the 22nd ult., is entirely devoted to the defence of our system of patent-law rights, and only goes to show that great benefit may sometimes accrue thereby to inventors and manufacturers, but makes no attempt to prove that those rights offer the slightest advantage to consumers, or that portion of the population of the empire who may have no connection with trade or commerce of any kind. The fact is also unnoticed that our patent laws, in their present form, must inevitably be a lottery, because the value of a new invention cannot be ascertained until its merits are proved by public approval, and a verdict passed in its favour.

To obtain proof of this assertion it is only necessary to look down the monthly list of patents applied for, when it will be found that a very large portion are regularly withdrawn after the first notice. A comparison may also be made between the number of well-known successful patents, with the whole number of those taken out and sealed in a given period, when it will appear that 99 out of a 100 sealed do not pay their expenses; and there is a true saying among patentees that a patent is never perfectly secure until it has been successfully carried through a Chancery process, costing between two and three thousand pounds, the whole of which passes into legal hands, and gives of course no benefit to the public at large.

The assertion that our patent system is the sole cause and promoter of invention is a mere idle fancy, for discoveries are never patented, and yet they follow one another without cessation. It should also be borne in mind that the system was first devised during semi-barbarous times compared with our present state of civilisation.

The attempt to amend them by only granting royal letters patent to really new, useful, and profitable inventions, as may be decided by a permanent Commission, would be a project far beyond the powers of gentlemen of the legal or any other professson.

I cannot conclude without observing that the great powers and energy of the Society established for the promotion of the Arts and Sciences are now continually devoted to what may be called the advertisements of aspiring and rival patentees, a line of business strictly prohibited in its original constitution, but, like everything else, it must, I suppose, succumb to the colossal and overwhelming power of the advertising world.—I am, &c.,

HENRY W. REVELEY.

Reading.

The exports of pig iron from America for the fiscal year ending June 30, 1873, were 140,683 dols. against only 69,331, dols. for the previous year, and of bar iron 33,767 dols. against 4,532 for the preceding year.

It is stated that a small cylindrical point of steel when made to rotate upon glass in such a manner that its longitudinal axis shall make an angle of 45 deg. with the surface of the glass, approaches in effect so nearly to that of the real diamond that it is a very cheap and effective substitute as a glass-cutter.

It is stated on good authority that the Kimmeridge clay and oil-bearing shale, 400 feet deep, which has been discovered by the Sub-Wealden Exploring Expedition in Sussex, is of great value, as from it gas for lighting purposes can be easily extracted. A valuable bed of alabaster has also been found during the borings.

NOTES ON BOOKS.

Spectrum Analysis as Applied to Microscopical Observation. By W. T. Suffolk, F.R.M.S. (*J. Browning*).—This is a reprint of a lecture delivered by the author before the South London Microscopical Club, with the addition of an appendix descriptive of apparatus employed in micro-spectroscopic work, and some plates of various absorption spectra. There is also a chromo-lithograph of some of the more striking spectra—sodium, thallium, &c. The principal object of the lecture appears to have been to draw attention to the work that the spectroscope is capable of in microscopic observations, and to ask for more labourers in the field.

Elementary Chemistry. By F. S. Barff, M.A., &c. (*Cassell, Petter, and Galpin*).—The valuable courses of Cantor Lectures which Mr. Barff has in different sessions delivered before the Society will have rendered his name familiar to most of its members, and they will doubtless be ready to receive favourably any book which bears his name. The present work is what its name implies—a purely elementary treatise on chemistry. It is intended to enable young students to acquire a knowledge of the principal facts connected with the "non-metallic elements," and thus lay a foundation on which may afterwards be built a more extended knowledge of the science. The style is such as to adapt it to the comprehension of young boys, without any effort at that ultra simplicity which too often becomes childishness in such works, thus serving rather to repel than to attract the beginner. The first chapter is devoted to the "Action of heat on ice;" then follow chapters on "water," "the composition of chalk," and "atmospheric air;" a description and explanation of the phenomena of combustion comes next, and this leads to a chapter on "coal;" after which are some chapters on "ammonia," "chlorine," "sulphur," "phosphorus," &c., in all of which simple experiments are described for performance with each substance. At the end there is a chapter on apparatus, giving full instructions how to use—often how to make—all the simple chemical apparatus required in elementary experiments, and the book concludes with a collection of questions for working out.

GENERAL NOTES.

New Danger Signal.—MM. Lartique and Laforest have recently invented a novel device, intended as a danger signal, which the *Revue Industrielle* states is now in successful use on some of the French railroads. A whistle is arranged on the locomotive so that it will, when once opened, continue sounding until shut by the engineer. The same device which turns the disc signal, so as to show the danger side, is intended to transmit a current of electricity to a little projection between the rails. When the engine passes over this spot, a metallic brush hanging between its wheels strikes on the projection and sweeps over it, at the same time transmitting the current to an electro-magnet which pulls the whistle open. The latter, by continuously sounding, warns the engineer.

The Statistics of Paper-making.—Some curious statistics relative to paper-making have been recently published at Venice. It appears that there are 3,960 paper manufacturers in the world, employing 80,000 men and 180,000 women, besides 100,000 employed in the rag trade; 1,809 millions of pounds of paper are produced annually; one-half is used in printing, a sixth for writing, and the remainder for packing and other purposes. The United States, with 3,000 machines, produce yearly 200,000 tons of paper, which, for a population of 28,000,000, averages 17lb. per head; an Englishman consumes $11\frac{1}{2}$ lb.; a German, 8 lb.; a Frenchman, 7 lb.; an Italian, $3\frac{1}{2}$ lb.; a Spaniard, $1\frac{1}{2}$ lb.; and a Russian only 1lb. annually, on an average.

The Manufacture of Fancy Wood-work at Sorrento.—There are six manufactories of wood-work at Sorrento, near Naples, and the number of workmen employed is about 300. This wood-work, which somewhat resembles our Tunbridge ware, is extremely beautiful, and many articles received general admiration from the visitors in the Italian courts at the Vienna Exhibition. The wages paid in these manufactories are on the whole extremely low; for instance, designers 2·50 per day, the *intarsiatori* or inlayers 2 frs., and all other workmen only 1·50 per day.

Japanese Lacquer.—It is stated in the *Scientific American* that the well-known and much-admired Japan lacquer work, the secrets of which were supposed to be known only to the Easterns, has been successfully reproduced, or rather imitated, in Holland. The lacquer is prepared from Zanzibar copal, coloured black with Indian ink. The articles are painted with several coats of this lacquer, in which the pieces of mother-o'-pearl or other substances used for ornamentation are placed before it becomes hard. The lacquer is then dried by placing the articles in a heated oven or furnace, after which another coat of lacquer is applied, and when dry smoothed with pumice, which is repeated until all cracks are filled up and the surface has become perfectly smooth, when the whole is polished, or rather burnished, with tripoli.

Production of Iron.—The official report of the Vienna Exhibition gives the annual "output" of iron in the producing countries as follows:—England (1871), 134.664,227 cwt.; Zollverein, German Bund (1871), 33.296 042; France (1871), 23,620,000; Belgium (1871), 11,405,480; Austrian Hungary (1871), 8,492,122; Russia (1871), 7,208.141; Sweden and Norway (1871). 6 138,347; Italy (1872), 1,474.180; Spain (1866), 1,474,180; Switzerland (1872), 150.000; total for Europe, 227,793,099. North America, (1872). 46,900,000; South America, 1 000,000; Japan (1871), 187 000; other countries of Asia (approximated), 800,000; Africa, 500,000; Australia, 200 000; total for the world, 276,500.000 cwt. It appears from this statement that England produces more than one-half of the whole amount, North America about one-fifth, France about one-twelfth, and Belgium one-twenty-fourth: these four constituting the great iron-producing countries of the globe.

Cultivation of Madder in France. — M. Eugene Dollfus, of Dornach (Alsace), has submitted to the Central Society of Agriculture certain statistics which indicate how the foreign demand for French madder is diminishing. According to him, in the first eight months of 1873, 1,696,685 kilogrammes were exported. In the corresponding period of 1872, 2,523,534 kilogrammes were bought by foreign customers. The quantity shipped to England in those periods was, in 1872, 821,974 kilogrammes; in 1873, 693 648 kilogrammes. This seems to show that English dyers have not adopted the artificial dye so readily as other countries. The writer remarks that for reds and rose tints the madder flowers are still preferred to the artificial alizarine; but for violets the latter produces much more economically shades fully as rich as those obtained from the plant. It will be remembered that reference was made to this subject in Dr. Versmann's "Paper on Anthracene and Alizarine," recently read before the Society.

Mineral Produce of Russia.—The "Tableaux Statisque de l'Industrie des Mines de Russie en 1871," which was published by Mr. Skalijkowsy in connection with the Vienna Exhibition, contain the following data with regard to Russian mining industry In 1871, the number of mines owned by Russia, and producing gold, was 979; platinum, 6; silver lead, 21; copper, 76; iron, 1,174; zinc, 6; cobalt, 1; tin, 1; coal, 326; pyrites, 1; chrome, 6; rock salt, 4; besides 697 naphtha pits. Their yield was from 17,000,000 tons of gold sand, 86,406 lb. of gold, from 168,000 tons of platinum sand, 4,504 lb. of platinum, 35.120 tons of silver lead ore, 100,365 tons of copper ore, 820,000 tons of iron ore, 42,400 tons of zinc ore, 10½ tons cobalt ore, 8,000 tons pyrites, 817.000 tons of coal (black coal and brown coal) 22 000 tons of naphtha, 7,000 tons of chrome iron ore, and 455,000 tons of rock salt. The smelting works of Russia produced from these raw ores—silver, 29.000 lb.; lead, 1,740 tons; copper, 4,200; tin, 8; spelter, 2,700; pig-iron, 354,000; iron castings, 30.000; wrought iron, 241.500; steel, 7 000; copper sheets, 350; and zinc sheets, 500 tons; and material for 11,255,000 roubles. The works gave employment to 266,300 men.

Production of Aniline Colours in Germany.—Germany now produces quite as large an amount of aniline colours as all the remainder of Europe taken together, inclusive of England. This production, which in 1872 amounted to a value of a million and half sterling, is expanding immensely at the present time, but it is almost put in the shade by the gigantic development of the trade in artificial alizarine. The latter product, which was only discovered in 1868, has already led, in 1873, to the production of 1,100 tons, representing a value of £600,000, and one single works (there are 10 or 12 in Germany, and only one each in England and France) is now preparing for a production of 5,000 tons of alizarine paste per annum.

NOTICES.

THE LIBRARY.

The following works have been presented to the Library:—

Peat Fuels and their Economic Value, by John Plant, F.G.S. Presented by the Author.

Transactions of the American Institute of Mining Engineers. Vol. I.

A Chart of the Rainfall of the London District, and the daily and five-day averages for 47 years—1826 to 1872. By George Dines. Presented by the Compiler.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Mon. ...Royal United Service Institution, Whitehall-yard, 8½ p.m., Major J. P. Morgan, R.A, "Breech-loading and Muzzle-loading Systems for Guns."

Tues. ...British Association of Gas Managers, 11. (At the House of the Society of Arts.)
Photographic, 9, Conduit-street, W., 8 p m.
Anthropological Institution 4, St Martin's-place, W.C. 1. Sir John Lubbock, "Note on the Discovery of Stone Implements in Egypt." 2 Professor Richard Owen, "On the Ethnology of Egypt." 3. Dr. Eugene Schnyler, "The Batchäs of Central Asia." 4. Mr. Robert Dunn, "Ethnic Psychology"

Wed... Geological, Burlington House, W., 8 p.m. 1. Mr. W. Whitaker, "On the occurrence of Thanet-beds and of Crag at Sudbury, Suffolk." 2. Mr. Joseph Prestwich, "Notes on the Phenomena of the Quateroary Period in the Isle of Portland and around Weymouth" 3. Prof. J Young and Mr J Young, "New Carboniferous Polyzoa" 4. Prof. J. Young and Mr J. Young, "On *Palæocoryne* and other Polyzoal Appendages." 5. Prof. N. Story Maskelyne and Dr. Flight, "On the character of the Diamantiferous Rock of South Africa." 6 Mr. J W Hulke, "Note on a modified form of Dinosaurian ilium, hitherto reputed scapula indicative of a new genus, or possibly of a new order of Sauria" 7 Mr J W Hulke, "Note on a Reptilian Tibia and Humerus (probably of *Hylæosaurus*), from the Wealden Formation in the Isle of Wight"
British Association of Gas Managers, 11. (At the House of the Society of Arts.)
Royal Literary Fund, 10, John-street, Adelphi, W.C., 3 p m.
Royal Society of Literature, 4, St. Martin's-place, W.C., 4¼ p m.
Archæological Association, 32, Sackville-street, W., 8 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.

Thur....Royal, Burlington House, W, 8½ p m.
Antiquaries, Somerset House, W.C., 8½ p.m.
Fisheries Association, 3 p.m. (At the House of the Society of Arts)
Mathematical, 22, Albemarle-street, W, 8 p.m.

Fri.......Royal Botanic, Inner Circle, Regent's-park, N W, 4 p m. Prof Bentley, "On the Reproductive Organs of Plants."
Astronomical, Somerset House, W.C., 8 p.m.
Literary and Artistic, 7, Gower-street, W.C., 7 p m.
New Shakspere Society, University College, W C., 8 p m. Rev. F. G. Fleay, "On certain Plays of Shakspere, of which portions were written at different periods from other portions; namely, 'All's Well that ends Well,' 'Troylus and Cressida;' with some Considerations as to the Peculiarities of 'The Life and Death of Richard the Third.'"

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,125. Vol. XXII.

FRIDAY, JUNE 12, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

CONVERSAZIONE.

The Annual Conversazione of the Society will be held on Friday, June 19, at the South Kensington Museum.

The issue of tickets is now proceeding, and members not receiving their tickets in good time are requested to communicate with the Secretary.

The following are the arrangements for the evening:—

1. A vocal concert, consisting of glees, by the London Glee and Madrigal Union, directed by Mr. Land, will be given from 9 to 11 o'clock, with intervals, in the Lecture Theatre; and the Council request that, as the theatre will only hold 700 persons, the audience will change at every interval, to enable the greatest number to have the pleasure of listening to the concert.

A promenade concert will also be given by the Band of the Grenadier Guards in the North Court.

2. Visitors will be able to make the tour of the Art Schools both on the first and second floors.

3. The Raphael Cartoons, the Sheepshanks and the National Gallery's Picture Galleries will be open.

4. The courts and corridors of the ground floor will be open. The reception will be held in the South Court by Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman, and other members of the Council.

5. The Art Library will be opened.

CONFERENCE.

The Twenty-third Annual Conference between the Council of the Society and the representatives of Institutions in Union, will take place at the Society's House, on Friday, the 19th June. The chair will be taken at 12 o'clock, by Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman of Council.

Secretaries of Institutions and Local Boards are requested to send, *immediately*, the names of the Representatives appointed to attend the Conference; and early notice should be given of any subjects which Institutions or Local Boards may desire their representatives to introduce to the notice of the Conference.

ECONOMICAL USE OF FUEL.

A meeting of this Committee was held at the Testing Houses, Western Annexe, International Exhibition, on Saturday, 6th inst. Present—Major-General F. Eardley Wilmot, R.A., F.R.S. (in the chair), Capt. D. Galton, C.B., Dr. Mann, and Major Webber, R.E., with Mr. Le Neve Foster, Secretary, and Mr. S. W. Davies. The Committee settled the arrangements and conditions for testing the gas cooking apparatus.

FOOD COMMITTEE.

The Committee met on Tuesday, the 9th inst. Present—Mr. Benjamin Shaw (in the chair), Dr. Peyton Blakiston, Mr. W. Flux, Mr. E. B. Savile, Mr. C. Wren Hoskyns, and Mr. J. A. Youl, with Mr. Le Neve Foster, Secretary. The Secretary laid before the Committee a report on the importation of fresh meat from Hungary preserved in ice. The report will be published in a subsequent *Journal*. The Committee had before them specimens of "Pemmican," or dried powdered meat, and preserved sweet potatoes from Queensland sent by Mr. J. B. Alexander.

The Committee had also before them a specimen of condensed milk, treated by Mr. Hooker's process. The specimen had been in the International Exhibition at South Kensington, from March to November, 1873, after which time it had been in the possession of the Society, in all 15 months, during which period it had been kept in an open vessel exposed to the action of the air. The accounts of the process stated that it had been for eighteen months similarly exposed, previous to its being placed in the Exhibition. The milk was in excellent condition, free from taint or decomposition of any kind.

Mr. Hooker attended, and with a churn in a few minutes converted some of the milk into excellent butter.

The process by which the result is obtained is secret, but the inventor assured the Committee that no chemical of any kind or any other ingredient than sugar were added to the milk.

IMPROVED RAILWAY LAMP.

The Society's Gold Medal, or Twenty Guineas, is offered for an improved lamp or means of illumination, suitable for railway passenger-carriages, that shall produce a good, clear, steady, durable, and safe light.

It must be simple in construction, and capable of being readily cleaned and repaired.

In judging the merits, cost will be taken into consideration.

Specimens in a condition suitable for trial to be sent in to the Society's House not later than the 1st of November, 1874.

The Council reserve to themselves the right of withholding the medal or premium offered, if, in the opinion of the judges, none of the articles sent in competition are deserving of reward.

GENERAL EXAMINATIONS, 1874.

PRIZES AND CERTIFICATES AWARDED TO CANDIDATES.

PRIZES.

His Royal Highness the Prince Consort's Prize of Twenty-Five Guineas to

No. 1051—Alexander Gibson, aged 20, of the Manchester Mechanics' Institution, draughtsman, who has obtained the following First-class Certificates in the present and three preceding years :—

1871—Domestic Economy—First-class Certificate, with a Prize of Books to the value of £1.
Mensuration—First-class Certificate.
1872—Metric System—First-class Certificate, with the First Prize of £5.
Geography—First-class Certificate, with the Second Prize of £3.
1873—Logic—First-class Certificate, with the First Prize of £5.
Political Economy—First-class Certificate, with a Prize of Books to the value of £1.
English Language—First-class Certificate.
1874—Arithmetic—First-class Certificate.
Bookkeeping—First-class Certificate
English History—First-class Certificate, with the Second Prize of £3.

The Council Prize (for Female Candidates) of Ten Guineas to

No. 642—Mary Elizabeth Martin, aged 25, of the Birkbeck Literary and Scientific Institution (no occupation stated), who has obtained the following First-class Certificates :—

1872—German—First-class Certificate, with the First Prize of £5, and the Special Prize of £2 for Females.
1874—French—First-class Certificate, with the Special Prize of £2 for Females.

Arithmetic	1st Prize	£5	To No. 361—George Coulter, 19, Birkbeck Literary and Scientific Institution, Civil Service clerk.
	2nd Prize	3	„ 696—George Weatherley, 20, Birkbeck Literary and Scientific Institution, clerk.
			* *No Prize for Females awarded.*
Book-keeping	1st Prize	5	„ 712—Ebenezer Glencross, 24, Birkbeck Literary and Scientific Institution, clerk.
	2nd Prize	3	„ 602—John T. Hutton, 19, Birkbeck Literary and Scientific In-Institution, clerk.
			* *No Prize for Females awarded.*
Floriculture	1st Prize	5	„ 707—Frederick W. Burbidge, 26, Birkbeck Literary and Scientific Institution, reporter.
	2nd Prize	3	„ 201—William Bell, 24, Carlisle Mechanics' Institute, gardener.
Fruit and Vegetable Culture	1st Prize	5	„ 707—Frederick W. Burbidge, 26, Birkbeck Literary and Scientific Institution, reporter.
	2nd Prize	3	„ 201—William Bell, 24, Carlisle Mechanics' Institute, gardener.
Political Economy	1st Prize	5	„ 681—Henry Eede, 25, Birkbeck Literary and Scientific Institution, solicitor's clerk.
	2nd Prize	3	„ 690—William J. Pratt, 25, Birkbeck Literary and Scientific Institution, assistant of Excise.
English History	1st Prize	5	„ 577—William C. Hudson, 19, Liverpool Institutute, clerk.
	2nd Prize	3	„ 1051—Alexander Gibson, 20, Manchester Mechanics' Institution, draughtsman.
			* *No Prize for Females awarded.*
English Language	1st Prize	5	„ 696—George Weatherley, 20, Birkbeck and Scientific Institution, clerk.
	2nd Prize	3	„ 100—Frederick W. Grew, 18, Birmingham and Midland Institution, lithographer.
	Females' Prize	2	„ 195—Mary E. Rudd, 18, Carlisle Mechanics' Institution (no occupation stated).
Logic	1st Prize	5	„ 825—John J. Parker, 25, City of London College, clerk.
			† *No Second Prize awarded.*

* No Female Candidate qualified to receive Prizes obtained a First-elass Certificate in this subject.
† No other First-class Certificates were givenin this subject.

French	1st Prize......	5	,, 598—Paul J. Descours, 17, Birkbeck Literary and Scientific Institution, in Civil Service.
	2nd Prize	3	,, 723—Thomas Stock, 28, Birkbeck Literary and Scientific Institution, Civil Service writer.
	Females' Prize	2	,, 642—Mary E. Martin, 25, Birkbeck Literary and Scientific Institution (no occupation stated).
German	1st Prize......	5	,, 1069.—William Potter, 17, Newcastle-on-Tyne Church Institute, apprentice to merchant.
	2nd Prize	3	,, 651—Richard W. Bennett, 21, Birkbeck Literary and Scientific Institution, clerk.
	Females' Prize	2	,, 883—Elizabeth Cosier, 31, Royal Polytechnic Institution, assistant.
Italian	1st Prize......	5	,, 675—Arthur H. Elliot, 23, Birkbeck Literary and Scientific Institution, leather merchant's salesman. † *No Second Prize awarded.* * *No Prize for Females awarded.*
Spanish	1st Prize......	5	,, 615—William W. Conolly, 21, Birkbeck Literary and Scientific Institution, clerk.
	2nd Prize	3	,, 98—Walter W. Davies, 18, Birmingham and Midland Institute, clerk. * *No Prize for Females awarded.*
Theory of Music	1st Prize......	5	,, 298—James Fleming, 27, Popular Evening Classes, Glasgow Andersonian University, pianoforte tuner.
	2nd Prize	3	,, 881—Ernest C. Winchester, 19, Royal Polytechnic Institution, clerk.
	Females' Prize	2	,, 553—Mary Redick, 23, Leeds Church Institute (no occupation).

The Prizes offered by Mrs. Harry Chester in Political Economy have been awarded as follows :—

Third Prize of £2 to No. 837—John H. Rose, 26, City of London College, clerk.
Prize of Books value £1 ,, 664—Alfred Carter, 22, Birkbeck Literary and Scientific Institution, clerk in Civil Service.
,, ,, ,, 737—George P. Austing, 30, City of London College, clerk.
The Third Book Prize was not awarded, no other Candidate being eligible to take a Prize in this subject.

The Prizes offered by the Council for Writing from Dictation have been awarded as follows :—

1st Prize of £3 to No 886—George C. Hughes, 19, Royal Polytechnic Institution, clerk.
2nd ,, 2 ,, 600—William H. Wright, 19, Birkbeck Literary and Scientific Institution, clerk.
3rd ,, 1 ,, 702—George Riorden, 23, Birkbeck Literary and Scientific Institution, engraver.

The Prizes offered by the Council for Writing and Manuscript Printing have been awarded as follows :—

1st Prize of £3 to No. 202—Macey F. Tayelor, 27, Carmarthen Literary and Scientific Institution, clerk and accountant.
2nd ,, 2 ,, 679—Frederick J. Thresher, 19, Birkbeck Literary and Scientific Institution, clerk.
3rd ,, 1 ,, 1208—Henry A. Hanson, 23, Quebec Institute, clerk.

The Prizes offered by the Council for the four best specimens of Handwriting, as shown in any of the Papers worked in any subject, have been awarded as follows :—

1st Prize of £5 to No. 813—George Morgan, 20, City of London College, shorthand writer.
2nd ,, 3 ,, 786—Arthur Hill, 20, City of London College, clerk in Civil Service.
3rd ,, 2 ,, 870—Edward Winwood, 19, City of London College, Civil Service writer.
4th ,, 1 ,, 599—Maurice Symes, 29, Birkbeck Literary and Scientific Institute, clerk in Civil Service.

VIVA-VOCE EXAMINATION IN MODERN LANGUAGES.

The vivâ-voce examination in Modern Languages, as proposed in the memorandum furnished by Mr. Hyde Clarke, Member of the Council, has been held this year, at four Institutions, the subject taken being French, and the Local Examiners having reported the following as having satisfactorily passed, the Council have awarded them Certificates of "Proficiency" :—

Edward Norton, 16, Penzance, student.
J. G. Robertson, 22, Birkbeck Literary and Scientific Institution, clerk.
John Wardle, 22, Manchester Mechanics' Institution, clerk.
Alfred Wheeler, 28, Birmingham and Midland Institute, teacher.

* No Female Candidate qualified to receive Prizes obtained a First-class Certificate in this subject.
† No other First-class Certificates were given in this subject.

CERTIFICATES.

The following is an Alphabetical List of the Candidates who have obtained Certificates.

The number following the name gives the age of the Candidate.

(1st) after a subject signifies a First-class Certificate.
(2d) „ „ Second-class „
(3d) „ „ Third-class „

The occupations stated are either present or proposed.

733—Abbott, Henry, 22, City of London Coll., clerk—Bkpg. (2d)
556—Adcock, Thomas, 26, Leicester W.M. Coll., teacher—Arith. (3d); Eng. Hist. (3d)
942—Adderson, Thomas, 17, King's Lynn Ath., pupil teacher—Arith. (2d); Eng. Hist. (2d)
1028—Addison, Joseph, 17, Manchester M.I., cashier — Bkpg. (2d)
1220—Adgie, John, 17, Leeds Young Men's Chr. Assoc., clerk—Arith. (3d)
390—Aitken, John, 22, Glasgow Ath., warehouseman —French (3d)
183—Akitt, Henry, 18, Carlisle M.I. (no occupation)—Arith. (3d)
89—Aldrich, Alice E., 18, Birmingham and Mid. Inst. (no occupation)—French (3d)
468*-Allan, James, 24, Huddersfield M.I., book-keeper —French (3d)
1165—Allan, Robert, 18, Sunderland Young Men's Chr. Assoc., clerk—Arith. (3d); Eng. Hist. (2d); Pol Econ. (3d); Eng. Lang. (3d)
368—Allan, William, 21, Glasgow Ath., clerk—Bkpg. (1st)
1148—Allcock, Alfred R., 16, Stockport M.I., mechanic —Arith. (3d)
1042—Allen, Joseph B., 18, Manchester M.I., book-keeper—Bkpg. (2d)
940*-Allen, William A., 20, Tonic Sol-fa Teachers' Assoc., teacher—Th. of Music (2d)
231—Allen, William C., 19, Dublin, soldier—Arith. (3d); Eng. Lang. (3d)
1225—Allen, William J., 17, Leeds Young Men's Chr. Assoc., clerk—Eng. Hist. (2d); Eng. Lang. (3d)
610—Allingham, William, 23, Birkbeck Lit. and Sci. Inst., writer in Civil Service—Arith. (1st.)
734—Allnutt, Frank, 17, City of London Coll., lawyer's clerk—Arith. (2d); Eng. Hist. (1st); Eng. Lang. (2d)
735—Allsop, Peter J., 19, City of London Coll., clerk —Bkpg. (3d)
1020—Alston, Thomas, 16, Manchester M.I., mechanic —Arith. (3d)
736—Althaus, George A., 16, City of London Coll., clerk—Arith. (3d); Bkpg. (2d)
165—Amos, Henry W., 27, Bromley (Kent) Lit. Inst., clerk—Arith. (3d); Bkpg. (1st)
29—Anderson, Arthur, 16, Aberdeen M.I., clerk—Eng. Lang. (3d)
360—Anderson, John M., 18, Glasgow Ath., clerk—French (3d)
156—Anderson, William A., 20, Bolton M.I., clerk—Arith. (3d)
284—Andrew, John, 20, Glasgow Anderson. Univ. Pop. Evg. Classes, stationer's assistant—Th. of Music (3d)
282—Andrew, Noah, 20, Freetown W.M. Inst., clerk —Bkpg. (2d)
1216—Andrews, Richard, 33, Leeds Young Men's Chr. Assoc., clerk—Bkpg. (2d)
348—Annan, John, 17, Glasgow Ath., accountant's clerk—French (3d)
558—Annis, William, 19, Leicester W.M. Coll., ironmonger—Eng. Lang. (3d)
91—Anslow, Anna, 28, Birmingham and Mid. Inst., teacher—French (2d)
147—Arden, Richard P., 16, Bolton Ch. Inst. (no occupation)—Arith. (3d); Eng. Hist. (3d); Eng. Lang. (2d)
193—Armstrong, James, 19, Carlisle M.I. (no occupation stated)—Arith. (3d)
285—Arneil, James A., 19, Glasgow Anderson. Univ. Pop. Evg. Classes, land surveyor—Arith. (1st); Eng. Hist. (3d); Eng. Lang. (2d)
90—Arundel, Walter C., 17, Birmingham and Mid. Inst., clerk—German (3d); French (1st)
1191—Ashmore, George, 17, York Inst., pupil teacher—Arith. (3d)
279—Ashton, John, 29, Edinburgh Watt Inst., goldsmith—Th. of Music (1st)
77—Ashworth, James, 17, Bacup M.I., pupil teacher —Arith. (3d); Eng. Lang. (3d)
78—Ashworth, John T., 17, Bacup M.I., pupil teacher Arith. (3d)
1115—Ashworth, Joseph, 18, Salford W.M. Coll., clerk —Bkpg. (1st)
473—Assmus, Heinrich O., 21, Hull Ch. Inst., clerk—French (3d)
565—Austin, Abraham, 29, Liecester W.M. Coll., labourer—Arith. (3d)
224—Austin, Mary B. J., 19, Devonport M.I. (no occupation stated)—Th. of Music (2d)
737—Austing, George P., 30, City of London Coll., clerk—Pol. Econ. (1st), with a Prize of Books value £1
715—Ayling, Joseph J., 39, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)
548—Aylward, Walter C., 18, Ipswich W.M. Coll., shoemaker—Bkpg. (1st)
1169—Aynsley, Christopher, 21, Sunderland Young Men's Chr. Assoc., clerk—Eng. Lang. (2d)

971—Bailey, Isaac, 27, Manchester M.I., warhouseman—French (3d)
521—Bailey, William, 17, Hull Young People's Chr. and Lit. Inst., compositor—Eng. Lang. (3d)
633—Baker, Amy F., 19, Birkbeck Lit. and Sci. Inst., governess—French (3d)
634—Baker, Emily G., 22, Birkbeck Lit. and Sci. Inst., governess—French (3d)
151—Balshaw, James, 17, Bolton M.I., clerk—Arith. (3d)
267—Band, David, 18, Dundee Young Men's Chr. Assoc., clerk—Eng. Lang. (3d)
568—Barclay, Thomas P., 21, Leicester W.M. Coll., framework knitter—Eng. Lang. (3d)
910—Barnes, Charles N., 30, Royal Polytechnic Inst., teacher—Th. of Music (3d)
739—Barnes, Lawrence L., 17, City of London Coll. (no occupation stated)—French (3d)
59—Barnett, William J., 17, Ashford M.I., blacksmith —Arith. (3d)
1156—Barrodale, Samuel, 16, Stockport Sund. Sch. Imp. Soc., pupil teacher—Arith. (1st); Eng. Hist. (3d); Eng. Lang. (2d)
966—Barry, Thomas, 21, Manchester M.I., clerk—German (3d)
181—Barwise, William, 16, Carlisle M.I. (no occupation stated)—Arith. (3d)
965—Bateman, Alfred, 16, Manchester M.I., book-keeper—Arith. (3d.); Bkpg. (1st)
93—Bates, George W., 19, Birmingham and Mid. Inst., organist—Th. of Music (2d)
1060—Baxter, Fred, 16, Mossley M.I., tailor—Bkpg. (3d)
1067—Baxter, John, 18, Mossley M.I., tailor—Eng. Hist. (3d); Eng. Lang. (2d)
95—Bayley, Elizabeth, 19, Birmingham and Mid. Inst. (no occupation)—Th. of Music (1st)
934—Beaton, Lachlan, 23, Tonic Sol-fa Teachers' Assoc., clerk—Th. of Music (1st)
222—Beer, George K., 21, Devonport M.I., solicitor's clerk—Arith. (1st)
740—Beer, Henry, 23, City of London Coll., clerk—Arith. (2d); Th. of Music (1st)

9—Bell, David, 18, Aberdeen M.I., compositor—Eng. Lang. (3d)
201—Bell, William, 24, Carlisle M.I., gardener—Floriculture (1st), Fruit and Vegetable Culture (1st), with the Second Prize of £3 in each subject
491—Bellamy, George, 23, Hull Ch. Inst., bookseller and stationer—Bkpg. (1st)
474—Bennett, Charles L., 21, Hull Ch. Inst., clerk—Bkpg. (2d)
1154—Bennett, Harry, 17, Stockport M.I., hatter—Bkpg. (3d)
742—Bennett, Horatio H., 20, City of London Coll., clerk—Commercial German (1st)
651—Bennett, Richard W., 21, Birkbeck Lit. and Sci. Inst., clerk—Arith. (3d); German (1st), with the Second Prize of £3; Eng. Lang. (1st)
1062—Berry, John J., 18, Mossley M.I., cotton piecer—Bkpg. (3d)
1093—Bettany, Caroline, 18, Penzance, at school—Th. of Music (2d)
1075—Bickerton, Henry, 16, Oldham Lyceum, bookkeeper—Arith. (3d)
743—Biden, Lewis M., 17, City of London Coll., articled clerk—Eng. Hist. (3d); Eng. Lang. (2d)
1104—Bisbey, John, 20, Rotherham Lit. and Sci. Inst., schoolmaster—Arith. (3d); Eng. Lang. (3d)
671—Bishop, Charles E., 20, Birkbeck Lit. and Sci. Inst., chemist—Th. of Music (2d)
187—Black, Margaret, 25, Carlisle M.I. (no occupation stated)—Arith. (2d)
274—Blair, George A., 36, Edinburgh Watt Inst., clerk—Arith. (2d); Bkpg. (3d)
1197—Bland, Frank, 18, York Inst., teacher—Arith. (3d); Bkpg. (2d)
177—Blaycock, Robert, 21, Carlisle M.I., clerk—Arith. (3d)
1044—Bleasdale, John, 23, Manchester M.I., clerk—Bkpg. (2d)
713—Boak, Richard F., 20, Birkbeck Lit. and Sci. Inst., solicitor's clerk—Bkpg. (1st)
895—Booth, Benjamin, 20, Royal Polytechnic Inst., clerk—Arith. (3d)
1004—Booth, James, 20, Manchester M.I., clerk—Eng. Hist. (1st); Pol. Econ. (2d); Bkpg. (1st)
1076—Boothby, William, 20, Oldham Lyceum, surveyor's apprentice—Th. of Music (3d)
899—Bourne, Frederick, 22, Royal Polytechnic Inst., clerk—Bkpg. (2d)
286—Bowie, James, 29, Glasgow Anderson. Univ. Pop. Evg. Classes, clerk—Th. of Music (3d)
1096—Bradbury, Samuel, 16, Penzance, pupilteacher—Th. of Music (1st)
953—Bradfield, Henry, 27, King's Lynn Ath., attorney's clerk—Bkpg. (1st)
975—Bradley, John, 24, Manchester M.I., hosier—Eng. Hist. (2d)
1056—Bradley, Thomas, 27, Manchester M.I., clerk—French (3d)
1018—Bradley, William, 22, Manchester M.I., clerk—Arith. (1st); German (3d); Bkpg. (1st)
993—Bradshaw, James, 21, Manchester M.I., clerk—Arith. (3d)
647—Bramham, Benjamin, 19, Birkbeck Lit. and Sci. Inst., clerk—Th. of Music (1st)
968—Bramwell, Robert, 20, Manchester M.I., clerk—Arith. (3d)
210—Bransfield, Richard J., 16, Cork Catholic Young Men's Soc., accountant—Arith. (3d); Eng. Lang. (3d)
429—Brear, Thomas, 18, Halifax W.M. Coll., warehouseman—Arith. (3d); Pol. Econ. (2d); Bkpg. (2d)
12—Brebner, George, 19, Aberdeen M.I., student—French (1st)
13—Brebner, Jane, 17, Aberdeen M.I. (no occupation stated)—French (3d)
47—Brew, Michael W., 22, Aldershot and Farnham District, soldier—Arith. (3d)
746—Brighton, George, 24, City of London Coll., clerk—French (3d)
507—Broadhead, Charles K., 21, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (1st)
149—Brockbank, George A., 16, Bolton Ch. Inst. (no occupation)—Eng. Hist. (3d); Eng. Lang. (3d)
184—Brockbank, John, 22, Carlisle M.I., architectural draughtsman—Eng. Hist. (2d)
6—Brockie, James, 21, Aberdeen M.I., clerk—French (3d)
94—Brockington, Walter, 16, Birmingham and Mid. Inst., pupil teacher—French (3d)
1052—Brodrick, Thomas, 17, Manchester M.I., bookkeeper—Bkpg. (1st)
641—Brook, Frederick H., 19, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)
933—Brooks, Francis T., 22, Tonic Sol-fa Teachers' Assoc., teacher—Th. of Music (2d)
1116—Broom, James W., 20, Salford W.M. Coll., warehouseman—Arith. (3d)
1152—Broome, Robert, 18, Stockport M.I., joiner—Arith. (3d)
1009—Brotherton, Edward A., 17, Manchester M.I., engineer—Arith. (3d)
460—Brown, George E., 17, Hertford Lit. and Sci. Inst., pupil teacher—Arith. (3d); Eng. Lang. (3d)
1117—Brown, James B, 17, Salford W.M. Coll., pupil teacher—Arith. (3d)
661—Brown, John, 20, Birkbeck Lit. and Sci. Inst., warehouseman—French (3d)
747—Brown, Patrick, 21, City of London Coll., clerk—Arith. (3d); Commercial French (1st); Bkpg. (3d)
287—Brown, Robert, 23, Glasgow Anderson. Univ. Pop. Evg. Classes, clerk—Bkpg. (1st)
288—Brown, William, 23, Glasgow Anderson Univ. Pop. Evg. Classes, warehouseman—Th. of Music (2d)
1227—Browning, John, 17, Leeds Young Men's Chr. Assoc., clerk—Arith. (3d)
367—Brownlie, John, 23, Glasgow Ath., law clerk—German (3d)
555—Bruce, Henry B., 31, Leicester W.M. Coll., warehouseman—French (3d)
1063—Buckley, George, 18, Mossley M.I., roller coverer—Bkpg. (1st)
1064—Buckley, William H., 17, Mossley M.I., draughtsman—Bkpg. (3d)
290—Buchanan, James, 21, Glasgow Anderson. Univ. Pop. Evg. Classes, clerk—Th. of Music (1st)
943—Bunting, Robert, 17, King's Lynn Ath., pupil teacher—Arith. (3d); Eng. Hist. (2d)
707—Burbidge, Frederick W., 26, Birkbeck Lit. and Sci. Inst., reporter—Floriculture (1st), Fruit and Vegetable Culture (1st), with the First Prize of £5 in each subject
750—Burke, Charles, 24, City of London Coll., clerk—Commercial German (1st)
751—Burke, Edward, 22, City of London Coll., clerk—Bkpg. (2d)
752—Burnett, David, 23, City of London Coll., clerk—Bkpg. (1st)
753—Burt, Charles F., 19, City of London Coll., clerk—French (2d)
1212—Busfield, John R., 17, Farsley M.I., cloth weaver—Arith. (3d); Bkpg. (3d)
620—Bushnell, Francis H. D., 16, Birkbeck Lit. and Sci. Inst., clerk in savings bank—Arith. (2d)
754—Butler, James, 19, City of London Coll., chronometer maker's assistant—Arith. (3d); French (3d)
755—Butler, Joseph, 21, City of London Coll., engineer—French (3d); Bkpg. (2d)
26—Byres, Alexander M., 16, Aberdeen M.I., accountant's clerk—Arith. (3d)

699—Cable, Robert Mc C., 18, Birkbeck Lit. and Sci. Inst., clerk—Spanish (2d); French (3d)
372—Cameron, Samuel, 16, Glasgow Ath., clerk—Eng. Lang. (3d)
354—Campbell, John, 22, Glasgow Ath., clerk—French (3d)
418—Campbell, John, 18, Glasgow M.I., grocer—Eng. Lang. (3d)
756—Carson, John, 21, City of London Coll., clerk—Arith. (3d)
664—Carter, Alfred, 22, Birkbeck Lit. and Sci. Inst., clerk in Civil Service—Eng. Hist. (1st); Pol. Econ. (1st), with a prize of books, value £1; Eng. Lang. (1st)
1037—Carter, Mark A., 17, Manchester M.I., apprentice—Bkpg. (3d)
757—Casson, William A., 20, City of London Coll., clerk—Arith. (2d); Eng. Hist. (1st); Eng. Lang. (1st)
249—Chalmers, William, 20, Dundee Young Men's Chr. Assoc., clerk—Arith. (3d); German (1st)
283—Chappell, Walter, 19, Freetown W.M. Inst., cotton piecer—Bkpg. (3d)
1189—Charles, Benjamin, 20, Wakefield M.I., clerk—Bkpg. (2d)
566—Charlesworth, James, 24, Leicester W.M. Coll., clicker—Eng. Hist. (3d)
983—Cheetham, Samuel, 20, Manchester M.I., booker for spinners—Bkpg. (3d)
477—Clapham, George, 19, Hull Ch. Inst., clerk—Bkpg. (2d)
230—Clare, William, 20, Dublin, soldier—Arith. (3d)
220—Clark, Josiah B., 18, Devonport M.I., clerk—Arith. (2d)
758—Clarke, Ebenezer, 23, City of London Coll., clerk—Bkpg. (1st)
180—Clarke, Robert A., 17, Carlisle M.I., clerk—Bkpg. (1st)
96—Cleaver, Louisa M., 26, Birmingham and Mid. Inst., governess—Arith. (3d)
502—Close, John, 17, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (2d)
431—Close, Thomas, 18, Halifax W.M. Coll., warehouseman—Bkpg. (3d)
513—Cockerline, Walter H., 17, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (3d)
537—Cocks, James, 18, Hyde M.I., clerk—Eng. Hist. (2d); Eng. Lang. (2d)
215—Coffey, Edward, 18, Cork Catholic Young Men's Soc., bookkeeper—Arith. (2d); Bkpg. (3d)
623—Cohen, Joseph, 21, Birkbeck Lit. and Sci. Inst., teacher—Spanish (1st); Commercial French (1st)
41—Coleman, Richard H., 16, Aldershot and Farnham District, clerk—Arith. (1st); Eng. Hist. (2d)
432—Collins, John P., 18, Halifax W.M. Coll., clerk—Bkpg. (3d)
643—Collins, John W., 22, Birkbeck Lit. and Sci. Inst., lawyer's clerk—Th. of Music (1st)
1026—Conolly, John, 19, Manchester M.I., decorator—Bkpg. (3d)
1031—Conolly, William, 17, Manchester M.I., decorator—Bkpg. (3d)
615—Conolly, William W., 21, Birkbeck Lit. and Sci. Inst., clerk — Spanish (1st), with First Prize of £5
864*-Constantine, Edward, 24, City of London Coll., clerk—Pol. Econ. (2d)
1119—Cookson, John D., 16, Salford W.M. Coll., bootmaker—Arith. (3d)
1198—Cooper, John W., 19, York Inst., joiner—Arith. (3d)
15—Cooper, Robert, 26, Aberdeen M.I., tinsmith—Th. of Music (3d)
576—Cooper, William L., 18, Liverpool Inst., clerk—Bkpg. (2d)
374—Corbet, Robert, 23, Glasgow Ath., clerk—Eng. Lang. (3d)
883—Cosier, Elizabeth, 31, Royal Polytechnic Inst., assistant—German (1st), with the Prize of £2 for Females
1034—Cottrell, George E., 21, Manchester M.I., clerk—Bkpg. (1st)
613—Coulter, George, 19, Birkbeck Lit. and Sci. Inst., Civil Service clerk—Arith. (1st), with the First Prize of £5; French (2d)
1071—Cowan, Bernard, 25, Newcastle-on-Tyne Ch. Inst., gardener—Floriculture (2d); Fruit and Vegetable Culture (2d)
961—Cowle, Annie, 23, Manchester M.I. (no occupation stated)—Th. of Music (3d)
1058*-Cowle, Margaret, 27, Manchester M.I., teacher—French (3d)
609—Crabtree, Jean, 28, Birkbeck Lit. and Sci. Inst., teacher—German (2d)
364—Craig, James, 23, Glasgow Ath., clerk—French (3d)
291—Craig, Robert, 22, Glasgow Anderson. Univ. Pop. Evg. Classes, warehouseman—Th. of Music (3d)
433—Craven, Enoch, 18, Halifax W.M. Coll, watchmaker—Bkpg. (2d)
434—Craven, George, 19, Halifax W.M. Coll, pawnbroker—Bkpg. (2d)
435—Craven, Walter, 22, Halifax W.M. Coll., woolsorter—Arith. (3d); Bkpg. (2d)
292—Crawford, George, 26, Glasgow Anderson. Univ. Pop. Evg. Classes, blacksmith—Th. of Music (3d)
1043—Creer, John J., 21, Manchester M.I., warehouseman—Bkpg. (2d)
624—Cross, Frederick J., 20, Birkbeck Lit. and Sci. Inst., clerk—Eng. Hist. (1st); French (3d)
662—Crossingham, Thomas E., 23, Birkbeck Lit. and Sci. Inst., carpet salesman—Bkpg. (1st)
1011—Crossley, James, 17, Manchester M.I., draughtsman (apprentice)—Arith. (3d)
467—Crossley, William H., 18, Huddersfield M.I., warehouseman—Bkpg. (3d)
930—Crouch, William, 27, Tonic Sol-fa Teachers' Assoc., teacher—Th. of Music (2d)
761—Crowson, Samuel, 22, City of London Coll., clerk—Arith. (3d); Bkpg. (3d)
97—Crump, Sarah E., 29, Birmingham and Mid. Inst., governess—German (1st); French (1st)
762—Curtis, Harry, 17, City of London Coll., clerk—French (3d)
700—Curtis, John A., 25, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st)
763—Cuthbertson, Robert A., 16, City of London Coll., clerk—French (3d)

21—Dale, Eliza S., 18, Aberdeen M.I., pupil teacher—French (2d)
17—Dale, Robert, 16, Aberdeen M.I., student—French (3d)
516—Dales, John, 21, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (3d)
250—Dallas, James, 18, Dundee Young Men's Chr. Assoc., apprentice mechanic—Arith. (2d)
710—Dangerfield, Athelstan, 16, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)
764—Dansie, Crown, 21, City of London Coll., clerk—French (3d); Bkpg. (3d)
891—Davey, Charles, 22, Royal Polytechnic Inst., clerk—French (3d)
996—Davies, Joe S., 18, Manchester M.I., clerk—Arith. (3d); Eng. Hist. (3d); Bkpg. (2d)
1055—Davies, John, 21, Manchester M.I., cutter out—Arith. (3d)
967—Davies, Thomas A., 20, Manchester M.I., clerk—Bkpg. (1st)
976—Davies, Thomas W., 20, Manchester M.I., clerk—Arith. (2d); Eng. Hist. (1st); French (3d); Eng. Lang. (1st)

98—Davies, Walter W., 18, Birmingham and Mid. Inst., clerk—Spanish (1st), with the Second Prize of £3; French (1st)
162—Davis, James T., 23, Bow and Bromley Inst., clerk—Bkpg. (2d)
765—Davison, Frederick C., 22, City of London Coll., clerk—Arith. (1st); Eng. Hist. (2d); Bkpg. (1st)
545—Day, Walter, 17, Ipswich W.M. Coll., clerk—Bkpg. (3d)
529—Dealtry, Albert, 19, Hull Young People's Chr. and Lit. Inst. (no occupation stated)—Bkpg. (3d)
1041—Dean, John, 22, Manchester M.I., warehouseman—Bkpg. (1st)
1094—Dennis, Thomas, 16, Penzance, pupil teacher—Th. of Music (3d)
384—Dennistoun, Archibald, 22, Glasgow Ath., clerk—French (3d)
922—Derrick, Francis, 21, St. Stephen's Evg. Sch., Westminster, teacher—Arith. (3d)
598—Descours, Paul J., 17, Birkbeck Lit. and Sci. Inst., in Civil Service—Arith (1st); Eng. Hist. (1st); French (1st), with the First Prize of £5; Bkpg. (2d)
294—Dick, James, 23, Glasgow Anderson. Univ. Pop. Evg. Classes, teacher—Th. of Music (1st)
355—Dick, William, 17, Glasgow Ath., clerk—French (3d)
941—Dickes, Emma, 25, Walworth Lit. and Sci. Inst. (no occupation stated)—French (3d)
894—Dickes, Louise, 29, Royal Polytechnic Inst. (no occupation stated)—Th. of Music (2d)
972—Dobson, W., 17, Manchester M.I., clerk—Bkpg. (2d)
36—Donald, John, 20, Aberdeen M.I., saddler—Arith. (3d); Eng. Lang. (3d)
373—Donaldson, John, 17, Glasgow Ath., warehouseman—Arith. (3d)
593—Donkersley, Joe, 19, Lockwood M.I., clerk—Arith. (3d)
232—Donohoe, Patrick, 34, Dublin, soldier—Arith. (3d)
504—Dossor, Robert, 18, Hull Young People's Chr. and Lit. Inst., grocer's assistant—Bkpg. (1st)
588—Douglas, Archibald, 22, Liverpool Inst., clerk—Bkpg. (3d)
480—Downing, Arthur, 18, Hull Ch. Inst., clerk—Bkpg. (3d)
656—Dowthwaithe, Charles W 21, Birkbeck Lit. and Sci. Inst., clerk—Bkpg (1st)
948—Duffield, Lydia, 23, King's Lynn Ath. (no occupation)—Bkpg. (3d)
674—Dugard, Frederick J., 21, Birkbeck Lit. and Sci. Inst., clerk—Th. of Music (1st)
766—Dutton, William J., 23, City of London Coll., clerk—Bkpg. (2d)
939—Dyer, James, 21, Tonic Sol-fa Teachers' Assoc., organist—Th. of Music (1st)

767—Eardley, Edward L., 21, City of London Coll., Civil Service writer—Logic (2d); Eng. Hist. (2d); Eng. Lang. (2d)
681—Eede, Henry, 25, Birkbeck Lit. and Sci. Inst., solicitor's clerk—Pol. Econ. (1st), with the First Prize of £5
1204—Edgoose, Lucilla F., 18, York Inst., governess—Th. of Music (2d)
225—Edmonds, James C., 17, Devonport M.I., engineer—Arith. (1st); Eng. Hist. (3d)
768—Edney, John, 18, City of London Coll., clerk—Bkpg. (2d)
687—Edwards, John T., 16, Birkbeck Lit. and Sci. Inst., clerk—Arith. (3d)
587—Egan, William M., 21, Liverpool Inst., clerk—Bkpg. (2d)
675—Elliot, Arthur H, 23, Birkbeck Lit. and Sci. Inst., leather merchant's salesman—Italian (1st), with the First Prize of £5; French (3d)
499—Ellison, William, 23, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (3d)
1196—Elstob, Charles A., 16, York Inst., teacher—Arith. (2d); Bkpg. (3d)
2—Emslie, William, 17, Aberdeen M.I., watchmaker's apprentice—Eng. Lang. (2d)
570—Ensor, Joseph, 17, Leicester W.M. Coll., pupil teacher—French (3d)
982—Entwisle, Peter, 18, Manchester M.I., in warehouse—Arith. (2d)
1159—Entwistle, Benjamin, 19, Stockport Sund. Sch. Imp. Soc., warehouseman—Arith. (3d)
672—Epitaux, Albert R., 18, Birkbeck Lit. and Sci. Inst., restaurateur—Arith. (3d); Eng. Lang. (3d)
1106—Evans, Annie A. M., 17, Rugby, student—Eng. Hist. (2d); Eng. Lang. (2d)
99—Evans, Walter H., 19, Birmingham and Mid. Inst., clerk—Spanish (1st)
689—Evans, William, 20, Birkbeck Lit. and Sci. Inst., stamper—Arith. (3d); Bkpg. (2d)
680—Everitt, Philip, 24, Birkbeck Lit. and Sci. Inst., clerk—Pol. Econ. (2d)

725—Fagg, Frederic W., 16, Birkbeck Lit. and Sci. Inst., clerk—Arith. (2d)
296—Fairley, William, 23, Glasgow Anderson. Univ. Pop. Eng. Classes, warehouseman—Th. of Music (1st)
989—Fallon, John, 16, Manchester M.I., office boy—Eng. Lang. (3d)
52—Farmer, George, 22, Ashby-de-la-Zouch Young Men's Mut. Imp. Soc., clerk—Bkpg. (2d)
769—Farmer, William J., 20, City of London Coll., clerk—Bkpg. (2d)
141—Farnworth, Eli, 21, Bolton Ch. Inst., packer—Arith. (3d)
621—Fells, John M., 17, Birkbeck Lit. and Sci. Inst., clerk—Eng. Hist. (2d)
417—Ferguson, Peter, 24, Glasgow M.I., grocer—Eng. Lang. (3d)
1155—Ferns, Gregory, 17, Stockport M.I., office boy—Arith. (3d)
524—Fife, Lyon A., 19, Hull Young People's Chr. and Lit. Inst., stationer's apprentice—Bkpg. (2d)
297—Fingland, Samuel, 27, Glasgow Anderson. Univ. Pop. Evg. Classes, warehouseman—Th. of Music (1st)
437—Firth, Eli, 23, Halifax W.M. Coll., carpet weaver—Bkpg, (3d)
611—Fish, William D., 21, Birkbeck Lit. and Sci. Inst., in Civil Service—Arith. (1st); Eng. Hist. (2d)
500—Fisher, William H., 17, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (3d)
770—Fleck, Henry, 18, City of London Coll., clerk—French (2d); Bkpg. (2d)
694—Flegg, Robert, 23, Birkbeck Lit. and Sci. Inst., clerk—Eng. Lang. (2d)
626—Flegg, Thomas, 18, Birkbeck Lit. and Sci. Inst., clerk—Arith. (2d)
298—Fleming, James, 27, Glasgow Anderson. Univ. Pop. Evg. Classes, pianoforte tuner—Th. of Music (1st), with the First Prize of £5
299—Fleming, John, 26, Glasgow Anderson. Univ. Pop. Evg. Classes, coachbuilder—Th. of Music (3d)
359—Fleming, William, 19, Glasgow Ath., clerk—French (2d)
515—Flowers, Frederick, 23, Hull Young People's Chr. and Lit. Inst., music seller's assistant—Bkpg. (1st)
956—Floyd, Frank R., 19, King's Lynn Ath., clerk—Bkpg. (1st)
945—Floyd, William, 23, King's Lynn Ath., solicitor's clerk—Eng. Hist. (1st)
146—Foole, John, 18, Bolton Ch. Inst., pupil teacher—Arith. (3d); Eng. Hist. (3d); Eng. Lang. (3d)

1072—Foote, Edward C., 16, Oldham Lyceum, surveyor's apprentice—Arith. (1st); Eng. Lang. (3d)
8—Forbes, Alexander, 22, Aberdeen M.I., clerk—Arith. (3d); Bkpg. (3d)
16—Forbes, James, 29, Aberdeen M.I., compositor—Th. of Music (2d)
438—Fossard, Alfred, 38, Halifax W.M. Coll., warehouseman—Bkpg. (2d)
1222—Foster, William, 25, Leeds Young Men's Chr. Assoc., book-keeper—Bkpg. (2d)
1—Fotheringham, Thomas, 19, Aberdeen M.I., clerk—Bkpg. (2d)
501—Fowler, Skelton, 18, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (1st)
1175—Fowles, Walter, 20, Sunderland Young Men's Chr. Assoc., engineer—Arith. (3d)
963—Frethey, Henry T., 19, Manchester M.I., collector—Bkpg. (3d)
597—Furmston, Samuel C., 25, Birkbeck Lit. and Sci. Inst., chemist—Logic (2d)

730—Gardiner, Frederick, 18, Birkbeck Lit. and Sci. Inst., procuration clerk—Arith. (3d)
540—Garrod, George W., 16, Ipswich W.M. Coll., pupil teacher—Arith. (1st)
551—Garrod, Philander N., 18, Ipswich W.M. Coll., clerk—Bkpg. (2d)
1061—Gartside, William A., 16, Mossley M.I., piecer—Bkpg. (3d)
1153—Gaskell, Frederick, 18, Stockport M.I., joiner—Arith. (3d)
772—Gattke, Theodore, 19, City of London Coll., clerk—French (3d)
439—Gaukroger, Samuel, 18, Halifax W.M. Coll., clerk—Eng. Hist. (2d)
383—Gavin, William J., 16, Glasgow Ath., clerk—Eng. Lang. (3d)
676—Geddes, George, 24, Birkbeck Lit. and Sci. Inst., watchmaker—Th. of Music (2d)
218—Gibbons, John, 28, Cork Catholic Young Men's Soc., grocer's assistant—French (3d)
1051—Gibson, Alexander, 20, Manchester M.I., draughtsman—Arith. (1st); Eng. Hist. (1st), with the Second Prize of £3; Bkpg. (1st); and the Prince Consort's Prize of twenty-five guineas
494—Gibson, Anna E., 16, Hull Young People's Chr. and Lit. Inst., pupil teacher—Arith. (3d)
1021—Gibson, William, 18, Manchester M.I. pupil teacher—Arith. (3d); Eng. Lang. (3d)
19—Gilbert, Joseph, 16, Aberdeen M. I., clerk—Arith. (3d)
773—Glaser, Alfred, 17, City of London Coll., clerk—Bkpg. (2d)
712—Glencross, Ebenezer, 24, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st), with the First Prize of £5
721—Godard, John G., 22, Birkbeck Lit. and Sci. Inst., clerk—German (1st); Commercial French (1st); Eng. Lang. (1st)
1074—Gomersall, George, 18, Oldham Lyceum, pattern-maker—Arith. (3d)
412—Gordon, James, 16, Glasgow M.I., clerk—Arith. (2d)
554—Gordon, John, 19, Leeds Ch. Inst., clerk—French (2d)
199—Graham, George, 17, Carlisle M.I. (no occupation stated)—Arith. (2d)
189—Graham, Thomas M., 17, Carlisle M.I. (no occupation)—Arith. (3d)
300—Grange, Alexander, 44, Glasgow Anderson. Univ. Pop. Evg. Classes, warehouseman—Th. of Music (3d)
31—Grassick, Robert, 28, Aberdeen M.I., joiner—Th. of Music (3d)
986—Gratrix, Timothy, 22, Manchester M.I., clerk—Bkpg. (2d)
264—Gray, William, 25, Dundee Young Men's Chr. Assoc., overseer—Eng. Lang. (3d)
485—Green, Alfred, 23, Hull Ch. Inst., clerk—Bkpg. (1st)
775—Green, John F., 20, City of London Coll., clerk—Arith. (3d); Eng. Lang. (2d)
950—Green, Sophia, 17, King's Lynn Ath., hosier's assistant—Bkpg. (3d)
955—Green, Thomas C., 19, King's Lynn Ath., clothier and hosier—Bkpg. (2d)
776—Greenaway, John, 19, City of London Coll., clerk—French (2d); Bkpg. (1st)
281—Greenwood, Edwin, 21, Freetown W.M. Inst., weaver—Arith. (3d)
302—Gregor, Alexander, 21, Glasgow Anderson. Univ. Pop. Evg. Classes, stationer—Th. of Music (3d)
1170—Greig, David J., 17, Sunderland Young Men's Chr. Assoc., pupil teacher—Arith. (3d); Eng. Hist. (3d); Eng. Lang. (2d)
777—Greig, John, 25, City of London Coll., clerk—Bkpg. (1st)
100—Grew, Frederick W., 18, Birmingham and Mid. Inst., lithographer—Arith. (3d); German (2d); French (3d); Eng. Lang. (1st), with the Second Prize of £3
915—Grills, Francis J., 25, St. Stephen's Evg. Sch., Westminster, warehouseman—Arith. (3d)
1033—Grime, John, 31, Manchester M.I., cashier—Bkpg. (2d)
779—Groom, Henry, 20, City of London Coll. (no occupation stated)—Bkpg. (3d)
408—Groundwater, John M., 16, Glasgow M.I., clerk—Bkpg. (1st)
654—Grove, James E., 29, Birkbeck Lit. and Sci. Inst., goldsmith—Th. of Music (2d)
780—Gunn, Russell, 26, City of London Coll., clerk—Bkpg. (2d)
722—Gurrin, Thomas H., 25, Birkbeck Lit. and Sci. Inst., clerk—Spanish (1st)
398—Guy, Walter J., 16, Glasgow M.I., clerk—Spanish (1st)
1084—Gwyther, John H., 18, Pembroke Dock M.I., draper—Arith. (3d)

1150—Hadfield, Levi B., 20, Stockport M.I., clerk—Bkpg. (2d)
1151—Hadfield, Walter, 17, Stockport M.I., clerk—Bkpg. (3d)
1171—Haire, Alfred, 24, Sunderland Young Men's Chr. Assoc., clerk in Inland Revenue—Arith. (1st); Eng. Hist. (2d); Pol. Econ. (3d); Eng. Lang. (1st)
197—Hall, Joseph, 20, Carlisle M.I., clerk—Arith. (3d); Bkpg. (2d)
782—Hall, Henry O., 23, City of London Coll., clerk—French (3d)
1185—Hall, William, 22, Wakefield M.I., joiner—Arith. (3d)
673—Hallam, John, 23, Birkbeck Lit. and Sci. Inst., clerk—Logic (3d)
877—Hallowes, Thomas A. T., 24, Royal Polytechnic Inst., architect's assistant—Italian (3d)
464—Halstead, Charles W., 18, Huddersfield M.I., solicitor's clerk—German (3d)
84—Hamer, Ralph T., 22, Bacup M.I., warper—Arith. (3d)
489—Hammond, Charles F., 20, Hull Ch. Inst., clerk—Bkpg. (2d)
1121—Hampson, Thomas, 21, Salford W.M. Coll., clerk—Arith. (3d); Bkpg. (1st)
1122—Hancock, Lillias, 17, Salford W.M. Coll., pupil teacher—Arith. (3d)
1208—Hanson, Henry A., 23, Quebec Inst., clerk—The Third Prize of £1 for Writing and Manuscript Printing
697—Harding, James S., 34, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)

1123—Hardman, John, 22, Salford W.M. Coll., joiner—Arith. (3d)
706—Harman, Henry, 20, Birkbeck Lit. and Sci. Inst., clerk—French (3d)
951—Harper, John, 22, King's Lynn Ath., clerk—Bkpg. (1st)
441—Harrison, Thomas, 18, Halifax W.M. Coll., roller coverer—Bkpg. (3d)
783—Harrold, Henry, 20, City of London Coll., clerk—Bkpg. (1st)
973—Hartley, Henry, 26, Manchester M.I., warehouseman—Bkpg. (1st); French (3d)
784—Harvey, Francis, 34, City of London Coll., clerk—Bkpg. (2d)
1101—Harvey, George, 17, Penzance, pupil teacher—Eng. Hist. (3d); Eng. Lang. (3d)
977—Harvey, James, 21, Manchester M.I., clerk—Pol. Econ. (2d); Eng. Lang. (1st)
785—Harvey, Thomas, 24, City of London Coll., clerk—Bkpg. (2d)
688—Harvey, William A, 20, Birkbeck Lit. and Sci. Inst., clerk—Pol. Econ. (3d); Eng. Lang. (2d)
726—Haselden, William H., 21, Birkbeck Lit. and Sci. Inst., clerk—Th. of Music (1st)
1077—Hayes, Thomas, 23, Oldham Lyceum, mechanic—Arith. (3d)
940—Hazle, William R., 31, Tonic Sol-fa Teachers' Assoc., clerk—Th. of Music (1st)
714—Heard, William J., 32, Birkbeck Lit. and Sci. Inst., clerk in Civil Service—Bkpg. (1st)
876—Henderson, Henry, 17, Royal Polytechnic Inst., clerk—German (1st)
303—Henderson, John, 32, Glasgow Anderson. Univ. Pop. Evg. Classes, brass finisher—Th. of Music (2d)
693—Hennequin, Léonie A. H., 26, Birkbeck Lit. and Sci. Inst., teacher—French (1st)
103—Herbert, Josiah, 19, Birmingham and Mid. Inst., pupil teacher—Arith. (3d); French (3d); Eng. Lang. (1st)
188—Hetherington, Thomas G., 16, Carlisle M.I. (no occupation)—Arith. (3d)
918—Heywood, John, 23, St. Stephen's Evg. Sch., Westminster, draughtsman—Arith. (1st); Eng. Lang. (2d)
717—Higgens, William T., 26, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)
405—Higgins, John, 24, Glasgow M.I., clerk—Bkpg. (3d)
786—Hill, Arthur, 20, City of London Coll., clerk in Civil Service—Arith. (2d); Eng. Hist. (2d); Bkpg. (2d); and the Second Prize of £3 for Handwriting
550—Hill, Arthur W., 16, Ipswich W.M. Coll., printer—Bkpg. (2d)
1006—Hill, William, 19, Manchester M.I., book-keeper—Pol. Econ. (3d)
1176—Hillard, Charles W., 18, Swindon M.I., clerk—Arith. (1st); Eng. Lang. (1st)
711—Hind, Arthur J., 23, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)
442—Hindle, Charles E., 19, Halifax W.M. Coll., warehouseman—Bkpg. (3d)
1164—Hinds, James, 17, Stourbridge Assoc. Institutes, solicitor's clerk—Arith. (3d)
684—Hocken, John G., 23, Birkbeck Lit. and Sci. Inst., traveller—Pol. Econ. (2d)
787—Hodd, Edmund H., 16, City of London Coll., clerk—Arith. (2d); Eng. Hist. (3d); Bkpg. (2d)
101—Hodges, George F., 20, Birmingham and Mid. Inst., clerk—Spanish (2d)
241—Holbrook, Allie, 20, Dudley M.I. (no occupation stated)—French (3d)
102—Holbrook, Elizabeth, 39, Birmingham and Mid. Inst., teacher—French (3d)
172—Holgate, Thomas, 17, Burnley M.I., storekeeper—Arith. (1st)
304—Holmes, Alexander M., 24, Glasgow Anderson Univ. Pop. Evg. Classes, engineer—Th. of Music (2d)
1081—Holmes, Matthew, 26, Paisley Artisans' Inst., pattern maker—Th. of Music (2d)
508—Holmes, William B., 24, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (1st)
630—Hooke, George A., 17, Birkbeck Lit. and Sci. Inst., clerk in Civil Service—Arith. (1st)
1201—Hopwood, William, 16, York Inst., plaster dealer—Arith. (3d); Th. of Music (3d)
211—Horgan, Daniel, 21, Cork Catholic Young Men's Soc., accountant—Arith. (3d); Bkpg. (3d)
70—Horsfall, John, 17, Bacup M.I., jobber—Arith. (3d)
1098—Hosking, Edwin W. G., 18, Penzance, pupil teacher—Eng. Lang. (3d)
788—Houghton, Edward, 26, City of London Coll., clerk—Bkpg. (2d)
586—Houghton, Rowland, 18, Liverpool Inst., apprentice—Bkpg. (3d)
628—Howard, Harry, 18, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)
585—Howarth, Benjamin, 20, Liverpool Inst., accountant—Pol. Econ. (2d); Bkpg. (1st)
87—Howarth, Thomas, 16, Bacup M.I., joiner—Arith. (3d)
1144—Howe, Richard, 34, Sheffield Young Men's Chr. Assoc., clerk—Eng. Lang. (1st)
547—Howes, Charles S., 16, Ipswich W.M. Coll., clerk—Bkpg. (2d)
65—Hoyle, Isaac H., 18, Bacup M.I., in a warehouse—Arith. (3d)
560—Hubbard, John H., 20, Leicester W.M. Coll., warehouseman—French (3d)
577—Hudson, William C., 19, Liverpool Inst., clerk—Arith. (1st); Eng. Hist. (1st), with the First Prize of £5; Bkpg. (2d)
1025—Hughes, Edward, 22, Manchester M.I., clerk—Bkpg. (1st)
886—Hughes, George C., 19, Royal Polytechnic Inst., clerk—Arith. (3d); Bkpg. (2d); and the First Prize of £3 for Writing from Dictation
789—Hughes, Gibbard R., 19, City of London Coll., clerk—Bkpg. (2d)
105—Hulme, Isaiah, 20, Birmingham and Mid. Inst., clerk—Arith. (1st)
791—Hunt, John T., 23, City of London Coll., shopman—French (3d); Eng. Lang. (2d)
792—Hunter, John, 19, City of London Coll., clerk—Eng. Hist. (2d); Eng. Lang. (2d)
20—Hunter, Stephen, 20, Aberdeen M.I., clerk—Eng. Lang. (2d)
875—Huntley, Georgina, 23, Royal Polytechnic Inst., governess—German (2d)
386—Husband, William D., 21, Glasgow Ath., clerk—French (2d)
898—Hutchings, George D., 17, Royal Polytechnic Inst., clerk—Arith. (2d); Eng. Lang. (2d)
602—Hutton, John T., 19, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st), with the Second Prize of £3
1088—Huzzey, Richard H., 17, Pembroke Dock M.I., grocer's apprentice—Arith. (2d)

793—Iceley, Richard H., 20, City of London Coll., clerk—Spanish (3d)
564—Iliffe, John W., 16, Leicester W.M. Coll., pupil teacher—Arith. (3d); French (3d); Eng. Lang. (3d); Eng. Hist. (3d)
361—Ingram, Thomas, 17, Glasgow Ath., clerk—French (3d)
107—Insall, Jane R., 29, Birmingham and Mid. Inst., assistant—French (3d)

397—Jack, John, 19, Glasgow Ath., warehouseman—French (3d)

794—Jackson, Charles W. B., 25, City of London Coll., warehouseman—Arith. (3d); Bkpg. (2d)
1065—Jackson, John, 17, Mossley M.I., book-keeper—Bkpg. (2d)
478—Jackson, Thomas W., 20, Hull Ch. Inst., clerk—Bkpg. (1st)
987—Jackson, William, 17, Manchester M.I, clerk—Arith. (2d); Bkpg. (1st)
242—James, Job, 23, Dudley M.I., clerk—Bkpg. (2d)
1163—James, William L., 19, Stourbridge Assoc. Institutes, clerk—Arith. (3d)
665—Jaquet, Robert G., 17, Birkbeck Lit. and Sci. Inst., clerk in post-office—Arith. (1st); German (1st); French (2d); Bkpg. (1st)
1105—Jeayes, Elizabeth, 18, Rugby (no occupation)—Arith. (3d); Eng. Hist. (3d); French (3d); Eng. Lang. (3d)
584—Jefferys, Edward J., 28, Liverpool Inst., assistant book-keeper—Bkpg. (1st)
205—Jones, Charles R., 16, Carmarthen Lit. and Sci. Inst., student—Arith. (3d); Eng. Hist. (2d); French (3d); Eng. Lang. (2d)
583—Jones, David, 20, Liverpool Inst., farmer—Bkpg. (2d)
280—Jones, Edmund, 18, Edinburgh Watt Inst., chemist's apprentice—Eng. Hist. (3d)
1167—Jones, Howard, 28, Sunderland Young Men's Chr. Assoc., clerk in Inland Revenue—Arith. (3d)
1127—Jones, John G., 28, Salford W.M. Coll., clerk—Bkpg. (1st)
582—Jones, William, 27, Liverpool Inst., carpenter and joiner—Bkpg. (1st)
728—Johnson, Elizabeth, 23, Birkbeck Lit. and Sci. Inst., teacher—Arith. (3d); Eng. Hist. (3d); French (3d)
795—Johnson, Henry, 17, City of London Coll., storekeeper—French (3d)
1126—Johnson, Samuel A., 16, Salford W.M. Coll., machineman—Arith. (2d)
1001—Johnson, Thomas F., 18, Manchester M.I., clerk—Arith. (3d); Bkpg. (1st)
305—Johnston, Alice M. S., 19, Glasgow Anderson. Univ. Pop Evg. Classes (no occupation stated)—Th. of Music (3d)
517—Jordan, Alfred, 16, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (3d)
797—Jordan, Alfred, 20, City of London Coll., clerk—French (3d)
1054—Jordan, Henry G., 16, Manchester M.I., engineer—Arith. (3d)
903—Judd, Charles W., 18, Royal Polytechnic Inst., in china warehouse—Bkpg. (3d)
58—Justice, Thomas, 16, Ashford M.I., fitter's apprentice—Arith. (3d)

926—Kay, John, 17, St. Stephen's Evg. Sch., Westminster (no occupation stated)—Arith. (3d); Eng. Lang. (3d)
48—Keane, Michael, 21, Aldershot and Farnham District, soldier—Arith. (2d); Eng. Lang. (2d)
45—Keay, Patrick, 35, Aldershot and Farnham District, soldier—Arith. (2d); Eng. Lang. (3d)
549—Kedgley, Robert W., 18, Ipswich W.M. Coll., baker—Bkpg. (3d)
174—Keighley, Elijah, 16, Burnley M.I., mechanic—Arith. (3d)
1211—Keighley, Fred, 17, Farsley M.I., machine worker—Arith. (3d)
960—Kendle, Bernard C., 17, King's Lynn Ath, clerk—Bkpg. (3d)
798—Kendrick, George E., 23, City of London Coll., clerk—Arith. (2d)
212—Kennedy, Patrick, 18, Cork Catholic Young Men's Soc., accountant—Arith. (2d); Bkpg. (3d)
527—Kenningham, Robert H., 16, Hull Young People's Chr. and Lit. Inst., plumber and gas-fitter—Arith. (3d)
192—Ker, Joseph, 19, Carlisle M.I. (no occupation)—Arith. (3d)
444—Kershaw, Joe, 17, Halifax W.M. Coll., student—Arith. (3d)
253—Kidd, Thomas, 19, Dundee Young Men's Chr. Assoc., mechanic—Arith. (3d)
14—Kilgour, William, 17, Aberdeen M.I., clerk—French (3d)
55—King, John P., 25, Ashby-de-la-Zouch Young Men's Mut. Imp. Soc., clerk—Bkpg. (2d)
505—King, Walter, 16, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (2d)
724—Knott, Henry W., 19, Birkbeck Lit. and Sci. Inst., printer and bookseller—Th. of Music (1st)
30—Knox, William A., 20, Aberdeen M.I., ironmonger's assistant—Arith. (3d)
1172—Koller, Emil, 21, Sunderland Young Men's Chr. Assoc., teacher—Eng. Lang. (2d)

404—Laing, Alexander, 18, Glasgow M.I., clerk—Arith. (3d); Bkpg. (1st)
887—Lamb, Emily A., 33, Royal Polytechnic Inst., governess—German (1st)
191—Lambert, John, 17, Carlisle M.I. (no occupation)—Arith. (3d)
69—Lancaster, James H., 17, Bacup M.I., mule spinner—Arith. (3d)
170—Landless, Richard, 19, Burnley M.I., assistant in warehouse—Arith. (3d)
402—Lang, John, 17, Glasgow M.I., clerk—Spanish (3d)
911*-Larke, Arthur, 24, Royal Polytechnic Inst., clerk—Arith. (1st)
179—Lattimer, Margaret B., 17, Carlisle M.I., teacher—Eng. Hist. (2d); French (2d)
445—Lawrence, Frank, 19, Halifax W.M. Coll., assistant broker—Arith. (3d); Bkpg. (3d)
900—Leckenby, William E. A., 21, Royal Polytechnic Inst., clerk—French (3d)
800—Ledger, George, 24, City of London Coll., clerk—Spanish (1st)
801—Lee, William H., 21, City of London Coll., in Civil Service—Arith. (2d); Eng. Hist. (1st); Bkpg. (2d)
802—Le Maistre, Alfred J., 22, City of London Coll., clerk—French (3d)
952—Lemmon, Charles H., 19, King's Lynn Ath., clerk—Bkpg. (3d)
1129—Lenthall, Alfred, 16, Salford W.M. Coll., warehouseman—Arith. (3d)
1086—Lewis, William, 17, Pembroke Dock M.I., pupil teacher—Eng. Hist. (3d)
509—Limbach, Louisa, 24, Hull Young People's Chr. and Lit. Inst., scholmistress—German (2d)
420—Lindsay, Archibald, 18, Glasgow M.I., clerk—Eng. Lang. (2d)
803—Lindsay, John, 19, City of London Coll., clerk—Arith. (3d); French (3d)
110—Lloyd, Thomas H., 22, Birmingham and Mid. Inst., clerk—German (1st)
185—Lloyd, Thomas R., 18, Carlisle M.I. (no occupation)—Arith. (2d)
1087—Lloyd, William H., 29, Pembroke Dock M.I., shipwright—Arith. (1st)
804—Lloyd, William H. S., 20, City of London Coll., clerk—Arith. (3d); French (3d); Bkpg. (2d)
805—Loly, Gustavo, 16, City of London Coll., clerk—Arith. (3d); Commercial French (1st); Bkpg. (1st)
66—Lomax, Zeno, 18, Bacup M.I., pupil teacher—Arith. (2d); Eng. Hist. (3d); Eng. Lang. (1st)
806—Long, Alfred, 17, City of London Coll., clerk—Arith. (2d)
1016—Longrigg, Thomas, 19, Manchester M.I. (no occupation stated)—Bkpg. (1st)
546—Lord, Robert, 16, Ipswich W.M. Coll., clerk—Bkpg. (3d)

601—Lowrie, Arthur D., 18, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)
109—Luckett, Harry F., 17, Birmingham and Mid. Inst., clerk—German (3d); French (3d)
256—Lundie, John, 16, Dundee Young Men's Chr. Assoc., civil engineer—Arith. (3d.)
446—Lynch, Robert, 20, Halifax W.M. Coll., warp sizer—Eng. Lang. (3d)

1097—Mabbott, Charles J., 17, Penzance, pupil teacher—Eng. Hist. (3d); Eng. Lang. (3d)
306—McArthur, Charles S., 22, Glasgow Anderson. Univ. Pop. Evg. Classes, clerk—Bkpg. (2d)
307—McArthur, John, 25, Glasgow Anderson. Univ. Pop. Evg. Classes, warehouseman—Th. of Music (2d)
112—McBean, John, 23, Birmingham and Mid. Inst., clerk—Spanish (2d)
309—McCallum, James, 21, Glasgow Anderson. Univ. Pop. Evg. Classes, beamer—Th. of Music (3d)
363—McCallum, Robert A., 20, Glasgow Ath., clerk—Spanish (1st)
416—McColl, James R., 17, Glasgow M.I., in a warehouse—French (2d)
403—McIver, Roderick, 24, Glasgow M.I., clerk—Arith. (3d); Bkpg. (2d)
310—McKay, Alexander, 39, Glasgow Anderson. Univ. Pop. Evg. Classes, cloth-lapper—Th. of Music (2d)
233—McKay, Charles, 24, Dublin, soldier—Arith. (2d)
425—Mackay, John, 22, Glasgow M.I., clerk—Eng. Lang. (3d)
261—McKechnie, John, 16, Dundee Young Men's Chr. Assoc., clerk—Arith. (3d)
1085—Macken, Arthur, 17, Pembroke Dock M.I., pupil teacher—Eng. Hist. (2d); Eng. Lang. (1st)
32—Mackenzie, Douglas F., 17, Aberdeen M.I., clerk—Bkpg. (3d)
426—Mackenzie, Duncan, 26, Glasgow M.I. (no occupation stated)—Eng. Lang. (3d)
921—Mackie, Andrew, 17, St. Stephen's Evg. Sch., Westminster, draughtsman—Arith. (3d)
248—McKinlay, James, 24, Dundee Young Men's Chr. Assoc., mill overseer—Eng. Lang. (3d)
311—McKinlay, James, 26, Glasgow Anderson. Univ. Pop. Evg. Classes, hand mill warper—Th. of Music (2d)
401—McKinlay, Thomas M., 17, Glasgow M.I., clerk—Spanish (2d)
312—Macleod, William, 29, Glasgow Anderson. Univ. Pop. Evg. Classes, sanitary inspector—Th. of Music (3d)
207—McLoughlin, Edward, 17, Cork Catholic Young Men's Soc., student—Arith. (3d)
313—Macnaughton, James A., 27, Glasgow Anderson. Univ. Pop. Evg. Classes, clerk—Bkpg. (1st)
272—McPherson, Alexander, 22, Dundee Young Men's Chr. Assoc., clerk—Bkpg. (3d)
254—McPherson, Stewart, 21, Dundee Young Men's Chr. Assoc., mechanic—Arith. (3d)
1010—Madders, John W., 18, Manchester M.I., warehouseman—French (3d)
214—Mahoney, Daniel O., 20, Cork Catholic Young Men's Soc., accountant—Arith. (3d); Bkpg. (3d)
113—Mallinson, Joseph, 18, Birmingham and Mid. Inst., clerk—German (2d); French (3d)
409—Maltman, William, 16, Glasgow M.I., clerk—Bkpg. (2d)
116—Marlow, Frederick G., 23, Birmingham and Mid. Inst., teacher—Arith. (2d)
807—Marmont, Cecil, 26, City of London Coll., clerk—Bkpg. (1st)
382—Marr, Thomas, 21, Glasgow Ath., clerk—Commercial German (1st)
178—Marrs, William G., 19, Carlisle M.I. (no occupation stated)—Arith. (1st)
150—Marsh, John H., 16, Bolton Ch. Inst. (no occupation)—Arith. (3d); English Hist. (3d); French (3d); Eng. Lang. (3d)
400—Marshall, James, 19, Glasgow M.I., warehouseman—Spanish (1st)
447—Marshall, James T., 18, Halifax W.M. Coll., overlooker—Arith. (3d) Bkpg. (3d)
572—Marson, Thomas, 22, Lichfield Educational Inst., gardener—Th. of Music (1st)
808—Martin, Arthur J., 20, City of London Coll., warehouseman—Commercial German (1st)
111—Martin, Frederick H., 20, Birmingham and Mid. Inst., factor—Spanish (2d)
642—Martin, Mary E., 25, Birkbeck Lit. and Sci. Inst., (no occupation stated)—Commercial French (1st), with the Prize of £2 for Females, and the Council Prize (for Females) of ten guineas
1027—Mastin, James, 19, Manchester M.I., clerk—Bkpg. (1st)
258—Mathew, Alexander, 24, Dundee Young Men's Chr. Assoc., clerk—Arith. (3d)
44—May, Bessie C., 17, Aldershot and Farnham District, teacher—Th. of Music (3d); French (3d)
552—Mayes, West J., 17, Ipswich W.M. Coll., solicitor's clerk—Bkpg. (3d)
488—Melbourne, William W. J., 16, Hull Ch. Inst., clerk—Bkpg. (1st)
809—Mellersh, Frederick H., 18, City of London Coll., clerk—Arith. (2d); French (3d)
4—Meston, William, 24, Aberdeen M.I., clerk—Th. of Music (1st)
1168—Metcalf, Thomas, 20, Sunderland Young Men's Chr. Assoc., clerk—Arith. (3d)
171—Metcalfe, Theodore G., 18, Burnley M.I., pupil-teacher—Arith. (3d); Eng. Hist. (3d); Eng. Lang. (1st)
1223—Mickle, Hannah, 25, Leeds Young Men's Chr. Assoc. (no occupation stated)—Th. of Music (1st)
1103—Middleton, Ellis, 24, Rotherham Lit. and Sci. Inst., clerk—Eng. Hist. (3d)
1053—Mills, Thomas G., 23, Manchester M.I., draughtsman—Arith. (2d)
483—Milner, Alfred, 16, Hull Ch. Inst., sub-librarian—Bkpg. (1st)
448—Milner, Farnell, 18, Halifax W.M. Coll., iron and tinplate worker—Arith. (3d); Eng. Lang. (3d)
469—Milner, Thomas G., 23, Hull Ch. Inst., clerk—Bkpg. (2d)
346—Mitchell, Andrew J. A., 16, Glasgow Ath. (no occupation stated)—German (2d)
186—Molineux, James, 18, Carlisle M.I., clerk—Arith. (3d)
114—Monk, Havilah, 23, Birmingham and Mid. Inst., clerk—Eng. Lang. (1st)
811—Montague, Frederick B., 17, City of London Coll., clerk in Civil Service—Eng. Hist. (2d)
813—Morgan, George, 20, City of London Coll., shorthand writer—The First Prize of £5 for Handwriting
392—Morgan, Henry, 23, Glasgow Ath., clerk—Logic (3d)
648—Morris, Herbert A., 24, Birkbeck Lit. and Sci. Inst., artist—Th. of Music (1st)
369—Morris, John, 18, Glasgow Ath., power-loom tenter—Eng. Lang. (2d)
908—Morse, Rosa E. S., 27, Royal Polytechnic Inst., governess—German (2d)
925—Mortimore, Thomas, 23, St. Stephen's Evg. Sch., Westminster, teacher—Arith. (3d); Eng. Lang. (3d)
997—Morton, Frederick, 21, Manchester M.I., warehouseman—Arith. (3d); Bkpg. (1st)
815—Mosey, Philip S., 25, City of London Coll., clerk—Arith. (3d); Bkpg. (2d)
981—Mott, Henry, 20, Manchester M.I., clerk—Eng. Hist. (1st)

816—Mountford, Allen W., 18, City of London Coll., clerk—German (3d); Eng. Lang. (3d)
923—Muir, George J., 17, St. Stephen's Evg. Sch., Westminster, pupil teacher—Arith. (3d)
388—Muir, James, 18, Glasgow Ath., clerk—French (3d)
817—Munday, Philip, 19, City of London Coll., clerk—Eng. Lang. (1st)
622—Mungeam, Mary S., 31, Birkbeck Lit. and Sci. Inst. (no occupation stated)—German (1st); Eng. Lang. (1st)
449—Murgatroyd, Arthur, 20, Halifax W.M. Coll., painter—Bkpg. (3d)
209—Murphy, John, 16, Cork Catholic Young Men's Soc., clerk—Arith. (3d)
33—Murray, Marion M., 17, Aberdeen M.I. (no occupation)—French (2d)
115—Myers, Mathilda L., 22, Birmingham and Mid. Inst. (no occupation)—French (2d)

117—Naish, Charles E., 20, Birmingham and Mid. Inst., chemist's assistant—Arith. (3d); Eng. Hist. (3d)
1089—Narbeth, Louisa M., 16, Pembroke Dock M.I., pupil teacher—Arith. (2d)
819—Nash, Henry, H. A., 16, City of London Coll., clerk—Arith. (3d); Eng. Hist. (3d)
938—Nattrass, William W., 18, Tonic Sol-fa Teachers' Assoc., pupil teacher—Th. of Music (2d)
1143—Neave, William H. M., 18, Sheffield Young Men's Chr. Assoc., clerk—German (1st); French (3d)
1024—Needham, Charles, 17, Manchester M.I., salesman—Arith. (3d)
315—Neil, James W., 24, Glasgow Anderson. Univ. Pop. Evg. Classes, warper—Th. of Music (2d)
316—Neilson, David, 28, Glasgow Anderson. Univ. Pop. Evg. Classes. book-keeper—Bkpg. (2d)
663—Nevers, Claudius, 38, Birkbeck Lit. and Sci. Inst., gardener—Floriculture (2d); Fruit and Vegetable Culture (2d); German (3d)
571—Newell, George, 25, Leicester W.M. Coll., framework knitter—Eng. Lang. (3d)
486—Nicholson, Samuel R., 23, Hull Ch. Inst., clerk—Bkpg. (2d)
1130—Noar, Herbert, 21, Salford W.M. Coll., clerk—French (3d)
581—Norton, Ewart H., 20, Liverpool Inst., warehouseman—Bkpg. (3rd)
682—Nutter, George, 31, Birkbeck Lit. and Sci. Inst., broker—Pol. Econ. (2d)
901—Nye, Henry S., 23, Royal Polytechnic Inst., surgical instrument maker—French (3d)

927—Oakshott, Willis G., 18, St. Stephen's Evg. Sch., Westminster, clerk—Arith. (3d)
206—O'Callaghan, Patrick, 26, Cork Catholic Young Men's Soc., clerk—French (3d)
998—Officer, William, 22, Manchester M.I., warehouseman—Arith. (3d)
118—Olorenshaw, Joseph R., 24, Birmingham and Mid. Inst., clerk—Arith. (3d); French (3d)
168—O'Malley, Patrick C., 33, Burnley M.I., bookkeeper—Bkpg. (3d)
51—Orchard, George D., 20, Ashby-de-la-Zouch Young Men's Mut. Imp. Soc., auctioneer's assistant—Bkpg. (3d)
190—Ostle, Wilson, 19, Carlisle M.I. (no occupation)—Arith. (3d)
217—O'Sullivan, Henry, 18, Cork Catholic Young Men's Soc., draper's apprentice—Arith. (3d); Bkpg. (3d)
824—Overall, Herbert, 23, City of London Coll., clerk—Bkpg. (2d)
905—Overton, Charles M., 16, Royal Polytechnic Inst., clerk—Arith. (3d)
904—Overton, Louisa A., 18, Royal Polytechnic Inst., teacher—Arith. (2d); Eng. Lang. (3d)
979—Owen, William A., 20, Manchester M.I., clerk—French (2d); Bkpg. (2d)

119—Pace, David, 21, Birmingham and Mid. Inst., clerk—Spanish (2d)
657—Parker, Alfred, 23, Birkbeck Lit. and Sci. Inst., shorthand-writer—Arith. (3d)
825—Parker, John J., 25, City of London Coll., clerk—Logic (1st), with the First Prize of £5; Pol. Econ. (2d)
1131—Parry, John H., 20, Salford W.M. Coll., clerk—Arith. (3d)
705—Partridge, Robert S., 22, Birkbeck Lit. and Sci. Inst., clerk—French (3d)
366—Paterson, Robert H., 19, Glasgow Ath., clerk—Arith. (3d)
317—Paterson, William, 27, Glasgow Anderson. Univ. Pop. Evg. Classes, blacksmith—Th. of Music (1st)
406—Paton, James, 38, Glasgow M.I., police-constable—Bkpg. (1st)
421—Patrick, James, 21, Glasgow M.I., bookbinder—Eng. Lang. (3d)
318—Paul, Thomas, 28, Glasgow Anderson. Pop. Univ. Evg. Classes, ironmonger's salesman—Th. of Music (1st)
1202—Peacock, Edwin, 21, York Inst., bookkeeper—Th. of Music (3d)
826—Pearce, Herbert J., 22, City of London Coll., clerk—Bkpg. (2d)
827—Pearce, Samuel, 21, City of London Coll., clerk in Civil Service—Arith. (1st); Bkpg. (2d)
882—Penfold, William, 16, Royal Polytechnic Inst., clerk—French (3d)
120—Perkins, Henry G., 22, Birmingham and Mid. Inst., clerk—French (3d)
604—Perratt, Alfred, 23, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)
605—Perratt, William H., 33, Birkbeck Lit. and Sci. Inst., accountant—Bkpg. (1st)
487—Petch, William, 24, Hull Ch. Inst., dyer—Bkpg. (3d)
319—Pettigrew, Gavin, 29, Glasgow Anderson. Pop. Univ. Evg. Classes, clerk—Th. of Music (2d)
46—Pewter, Philip, 35, Aldershot and Farnham District, soldier—Arith. (3d)
22—Phillips, Alexander, 23, Aberdeen M.I., clerk—Eng. Lang. (3d)
936—Phillips, William R., 22, Tonic Sol-fa Teachers' Assoc., letter carrier—Th. of Music (2d)
411—Philp, William F., 18, Glasgow M.I., draughtsman—Arith. (3d)
320—Picken, James, 24, Glasgow Anderson Pop. Univ. Evg. Classes, teacher—Arith. (1st); Eng. Lang. (3d)
1049—Pickering, Thomas W., 17, Manchester M.I., clerk—Bkpg. (1st)
538—Pickford, William B., 18, Hyde M.I., clerk—Arith. (2d)
911—Pike, Thomas, 25, Royal Polytechnic Inst., jeweller—Bkpg. (3d)
618—Pillar, Alfred C., 23, Birkbeck Lit. and Sci. Inst., joiner—Arith. (2d); Eng. Hist. (3d)
85—Pilling, William, 22, Bacup M.I., book-keeper—Eng. Lang. (3d)
255—Piper, Ebenezer, 18, Dundee Young Men's Chr. Assoc., clerk—Arith. (3d)
466—Pitts, Tom, 17, Huddersfield M.I., lawyer's clerk—Bkpg. (3d)
916—Plowright, Henry, 22, St. Stephen's Evg. Sch., Westminster, teacher—Pol. Econ. (2d); Eng. Lang. (2d)
493—Plummer, James E., 16, Hull Young People's Chr. and Lit. Inst., clerk—Arith. (3d)
533—Plummer, John G., 18, Hull Young People's Chr. and Lit. Inst., clerk—Arith. (3d); Bkpg. (3d)

1132—Pogson, Joseph, 21, Salford W.M. Coll., clerk—Arith. (3d); Bkpg. (2d)
1133—Pollitt, William, 22, Salford W.M. Coll., clerk—Spanish (1st); Pol. Econ. (2d)
413—Porteus, John H., 18, Glasgow M.I., warehouseman—Arith. (3d)
678—Potter, James H., 18, Birkbeck Lit. and Sci. Inst., clerk—French (2d)
1069—Potter, William, 17, Newcastle on-Tyne Ch. Inst., apprentice to merchant—German and Commercial German (1st), with the First Prize of £5
543—Powell, David C., 25, Ipswich W.M. Coll., gardener—Floriculture (1st); Fruit and Vegetable Culture (1st); Bkpg. (2d)
893—Pratt, Emma A., 30, Royal Polytechnic Inst., teacher—Eng. Lang. (1st)
690—Pratt, William J., 25, Birkbeck Lit. and Sci. Inst., assistant of Excise—Arith. (2d); Eng. Hist. (2d); Pol. Econ. (1st), with the Second Prize of £3; Eng. Lang. (1st)
970—Press, Alfred, 18, Manchester M.I., clerk—Bkpg. (1st)
638—Price, Edwin, 20, Birkbeck Lit. and Sci. Inst., warehouseman—French (3d)
50—Price, John, 17, Aldershot and Farnham District, teacher—Bkpg. (3d)
243—Price, William J., 19, Dudley M.I., assistant teacher—Th. of Music (3d)
1218—Prince, George A., 18, Leeds Young Men's Chr. Assoc., bookbinder's apprentice—Eng. Hist. (3d); Eng. Lang. (3d)
830—Purcell, Henry, 23, City of London Coll., clerk—Bkpg. (2d)
831—Purrier, Edward A. C., 28, City of London Coll., Civil Service writer—Eng. Lang. (2d)

670—Quilter, Elisha, 23, Birkbeck Lit. and Sci. Inst., shopman—Th. of Music (1st)

121—Ralls, James, 20, Birmingham and Mid Inst., ironmonger—Eng. Hist. (2d)
523—Ramsey, George, 28, Hull Young People's Chr. and Lit. Inst., warehouse foreman—Arith. (3d); Eng. Lang. (3d.)
888—Raynes, Alfred E., 23, Royal Polytechnic Inst., clerk—French (3d)
479—Raynor, Alfred, 26, Hull Ch. Inst., chemist and druggist—Bkpg. (1st)
1003—Redfern, John R., 21, Manchester M.I., warehouseman—Spanish (1st)
553—Redick, Mary, 23, Leeds Ch. Inst. (no occupation—Th. of Music (1st), with the Prize of £2 for Females; Eng. Lang. (2d)
25—Reid, Duncan J., 19, Aberdeen M.I., advocate's clerk—French (2d)
376—Reid, John, 17, Glasgow Ath., clerk—French (3d)
344—Reid, William, 20, Glasgow Ath., warehouseman—Spanish (1st)
321—Reid, William J. D., 21, Glasgow Anderson. Univ. Pop. Evg. Classes, accountant's clerk—Th. of Music (2d)
415—Reid, William P., 19, Glasgow M.I., engineer—Arith. (3d)
990—Restall, Ernest, 18, Manchester M.I, warehouseman—Arith. (3d); Eng. Hist. (3d); Bkpg. (1st)
660—Rich, C. Isabel, 32, Birkbeck Lit. and Sci. Inst., music teacher—Th. of Music (1st)
559—Richardson, Frederick, 25, Leicester W.M. Coll., warehouseman—French (3d)
322—Riddell, John, 27, Glasgow Anderson. Univ. Pop. Evg. Classes, joiner—Th. of Music (3d)
702—Riorden, George, 23, Birkbeck Lit. and Sci. Inst., engraver—Eng. Hist. (2d); and the Third Prize of £1 for Writing from Dictation.
323—Ritchie, John, 26, Glasgow Anderson. Univ. Pop. Evg. Classes, draughtsman—Bkpg. (2d)
603—Roberts, Robert A., 21, Birkbeck Lit. and Sci. Inst., clerk—Arith. (2d); Bkpg. (1st)
251—Robertson, David, 18, Dundee Young Men's Chr. Assoc., clerk—Arith. (3d)
163—Robertson, James, 28, Bow and Bromley Inst., clerk—Bkpg. (1st)
262—Robertson, John, 20, Dundee Young Men's Chr. Assoc., clerk—Arith. (3d)
716—Robertson, John G., 22, Birkbeck Lit. and Sci. Inst., clerk—Arith. (3d); French (2d); Bkpg. (2d)
1193—Robinson, Robert W., 16, York Inst., grocer—Arith. (3d)
1206—Robson, Thomas, 18, York Inst., attorney's clerk—Eng. Hist. (3d)
273—Rodger, David, 20, Dundee Young Men's Chr. Assoc., clerk—Bkpg. (2d)
511—Rodmell, George, 21, Hull Young People's Chr. and Lit. Inst., corporation sworn meter and weigher—Arith. (3d)
1035—Roe, John, 19, Manchester M.I., clerk—Arith. (3d); Bkpg. (1st)
122—Rollason, Carmichael A. T., 27, Birmingham and Mid. Inst., rivet manufacturer—Th. of Music (1st)
985—Roscoe, James, 17, Manchester M.I., clerk—Arith. (1st); Eng. Hist. (2d); Eng. Lang. (2d)
40—Rose, Herbert J., 16, Aldershot and Farnham District, teacher—Arith. (2d); Eng. Hist. (2d); French (3d); Eng. Lang. (1st)
837—Rose, John H., 26, City of London Coll., clerk—Pol. Econ. (1st), with the Third Prize of £2
325—Ross, David, 30, Glasgow Anderson. Univ. Pop. Evg. Classes, school master—Pol. Econ. (2d)
37—Ross, James A., 20, Aberdeen M.I., clerk—French (3d)
324—Ross, John, 27, Glasgow Anderson. Univ. Pop. Evg. Classes, teacher—Arith. (3d)
1136—Rotheram, John, 18, Salford W.M. Coll., patternmaker—Arith. (3d)
1048—Rothwell, Hamlet, 22, Manchester M.I., clerk—Bkpg. (1st)
71—Rothwell, William H., 17, Bacup M.I., warehouseman—Arith. (3d)
237—Round, Ellen, 23, Dudley M.I., teacher—Th. of Music (3d)
238—Round, Jane, 21, Dudley M.I., teacher—Th. of Music (2d)
839—Rowbotham, Samuel A., 21, City of London Coll., clerk—Pol. Econ. (1st)
1210*—Rowlatt, John H. B., 30, Quebec Inst., clerk—Arith. (2d); Eng. Hist. (3d); Eng. Lang. (2d)
931—Rowley, Charles, 17, Tonic Sol-fa Teachers' Assoc., pupil teacher—Th. of Music (2d)
195—Rudd, Mary E., 18, Carlisle M.I. (no occupation stated)—Eng. Hist. (2d); French (3d); Eng. Lang. (1st), with the Prize of £2 for Females
347—Russell, Charles, 26, Glasgow Ath., clerk—Commercial German (1st)
3—Ruxton, John C., 18, Aberdeen M.I., clerk—Arith. (2d); Eng. Lang. (2d)

462—Salmon, Julia E., 16, Hertford Lit. and Sci. Inst., pupil teacher—Arith. (3d)
840—Salmon, William, 20, City of London Coll., clerk—Bkpg. (3d)
57—Samson, William B., 21, Ashford M.I., boilermaker—Arith. (3d)
326—Sandeman, Christina, 39, Glasgow Anderson. Univ. Pop. Evg. Classes, music teacher—Th. of Music (1st)
1109—Saville, Laura J., 16, Rugby (no occupation)—Arith. (3d); Eng. Hist. (3d); Eng. Lang. (3d)
596—Schofield, Joseph, 21, Lockwood M.I., woollen weaver—Eng. Lang. (3d)

1068—Schofield, Joseph, 19, Mossley M.I., cotton piecer—Arith. (3d); Bkpg. (1st)
999—Schofield, Mark, 17, Manchester M.I., salesman—Arith. (3d)
327—Scobie, James, 25, Glasgow Anderson. Univ. Pop. Evg. Classes, warehouseman—Th. of Music (3d)
1162—Scott, Charles H., 18, Stourbridge Assoc. Institutes, clerk—Arith. (3d)
194—Scott, Joseph, 17, Carlisle M.I. (no occupation)—Arith. (2d)
328—Scott, William, 23, Glasgow Anderson. Univ. Pop. Evg. Classes, draper—Th. of Music (2d)
841—Scriven, William E., 21, City of London Coll., clerk—French (3d)
1149—Seal, James, 21, Stockport M.I., clerk—Bkpg. (2d)
655—Seary, Thomas C., 24, Birbeck Lit. and Sci. Inst., draughtsman—Th. of Music (1st)
452—Seed, John W., 17, Halifax W.M. Coll., bookkeeper—Arith. (3d)
650—Sellar, George W., 17, Birkbeck Lit. and Sci. Inst., clerk in Civil Service—Arith. (2d); Eng. Hist. (2d)
592—Semley, William, 20, Lockwood M.I., blacksmith—Eng. Lang. (3d)
557—Sharp, Newton, 23, Leicester W.M. Coll., joiner—French (3d)
614—Shaw, Arthur H., 17, Birkbeck Lit. and Sci. Inst., clerk—Arith. (2d)
453—Shaw, Edwin, 22, Halifax W.M. Coll., packer—Eng. Lang. (2d)
595—Shaw, John W., 25, Lockwood M.I., weaver—Eng. Lang. (3d)
350—Shaw, William, 20, Glasgow Ath., shorthand writer—Bkpg. (2d)
76—Shepherd, James, 17, Bacup M.I., weaver—Arith. (3d); Eng. Lang. (3d)
34—Shepherd, Mary J., 19, Aberdeen M.I. (no occupation stated)—French (2d)
88—Shillito, James, 20, Bacup M.I., tin-plate worker—Arith. (3d)
123—Shirley, John F., 24, Birmingham and Mid. Inst., schoolmaster—French (3d)
1161—Short, Francis J., 16, Stourbridge Assoc. Institutes, engineer's pupil—Arith. (3d)
182—Sibson, John, 19, Carlisle M.I. (no occupation stated)—Eng. Hist. (3d); Eng. Lang. (2d)
329—Simpson, James, 24, Glasgow Anderson. Univ. Pop. Evg. Classes, engineer—Arith. (3d)
175—Simpson, Jesse, 18, Burnley M.I., cutlooker—Arith. (3d)
994—Simpson, John W., 16, Manchester M.I., at school—Eng. Lang. (3d)
127—Sims, William, 20, Birmingham and Mid. Inst., clerk—Arith. (3d)
1224—Skelsey, Walter, 19, Leeds Young Men's Chr. Assoc., mannfacturer—German (1st)
944—Skerrey, Samuel C., 16, King's Lynn Ath., pupil teacher—Arith. (3d); Eng. Hist. (3d)
176—Slater, Frederick, 17, Burnley M.I., pupil teacher—Eng. Lang. (1st); Eng. Hist. (3d)
842—Sleap, Thomas A, 20, City of London Coll., clerk—Bkpg. (2d)
919—Slingo, William, 18, St. Stephen's Evg. Sch., Westminster, telegraphist—Arith. (3d); Eng. Hist. (2d); Pol. Econ. (3d)
580—Sloan, Robert A., 18, Liverpool Inst., engineer's apprentice—Arith. (1st); Eng. Hist. (1st)
683—Smith, Alfred, 28, Birkbeck Lit. and Sci. Inst., agent—Pol. Econ. (3d)
503—Smith, Francis, 25, Hull Young People's Chr. and Lit. Inst., compositor—Arith. (3d); Eng. Hist. (3d); Eng. Lang. (3d)
1137—Smith, Horace L., 16, Salford W.M. Coll., clerk—Arith. (3d)
957—Smith, James, 21, King's Lynn Ath., clerk—Bkpg. (3d)
1184—Smith, James L., 18, Wakefield M.I., clerk—Arith. (3d); Bkpg. (2d)
629—Smith, John, 29, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st); Pol. Econ. (2d)
718—Smith, John A., 20, Birkbeck Lit. and Sci. Inst., Civil Service writer—Arith. (3d)
158—Smith, John F., 19, Bow and Bromley Inst., clerk—Bkpg. (2d)
645—Smith, John F., 19, Birkbeck Lit. and Sci. Inst., clerk—Th. of Music (1st)
649—Smith, John H. A., 23, Birkbeck Lit. and Sci. Inst., clerk—French (3d)
843—Smith, John S., 18, City of London Coll., clerk—Bkpg. (3d)
330—Smith, Peter A., 23, Glasgow Anderson. Univ. Pop. Evg. Classes, warehouseman—Th. of Music (3d)
1139—Smith, Robert, 16, Salford W.M. Coll., clerk—Arith. (3d)
1138—Smith, Robert, 16, Salford W.M. Coll., clerk—Arith. (3d)
909—Smith, Sophia A., 27, Royal Polytechnic Inst., governess—German (2d)
579—Smith, William, 16, Liverpool Inst., in an office—Arith. (3d)
331—Smith, William N., 22, Glasgow Anderson. Univ. Pop. Evg. Classes, pawnbroker—Th. of Music (1st)
846—Smyth, James, 30, City of London Coll., clerk—Eng. Lang. (2d)
1070—Stanners, Thomas, 18, Newcastle-on-Tyne Ch. Inst., clerk—Bkpg. (1st)
461—Starr, Henry P., 17, Hertford Lit. and Sci. Inst., printer's apprentice—Arith. (3d); Eng. Lang. (3d)
708—Statham, John O., 18, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (2d)
969—Steele, William, 20, Manchester M.I., clerk—French (3d)
125—Stephens, Weaver, 29, Birmingham and Mid. Inst., bootmaker—Th. of Music (1st)
512—Steventon, Wilbert, 21, Hull Young People's Chr. and Lit. Inst., clerk—German (2d); Bkpg. (1st)
544—Stewart, James, 25, Ipswich W.M. Coll., gardener—Floriculture (1st); Fruit and Vegetable Culture (1st)
332—Stobo, Gavin, 28, Glasgow Anderson. Univ. Pop. Evg. Classes, mason—Th. of Music (2d)
723—Stock, Thomas, 28, Birkbeck Lit. and Sci. Inst., Civil Service writer—Arith. (2d); French (1st), with the Second Prize of £3
124—Stokes, Walter, 25, Birmingham and Mid. Inst. Inst. (no occupation)—Th. of Music (1st)
896—Stone, Mary A., 28, Royal Polytechnic Inst., housekeeper—German (3d); French (3d); Eng. Lang. (3d)
1177—Stone, Samuel, 29, Swindon M.I., clerk—Bkpg. (2d)
1066—Stopford, Albert, 16, Mossley M.I., cotton piecer—Bkpg. (3d)
535—Strachan, Ada M., 19, Hull Young People's Chr. and Lit. Inst. (no occupation stated)—Eng. Lang. (3d)
333—Strachan Charles, 31, Glasgow Anderson. Univ. Pop. Evg. Classes, commercial traveller—Th. of Music (3d)
362—Strang, David B., 21, Glasgow Ath., clerk—Spanish (1st)
335—Strang, Robert B., 19, Glasgow Anderson. Univ. Pop. Evg. Classes, clerk—Th. of Music (2d)
5—Stuart, Alexander, 22, Aberdeen M.I., clerk—Th. of Music (2d)
263—Sturrock, James, 17, Dundee Young Men's Chr. Assoc., mechanic—Arith. (3d)
703—Suffell, Arthur J., 20, Birkbeck Lit. and Sci. Inst., clerk—French (3d)

652—Sullivan, Daniel, 21, Birkbeck Lit. and Sci. Inst., compositor—Arith. (3d)
847—Summers, Thomas, 19, City of London Coll., clerk—Bkpg. (3d)
455—Sutcliffe, Novello, 18, Halifax W.M. Coll., warp sizer—Arith. (3d); Bkpg. (3d)
357—Sutherland, Robert, 20, Glasgow Ath., clerk—Bkpg. (1st)
454—Sweeney, Roderick, 28, Halifax W.M. Coll., carpet printer—Bkpg. (3d)
456—Sykes, John H., 18, Halifax W.M. Coll., warehouseman—Arith. (3d)
599—Symes, Maurice, 29, Birkbeck Lit. and Sci. Inst., in Civil Service—Commercial French (1st); Italian (3d); and the Fourth Prize of £1 for Handwriting

11—Tastard, James, 19, Aberdeen M.I., clothier's salesman—Eng. Lang. (3d)
202—Tayelor, Macey F., 27, Carmarthen Lit. and Sci. Inst., clerk and accountant—Spanish (1st); French (3d); Bkpg. (2d); and the First Prize of £3 for Writing and Manuscript Printing
848—Taylor, Charles W., 22, City of London Coll., clerk—Bkpg. (2d)
506—Taylor, Isaac, 19, Hull Young People's Chr. and Lit. Inst., cowkeeper—Bkpg. (3d)
129—Taylor, William H., 27, Birmingham and Mid. Inst., clerk—Pol. Econ. (3d); Eng. Lang. (1st)
954—Teasel, William, 23, King's Lynn Ath., solicitor's clerk—Bkpg. (2d)
221—Tenney, John, 18, Devonport M.I., solicitor's clerk—Arith. (1st); Bkpg. (1st)
1111—Theed, Sophia I., 21, Rugby (no occupation stated)—Arith. (3d); Eng. Hist. (3d); Eng. Lang. (3d)
247—Thom, James, 23, Dundee Young Men's Chr. Assoc., draper's assistant—Eng. Lang. (2d)
850—Thomas, Edward, 18, City of Lond. Coll., clerk—Bkpg. (3d)
1179—Thompson, Thomas P., 18, Swindon M.I., clerk—Arith. (3d)
365—Thomson, Fred, 19, Glasgow Ath., clerk—Eng. Lang. (3d)
39—Thomson, James, 17, Aberdeen M.I., clerk—French (3d)
351—Thomson, William A., 26, Glasgow Ath., clerk—Bkpg. (1st)
173—Thornber, Sharp, 16, Burnley M.I., cabinet-maker—Arith. (2d)
575—Thorp, Edward, 27, Liverpool Inst., shopman—Pol. Econ. (3d)
679—Thresher, Frederick J., 19, Birkbeck Lit. and Sci. Inst., clerk—the Second Prize of £2 for Writing and Manuscript Printing
336—Threshie, James, 27, Glasgow Anderson. Univ. Pop. Evg. Classes, law clerk—Th. of Music (1st)
213—Tobin, Garret, 21, Cork Catholic Young Men's Soc., grocer's assistant—Arith. (3d)
1015—Tongue, Albert, 19, Manchester M.I., clerk—Bkpg. (2d)
198—Topping, George, 17, Carlisle M.I., student—Arith. (2d); Eng. Hist. (3d); Eng. Lang. (2d)
1030—Totten, William J., 20, Manchester M.I., clerk—Bkpg. (2d)
719—Tozer, George T., 18, Birkbeck Lit. and Sci. Inst., clerk—Arith. (3d); Bkpg. (1st)
128—Trobridge, John, 20, Birmingham and Mid. Inst., clerk—Arith. (2d); French (3d); Eng. Lang. (2d)
1091—Trounson, John C., 18, Penzance, surveyor's pupil—Th. of Music (1st)
932—Tucker, Joseph, 24, Tonic Sol-fa Teachers' Assoc., clerk—Th. of Music (2d)
937—Tucker, Richard, 22, Tonic Sol-fa Teachers' Assoc., clerk—Th. of Music (2d)

853—Underhill, Thomas, 20, City of London Coll. clerk—Bkpg. (3d)
378*-Urquhart, William, 17, Glasgow Ath., clerk—Spanish (3d)

130—Vale, George, 18, Birmingham and Mid. Inst., clerk—Commercial German (1st)
68—Varley, James H., 16, Bacup M.I., weaver—Arith. (3d)
890—Vey, Alice, 29, Royal Polytechnic Inst., clerk—French (3d)
1095—Vingoe, Robert H., 18, Penzance, pupil-teacher—Th. of Music (2d)
854—Vinicombe, Samuel W., 25, City of London Coll., clerk—Arith. (2d); Pol. Econ. (2d)
855—Von der Nast, Louis M., 16, City of London Coll., clerk—Bkpg. (2d)
1022—Vosper, Henry, 23, Manchester M.I., buyer—Eng. Hist. (1st); Eng. Lang. (2d)

606—Wade, Henry, 20, Birkbeck Lit. and Sci. Inst., compositor—Bkpg. (1st)
619—Waite, Frederick, 22, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (3d)
1166—Wallace, George W., 19, Sunderland Young Men's Chr. Assoc., clerk—Arith. (2d); Eng. Hist. (3d)
339—Walker, Charles A., 25, Glasgow Anderson. Univ. Pop. Evg. Classes, warehouseman—Th. of Music (1st)
257—Walker, George, 28, Dundee Young Men's Chr. Assoc., engineer—Arith. (3d)
414—Walker, James, 17, Glasgow M.I., warehouseman—Arith. (3d)
1046—Walker, Richard, 19, Manchester M.I., clerk—German (3d)
907—Walker, Philip G., 22, Royal Polytechnic Inst., clerk—Bkpg. (2d)
617—Walton, Oliver, 18, Birkbeck Lit. and Sci. Inst., solicitor's clerk—Bkpg. (2d)
1194—Ward, John B., 17, York Inst., book-keeper—Arith. (3d)
133—Ward, John W., 19, Birmingham and Mid. Inst., pupil teacher—French (2d)
534—Warden, John, 17, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (2d)
498—Warden, Martha, 22, Hull Young People's Chr. and Lit. Inst., governess—Eng. Lang. (3d)
522—Warden, Mary J., 19, Hull Young People's Chr. and Lit. Inst. (no occupation)—Arith. (3d); Eng. Lang. (3d)
1014—Wardle, John, 22, Manchester M.I., clerk—French (1st); Bkpg. (1st)
542—Waring, Henry, 18, Ipswich W.M. Coll., engineer—German (3d)
138—Waters, Walter, 20, Birmingham and Mid. Inst., clerk—Th. of Music (1st)
1080—Waters, William, 24, Paisley Artisans' Inst., book-keeper—Th. of Music (2d)
859—Watson, Alfred, 24, City of London Coll., clerk—Bkpg. (1st)
23—Watson, James, 16, Aberdeen M.I., clerk—French (3d)
10—Watson, John, 41, Aberdeen M.I., dyer—Th. of Music (1st)
731—Watson, John B., 20, Birkbeck Lit. and Sci. Inst., clerk—German (3d)
686—Watt, James, 23, Birkbeck Lit. and Sci. Inst., clerk—Pol. Econ. (2d)
276—Waugh, Percival, 19, Edinburgh Watt Inst., clerk—Pol. Econ. (3d); Bkpg. (2d)
223—Way, Samuel J., 17, Devonport M.I., clerk—Arith. (3d); Eng. Hist. (2d)
1214—Wearer, Henry, 33, Leeds Young Men's Chr. Assoc., exciseman—Arith. (3d)
696—Weatherley, George, 20, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st), with the Second Prize of £3; Eng. Lang. (1st), with the First Prize of £5; Eng. Hist. (2d)

860—Webb, Alfred J., 16, City of London Coll., clerk—French (3d)
1002—Webster, John W., 17, Manchester M.I., clerk—Arith. (3d)
861—Weightman, Henry, 20, City of London Coll., clerk—French (3d)
340—Weir, John, 27, Glasgow Anderson. Univ. Pop. Evg. Classes, warehouseman—Th. of Music (3d)
1029—Welch, John H., 16, Manchester M.I., clerk—Bkpg. (1st)
1112—Weller, Ellen, 17, Rugby, student—Eng. Lang. (3d)
142—Wells, Samuel B, 17, Bolton Ch. Inst., surveyor—Eng. Lang. (3d)
139—Wheeler, Alfred, 28, Birmingham and Mid. Inst., teacher—French (3d)
862—Wheeler, Edward J., 28, City of London Coll., clerk—Arith. (1st); French (2d); Bkpg. (1st)
880—White, Alfred H., 16. Royal Polytechnic Inst., clerk—German (2d); French (3d)
879—White, Alice, 18, Royal Polytechnic Inst. (no occupation stated)—French (3d)
863—White, Andrew, 21, City of London Coll., clerk—French (3d); Bkpg. (3d)
865—White, Henry G., 23, City of London Coll., clerk—French (3d)
134—White, William, 18, Birmingham and Mid. Inst., pupil teacher—French (3d); Eng. Lang. (2d)
1187—Whiteley, Thomas, 27, Wakefield M.I., cabinet maker—Arith. (3d)
964—Whitelow, Edward T., 19, Manchester M.I., engineer—Commercial German (1st)
457—Whitley, Phineas, 22. Halifax W.M. Coll., teacher of music—Arith. (3d); Eng. Hist. (2d); Pol. Econ. (1st)
514—Whitlow, Mary, 18, Hull Young People's Chr. and Lit. Inst., governess—German (1st)
395—Whyte, Dugald M., 20, Glasgow Ath., clerk—French (1st)
889—Wigzell, John J., 18, Royal Polytechnic Inst., clerk—French (3d)
148—Wild, Joseph, 16, Bolton Ch. Inst., student—Eng. Lang. (3d)
1050—Wilkes, Thomas J., 17, Manchester M.I., clerk—Bkpg. (2d)
60—Wilkinson, John F., 16, Bacup M.I., weaver—Arith. (2d)
83—Wilkinson, John, 16, Bacup M.I., cloth-booker—Arith. (1st); Eng. Lang. (2d)
1047—Wilks, John, 20, Manchester M.I., clerk—Bkpg. (1st)
1140—Willett, Alfred, 19, Salford W.M. Coll., clerk—Arith. (3d); Bkpg. (2d)
867—Williams, John R., City of London Coll., clerk—French (3d); Bkpg. (2d)
574—Williams, Mary, 18, Liverpool Inst., pupil teacher—Eng. Hist. (3d)
465—Williamson, George, 22, Huddersfield M.I., schoolmaster—French (3d)
868—Willoughby, William H., 32, City of London Coll., clerk—German (1st)
458—Wilson, Arthur, 17, Halifax W.M. Coll., apprentice to wool trade—Bkpg. (2d)
1032—Wilson, Arthur E., 19, Manchester M.I., clerk—Bkpg. (3d)
378—Wilson, Gavin, 22, Glasgow Ath., warehouseman—French (1st)
341—Wilson, George, 24, Glasgow Anderson. Univ. Pop. Evg. Classes joiner—Th. of Music (2d)
536*-Wilson, George T., 18, Hull Young People's Chr. and Lit. Inst., clerk—German (3d)
358—Wilson, William, 19, Glasgow Ath., clerk—Bkpg. (1st)
709—Wiltshire, Thomas, 27, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)
881—Winchester, Ernest C., 19, Royal Polytechnic Inst., clerk—Th. of Music (1st), with the Second Prize of £3
869—Winser, George F., 27, City of London Coll., clerk—Commercial German (1st)
870—Winwood, Edward, 19, City of London Coll., Civil Service writer—Arith. (1st); Eng. Hist. (1st); Bkpg. (1st); and the Third Prize of £2 for Handwriting
612—Winwood, William, 18, Birkbeck Lit. and Sci. Inst., clerk—Arith. (3d)
871—Withers, Edmund, 40, City of London Coll., clerk—Bkpg. (2d)
475—Witty, Frederic, 19, Hull Ch. Inst., bookseller's assistant—Bkpg. (3d)
131—Wood, Charles, 24, Birmingham and Mid. Inst., clerk—Spanish (1st)
482—Wood, Charles H., 25, Hull Ch. Inst., clerk—Bkpg. (3d)
992—Wood, Henry, 21, Manchester M.I., clerk—German (1st)
132—Wood, William, 22, Birmingham and Mid. Inst., clerk—Spanish (2d)
468—Woodcock, Herbert, 16, Huddersfield M.I., bookseller—Arith. (3d)
872—Woodrow, James J., 18, City of London Coll., clerk—French (3d)
1059—Woolley, Abel, 18, Mossley M.I., piecer—Bkpg. (3d)
644—Woolmer, Theophilus, 24, Birkbeck Lit. and Sci. Inst., bank cashier—Th. of Music (1st)
698—Woolston, Charles F., 25, Birkbeck Lit. and Sci. Inst., clerk—French (3d)
1146—Woolston, Thomas, 20, St. Martin's Sch. of Art, Stamford, builder—Arith. (3d)
873—Wootten, John J., 20, City of London Coll., clerk—Arith. (2d)
135—Wootton, Bertha M., 20, Birmingham and Mid. Inst. (no occupation)—German (2d)
203—Woozley, David A., 27, Carmarthen Lit. and Sci. Inst., officer of Inland Revenue—Arith. (2d); Eng. Hist. (1st)
1141—Worthington, Henry, 20, Salford W.M. Coll., warehouseman—Arith. (3d)
1057—Wrathmall, John H., 19, Manchester M.I., print overlooker—Arith. (3d)
704—Wretts, John R., 23, Birkbeck Lit. and Sci. Inst., chemist's assistant—Commercial French (1st)
1102—Wright, Albert T., 19, Rotherham Lit. and Sci. Inst., clerk—Arith. (3d)
727—Wright, Charles, 16, Birkbeck Lit. and Sci. Inst., clerk—Eng. Hist. (1st)
600—Wright, William H., 19, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st); and the Second Prize of £2 for Writing from Dictation

1142—Yates, Artemas, 24, Salford W.M. Coll., clerk—Arith. (2d); Bkpg. (1st)
268—Yeaman, James N., 17, Dundee Young Men's Chr. Assoc., compositor—Eng. Lang. (3d)
342—Yorston, James, 30, Glasgow Anderson. Univ. Pop. Evg. Classes, shoemaker—Th. of Music (3d)
669—Young, George H., 28, Birkbeck Lit. and Sci. Inst., draughtsman—Logic (3d)
252—Young, Frank W., 22, Dundee Young Men's Chr. Assoc., chemist and science teacher—Arith. (3d)

There is every probability that Australia will soon have another telegraphic cable connecting her with India and other parts of the world. The New South Wales Government has arranged with Queensland and New Zealand for the laying of a cable from Singapore to the Queensland coast. The New South Wales Parliament is to be asked to sanction the scheme before the present session closes.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

The Ethnological Society's Collection now arranged in the Gallery of the Royal Albert Hall, and which forms a part of the International Exhibition, has lately been enriched by several interesting articles from the West Coast of Africa; among them are a Prince's State umbrella, stool, robes, dagger, &c., from Dahomey, which are lent by Mr. J. A. Skertchley, who was for many years resident in that country, and to whom they were presented by the king, who created him a Prince. The umbrella is nine feet in height and eight feet in diameter. The frame is of wood, covered with dark maroon-coloured velvet, on which is worked an elaborate pattern in yellow, scarlet, and blue; when expanded it is quite flat. From the edge hangs a deeply scolloped fall or valance, on every alternate lobe of which a bird holding a fish in its mouth is represented; the whole is surmounted by a small idol. The stool is about two feet high, and is cut from a solid block of wood; the seat is curved, and supported by an ornamental pedestal. Mr. H. Cole, C.B., exhibits three cases of gold ornaments from Coomassie; these are extremely interesting, as they show native designs and workmanship. There is also a case of very beautiful jewellery, lent by Mrs. Harley, which was made on the Gold Coast; the filagree work is very delicate, and is a great contrast to the ornaments from Coomassie. Col. Harley, C.B., exhibits a Prince's stool and pipes from Ashantee.

The Working Men's Club and Institute Union are making arrangements for the delivery of lectures at the Exhibition, illustrative of the various classes of objects. With the aid of her Majesty's Commissioners they hope to secure the services of gentlemen specially qualified to give information of the branches of art and industry on view. The members of the metropolitan clubs affiliated to the Union will be furnished with tickets admitting them on successive Saturdays to these lectures and to the Exhibition. By the kindness of several subscribers to the National Association for the Promotion of Technical Instruction, the Union has been supplied with tickets for the purpose, and they are especially indebted for this help to Lord Lichfield, Messrs. Mintons, Sir James Ramsden, Messrs. Bell Brothers, and Messrs. Thomas Firth and Sons.

The Commissioners have resolved that artisans and school tickets purchased by promoters of technical instruction shall be admitted to the exhibition on all days except the Wednesdays before the 21st of July.

The following is the return of admissions for the ninth week, ending June 6th:—Season tickets, 2,246; payment, 11,601; total, 13,847.

EXHIBITIONS.

Cincinnati Industrial Exhibition.—Cincinnati proposes to have another industrial exhibition in the autumn. The buildings erected for the purposes of the exhibition have an available space of 338,000 square feet, or nearly 8 acres, under roof, and they thus afford room for the largest industrial exhibition ever held in the United States.

PUBLIC MUSEUMS AND LIBRARIES.

The following returns of the numbers of visitors for May have been received up to the present date:—

	Number of Visitors.
British Museum	(no return)*
National Gallery (Trafalgar-square)	83,301
Kew Gardens and Museum	148,808
South Kensington Museum	97,937
Bethnal-green Museum	54,464
Geological Museum, Jermyn-street	2,648
Patent-office Museum	23,399
Edinburgh National Gallery	8,490
Edinburgh Museum of Antiquities	7,832
Edinburgh Museum of Science and Art	19,375
Royal Dublin Society:—	
Natural History Museum	5,277
Botanic Gardens, Glasnevin	30,404
Dublin National Gallery	
Zoological Society, Dublin	
Museum of Irish Society, Dublin	
Tower of London	14,506
Royal Naval College, including Greenwich Painted Hall	35,936

CORRESPONDENCE.

ARCHÆOLOGY AND CULTURE.

Sir,—Mr. Epps's imaginations will be found to answer themselves. If there were no ships to carry horses, no horses would be carried; and such would be the case were the emigration of Babylonian civilisation to Peru earlier than the establishment of shipping, and afterwards disturbed by the Malay invaders of Polynesia.

I do not, however, wish to take up the space of the Society's *Journal* with recondite and remote inquiries, although it may serve to attract curiosity to call attention to the fact, that Moses and his predecessors had an acquaintance with America, which had been lost in the time of Aristotle. That was not my object in referring to the results of my philological discoveries as to Ashantees, or as to the Sumerian origin of civilisation in America.

What is wanted to be impressed is this, that culture, high or low—that of the savage in horrible sacrifices, or that of the more advanced man in the propagation of learning—is abiding, in many cases, beyond material results. Throughout the Vasco-Kolarian nations we find a warlike spirit established, as a consequence of culture in that respect. With regard to the nations under Sumerian influence, in Babylonia, in India, in Pegu, Siam, and Cambodia, in Peru, Central America, and Mexico, we find great cities, vast structures, and an acquaintance with the practical arts.

My object is then to call attention to the desirability of promoting by every means, as is the object of this Society, the extension of the most advanced culture, being confident that it must give large and lasting fruits. We may promote English civilisations and the English language among the Sonthals, Kols, and hill tribes of India; we must not abandon our mission on the West Coast of Africa; and in promoting Arts, Manufactures, and Commerce in all directions we shall do good.

Our intercourse with Siam and Cambodia is so restricted that they do not figure in the Postal List, and therefore the attention given to them by the Indian Section will do good. Next year it is to be hoped Indo-China, China, and Japan will receive special notice at our hands.—I am, &c., Hyde Clarke.

32 St. George's-square, S.W., 6th June, 1874.

* The average monthly numbers, including readers and students, were, in 1873, 48,000.

NOTES ON BOOKS.

Un Projet de Musee Populaire. par C. Buls (*Bruxelles, C. Maquardt*).—The author of this *brochure* is the secretary-general of the Belgian Education League. Its object is to point out what might be done for the higher culture of the masses by the establishment of museums for instruction in art and the natural sciences. M. Buls prefaces his suggestions by an argument intended to show that the State, to ensure the universal diffusion of useful knowledge, must direct its best efforts towards three points—it must awaken a general desire to gain information, facilitate the means of acquiring useful knowledge, and disseminate clear and accurate ideas "on all human knowledge." He then proceeds to elaborate in detail a scheme for the establishment and conduct of such museums, describing the arrangements and classifications he would prefer, and giving a plan of an ideal museum. Though all the suggestions are made with a special view to the country of their author—Belgium—they are of course almost equally applicable to other countries. Many who have over here been labouring in the same field may perhaps see in the remarks of M. Buls a peculiar suitability to England. Indeed it is to a well-known English advocate of his own creed that he has seen fit to dedicate his labours, "Thomas Twining, Esq., le persévérant promoteur des Musées populaires en Angleterre."

GENERAL NOTES.

Tea in Italy.—It is stated in an Italian paper that the attempts made last year in Italy, without success, to grow the tea plant, are being renewed in the southern districts of Sicily. It is hoped that this attempt will prove successful, as special pains have been taken to procure seeds and plants from the best sources direct from Japan. Last year's failure is attributed to the fact that the entire stock of seeds and plants had been injured by immersion in sea-water through the shipwreck of the cargo.

Orange Trade in the Pacific.—The trade in oranges between Tahiti and Sans Francisco is becoming more and more important. The French Colonial statistics state that in the close of 1869 eleven vessels left the port of San Francisco to take in cargoes of this fruit; their aggregate tonnage was 1,468 tons, and they returned loaded early in 1870. The ordinary cargo is from 100,000 to 300,000 oranges, besides other produce. Now that a railway runs through from San Francisco to New York, oranges can be sent as far as Chicago, and even to the towns bordering on the Atlantic. One influential firm at Papeite has taken measures for collecting two million oranges to meet the demands made upon it.

Asphalte in America.—In America, asphalte occurs in large beds in New Brunswick and West Virginia. The material from the first place is known as "Albertite;" that from the second as "Grahamite." Both occur in fissures opened across their bedding in strata of the carboniferous age. There is little room for doubt that the fissures which contain the asphalte have afforded convenient reservoirs into which petroleum has flowed, and from this all the lighter parts have been removed by evaporation. Similar deposits, but of less magnitude, are known in Colorado, Arkansas, Ohio, and Kentucky. In Southern California, Western Canada, and elsewhere, asphalte may still be seen passing through the process of formation from petroleum, and especially in Santa Barbara and San Luis Obispo, where the accumulations of asphalte are well known to geologists. It also occurs on the shores of the Gulf of Mexico, but it is chiefly Trinidad to which the United States will have to look for the greater part of the supply of asphalte for various purposes, especially for road-making. The quantity seems inexhaustible, and this quality is the very best.—*American Chemist.*

Birkbeck Institution.—Mr. J. H. Levy will deliver a lecture on "The Study of Political Economy, and its Application to the Purposes of Life," to his past students, and the members and friends of the institution, on Thursday evening, June 18, being the occasion of his retiring from the office of Professor of Political Economy. The chair will be taken at eight o'clock.

Deciphering Burnt Documents.—Mr. Rathelot, an officer of the Paris law courts, has succeeded in an ingenious manner in transcribing a number of the registers which were burnt during the Commune. These registers had remained so long in the fire that each of them seemed to have become a homogenous block, more like a slab of charcoal than anything else, and when an attempt was made to detach a leaf it fell away into powder. Many scientific men had examined these unpromising black blocks, when M. Rathelot hit upon the following method of operation:—In the first place he cut off the back of the book so as to leave nothing but the mass of leaves which the fire had caused to adhere to each other; he then steeped the book in water, and afterwards exposed it, all wet as it was, to the heat at the mouth of a *calorifère*; the water, as it evaporated, raised the leaves one by one, and they could be separated, but with extraordinary precautions. Each sheet was then deciphered and transcribed, and the copy certified by a legal officer. In this way the records of nearly 70,000 official acts have been saved. The appearance of the pages was very curious; the writing appeared of a dull black, while the paper was of a lustrous black, something like velvet decorations on a black satin ground, so that the entries were not difficult to read.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Mon. ...Royal Geographical, 1, Savile-row, W., 8½ p.m. 1. Mr. Eugene Schuyler, "A Month's Journey in Kokand in 1873." 2. Major-General Sir H. C. Rawlinson, "Progress of Forsyth's Mission to Kashgar and Exploration of the Pamir Steppe."
Victoria Institute, 8 p m. (At the House of the Society of Arts.) Annual Meeting.

Tues....Statistical. 12, St. James's-square, S.W., 7¾ p.m. 1. Sir Charles W. Dilke, "Local Government among different Nations." 2. Mr. E. W. Brabrook, "The Co-operative Land Movement."
Zoological, 11, Hanover-square, W., 8½ p.m.
Royal Society for the Prevention of Cruelty to Animals, 10. Conference. (At the House of the Society of Arts.)

Wed... Royal Society for the Prevention of Cruelty to Animals, 10. Conference. (At the House of the Society of Arts.)
Meteorological, 25, Great George-street, S W., 7 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.

Thur....Royal, Burlington House, W., 8½ p.m.
Antiquaries, Somerset House, W.C., 8½ p.m.
Linnæan, Burlington House, W., 8 p.m. 1. Mr. John Miers, "On the Auxemmeæ, a new Tribe of the Cordiaceæ." 2. Mr. F. Curry, "On some Fungi collected by Dr. Kurz, in Yomah, Pegu." 3. Professor Schiödte, "Notes on the Letters from Danish and Norwegian Naturalists contained in the Linnean Correspondence."
Chemical, Burlington House, W., 8 p.m. 1. Mr. W. Smith, "On Isodinaphthyl." 2. Dr. Armstrong, "Communications from the Laboratory of the London Institution." 3. Mr. E. Neison, "On the Products of Decomposition of Castor Oil, No. III. Action of excess of Alkaline Hydrates." 4. Mr. J. L. Davies, "On the Restitution of Burnt Steel." 5. Mr. William Ramsey, "On Hydrogen per Sulphides." 6. Dr. Schorlemmer, "On Suberone." 7. Mr. W. Fielden, "On the Action of Chloride of Phenol." 8. Dr. Tommassi, "On a new Apparatus for determining Carbonic Anhydride and Moisture. Apparatus for determining Ozone in presence of Chlorine and Hypombrous Acid of Urea."
Royal Society for the Prevention of Cruelty to Animals, 10. Conference. (At the House of the Society of Arts.)
Zoological, 11, Hanover-square, W., 4 p.m.
Numismatic, 13, Gate-street, W.C., 7 p.m.
Philosophical Club, Willis's Rooms, St. James's, S.W., 6 p.m.

Fri.......SOCIETY OF ARTS, 12. Conference. 8 p.m. (Annual Conversazione at South Kensington Museum.)
Society of Engineers. Visit to Loudon-yard Engineering Works, Isle of Dogs, and Bessemer Steel and Ordnance Company.
Philological, University College, W.C., 8 p.m.
Royal Botanic, Inner Circle, Regent's-park, N W., 4 p.m. Prof. Bentley, "On the Reproductive Organs of Plants."

Sat......Royal Society for the Prevention of Cruelty to Animals, 10. Conference. (At the House of the Society of Arts.)

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,126. Vol. XXII.

FRIDAY, JUNE 19, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

FINANCIAL STATEMENT.

The following statement is published in this week's *Journal*, in accordance with Sec. 42 of the Society's Bye-laws:—

TREASURERS' STATEMENT OF RECEIPTS, PAYMENTS, AND EXPENDITURE, FOR THE YEAR ENDING MAY 30th, 1874.

Dr.

	£ s. d.	£ s. d.
To Cash in hand of Messrs. Coutts and Co., 31st May, 1873	478 3 9	
Do. do. Secretary	17 5 7	
		495 9 4
To Subscriptions received during the year from Members and Institutions in Union	6,253 9 0	
Life Contributions	546 0 0	
		6,799 9 0
To Dividends on Stock:—		
Consols, £4,914 6s. 8d.	145 11 8	
Reduced 3 per cents., £1,956 0s. 11d.	57 18 10	
New 3 per cents:—		
Dr. Fothergill's Trust, £388 1s. 4d.	11 10 0	
Great Indian Peninsula Guaranteed 4 per cent. Railway Debenture Stock, £2,170	85 14 4	
£2,450 Bombay and Baroda Guaranteed Railway Stock	120 19 4	
£2,460 Oude and Rohilcund Guaranteed Railway Stock	121 9 2	
2,500 dols. United States Funded Bonds 1871, cost £509 1s. 3d	25 3 8	
		568 7 0
To Interest on Deposit Account with Messrs. Coutts and Co., £600		18 15 8
To Subscriptions and Donations:—		
Endowment Fund	97 15 0	
Memorial Window Fund	6 15 0	
		104 10 0
To Examinations:—		
The Prince Consort's Prize	26 5 0	
Mrs. Harry Chester's Prizes	5 0 0	
Candidates' Fees, sale of papers, &c.	10 1 11	
		41 6 11
To Sales:—		
Cantor Lecture Tickets, &c.	68 17 4	
Juvenile Lectures do.	185 17 0	
Journals, Advertisements, &c.	1,021 15 2	
Barry's Etchings	21 0 0	
		1,297 9 6
To Stove Competition	500 0 0	
Technical Examinations, for Prizes, &c.	226 13 0	
Do. do. Scholarships	50 0 0	
		776 13 0
To Exhibitions:—		
Annual International	0 1 6	
To House and Office	24 4 7	
To South Australian Institute	50 0 0	
		74 6 1
		£10,176 6 6

Cr.

	£ s. d.	£ s. d.
By House and Premises:—		
Rent, Rates, and Taxes	307 15 8	
Insurance, Gas, Coal, and House Charges	197 5 0	
Repairs and Alterations	76 19 1	
		581 19 9
By Office:—		
Salaries, Wages, and Commissions	2,114 19 4	
Stationery and Printing	304 16 7	
Advertising	67 19 3	
Postage Stamps and Parcels	173 1 8	
		2,660 16 10
By *Journal*, including Printing, Advertisements, Stamps, and Distribution to Members	2,756 14 0	
Library, Bookbinding, &c.	118 19 1	
Conversazione	251 17 1	
		3,127 10 2
By Union of Institutions, including Examinations, Prizes, Postage, Printing, &c.	424 5 5	
Prince Consort's Prize	26 5 0	
Technological Examinations	179 1 7	
Do. do. Scholarships	50 0 0	
		679 12 0
By Society's Albert Medal	22 7 6	
Do. Medals	23 17 6	
		46 5 0
By Prizes:—		
Dr. Swiney's	100 0 0	
Sir Joseph Whitworth's	26 12 0	
Mr. Buckle's	2 15 6	
Improved Cabs	120 0 0	
Stove Competition	317 18 5	
Mendelssohn Scholarship	20 0 0	
Hall-marking of Jewelry	1 0 0	
The Architectural Institution	20 0 0	
		608 5 11
By Exhibitions:—		
Annual International, Reports, &c.		154 1 6
By Committees:—		
General Charges	28 7 1	
Cab	1 10 8	
Drill	3 8 2	
Food	4 13 10	
Musical Education (National Training School)	246 7 7	
Indian Section	37 16 5	
African do.	13 13 9	
Chemical do.	13 2 0	
Museums	36 19 0	
Steel	3 3 6	
Memorial Tablets	10 0 0	
Road Traction	23 4 6	
Conflagrations	12 15 5	
		435 1 11
By Memorial Window Fund (postage, &c.)	4 6	
Endowment Fund	2 19 8	
Barry's Etchings	9 7 6	
		12 11 8
By Purchase of £663 15s 2d. Reduced 3 per Cent. Stock (Life Subscriptions)		609 0 0
By South Australian Institute	496 1 3	
Cantor Lectures	264 10 5	
Juvenile Lectures	208 2 9	
		968 14 5
		9,883 19 2
Cash in the hands of Messrs. Coutts and Co., 30th May, 1874		290 3 8
,, in the Secretary's hands		2 3 8
		£10,176 6 6

Liabilities.

	£.	s.	d.	£.	s.	d.
To Sundry Creditors:—						
Memorial Window Fund	6	11	6			
Prince Consort's Prize	26	5	0			
North London Exhibition Trust	12	8	9			
Examination Prizes (Society's)	138	10	0			
Do. Mrs. Harry Chester's Prize	4	0	0			
Examiners' Fees	138	12	0			
Rent, Rates, and Taxes	31	13	4			
Tradesmen's Bills	1,475	16	4			
Blenheim Literary Institute, New Zealand	1	2	7			
Musical Scholarship	50	0	0			
Technological Examinations Fees	52	10	0			
Do. to the Clothworkers' Company's Prizes	105	0	0			
Do. to Balance of Subscriptions*	45	5	2			
Journal Stamps	12	10	8			
Sections:— Indian, African, and Chemical	180	0	0			
Stove Competition	182	1	7			
Swiney Prize	100	0	0			
Endowment Fund	97	15	0			
				2,660	1	11
By excess of Assets over Liabilities				6,032	5	11
				£8,692	7	10

* The return of Prizes awarded has not yet been received.

Assets.

	£	s.	d.	£	s.	d.
By Society's money invested in—						
Reduced 3 per Cent. Stock, £2,619 16s. 1d., viz., £2,406 2s. 9d. less £366 7s. reserved to meet trusts stated below	2,040	2	9			
Consols, £146 19s. 5d., at 93⅛ per cent.	135	18	11			
Great Indian Peninsula Railway 4 per cent. Debenture Stock	200	0	0			
Oude and Rohilcund and Bombay and Baroda Guaranteed Debenture Railway Stock	355	2	7			
Deposit Account with Messrs. Coutts and Co. £600, less £421 13s. 9d. reserved to meet trusts stated below	178	6	3			
Subscriptions of the year uncollected £1,633 16 0; Less 15 per cent 245 0 0	1,388	16	0			
Do. of former years unpaid 2,282 14 0; Less 50 per cent 1,141 7 0	1,141	7	0			
Barry's Pictures and other property	2,000	0	0			
Prince Consort's Prize	26	5	0			
Mrs. Harry Chester's Prize	4	0	0			
Journals, by Advertisements and Sales*	930	2	0			
				8,400	0	6
Cash in hands of Messrs. Coutts and Co., 30th May	290	3	8			
Do. in hands of Secretary, petty cash	2	3	8			
				292	7	4
				£8,692	7	10

* A portion of this sum is still subject to charges for printing, &c., estimated at about £100.

P. Le Neve Foster, *Secretary.*

Stock and Cash Standing in the Name of the Soociety.

		£	s.	d.
Consols		£4,914	6	8
New 3 per Cents.		388	1	4
Reduced 3 per Cents.		2,619	16	1
Great Indian Peninsular Railway 4 per Cent. Guaranteed Debenture Stock	Deposited with Messrs. Coutts and Co.	2,170	0	0
Oude and Rohilcund " " "	Deposited with Messrs. Coutts and Co.	2,460	0	0
Bombay and Baroda " " "	Deposited with Messrs. Coutts and Co.	2,450	0	0
Cash in hand of Messrs. Coutts and Co., on deposit		600	0	0
United States 2,500 dols. five per Cent. Funded Bonds, 1871, cost		509	1	3

Trust Funds included in the above.

	£	s.	d.	
Dr. Swiney's Bequest	£4,500	0	0	Consols, chargeable with a sum of £200 once in five years.
John Stock's Trust	100	0	0	" " " the Award of a Medal.
North London Exhibition Trust	167	7	3	" " " Award of the Interest as a Money Prize.
J. Murray, Esq., in aid of a Building Fund	50	0	0	Reduced 3 per Cent. Stock.
Subscriptions to an Endowment Fund	226	7	0	Reduced 3 per Cent. Stock.
Dr. Aldred's Bequest	90	0	0	Reduced 3 per Cent. Stock.
Thomas Howard's Bequest	500	0	0	United States 5 per Cent. Funded Bonds, 1871.
Fothergill's Trust	388	1	4	New 3 per Cents., chargeable with the award of a Medal.
Dr. Cantor's Bequest	5,049	9	7	Bombay and Baroda and Oude and Rohilcund Guaranteed Railway Debenture Stock.
Alfred Davis's Bequest	1,800	0	0	Great Indian Peninsular Guaranteed Railway Debenture Stock.
Memorial Window Fund	321	13	9	Deposited with Messrs. Coutts and Co.
Sir W. C. Trevelyan's Prize	100	0	0	Deposited with Messrs. Coutts and Co.
Musical Scholarships	50	0	0	
Technical Examinations, Prizes, &c.	45	5	2	

The Receipts of the Society set forth above have been credited by Messrs. Coutts and Co.

The Payments set forth above have been made by authority of the Council.

The Assets, represented by stock at the Bank of England, and securities, cash on deposit, and cash balance at Messrs. Coutts, as above set forth, have been duly verified.

James T. Ware,
I. Gerstenberg, } *Auditors.*

Society's House, Adelphi, 12th June, 1874.

ANNUAL GENERAL MEETING.

The One Hundred and Twentieth Annual General Meeting, for the purpose of receiving the Council's report, and the Treasurers' statement of receipts, payments, and expenditure during the past year, and also for the election of officers, will be held, in accordance with the Bye-laws, on Wednesday next, the 24th of June, at four p.m.

At this meeting it will be moved, on the part of the Council, that Bye-law 99, regulating the preparation of the Balloting List, so far as it relates to the Treasurers, be altered, and that in lieu of the words "Provided that one of these shall not have served the office of Treasurer during the current year," there be inserted the following words, "Provided that neither of them shall have served the office of Treasurer for the five previous consecutive years."

The Council hereby convene a Special General Meeting of the Members of the Society to ballot for members, such meeting to take place at the close of the Annual General Meeting.

By Order,
P. Le Neve Foster, *Secretary.*

Society's House, Adelphi, June 17, 1874.

CONVERSAZIONE.

The Annual Conversazione of the Society will be held this evening (Friday, June 19), at the South Kensington Museum.

REVOLUTION INDICATOR.

In response to the offer of a prize for the best Revolution Indicator for Ships made by the Society, 84 competitors have sent in models or drawings.

PROCEEDINGS OF THE SOCIETY.

ANNUAL CONFERENCE.

The Twenty-third Annual Conference between the Council of the Society and the representatives of Institutions in Union, will take place at the Society's House, this day, Friday, the 19th of June.

The Educational Officer will read his Report to the Council, as follows:—

To the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce.

Gentlemen,—As the officer of the Society entrusted with the Educational Department, I have the honour to submit to the Council, for the information of the Conference, a report of its proceedings for the promotion of education during the year.

The first subject that I have to deal with is the Society's Examinations, to which the term "General" has been given, in order to distinguish them from the recently established Technological Examinations, to which I shall presently refer.

The General Examinations, which have now been carried on since 1856, were in the early stage of their existence the only agency by which the knowledge of students who had not passed through a regular curriculum at one of the Universities or elsewhere, and who may be described as self-educated, could be tested, and I need hardly remind you that it is from these examinations that have sprung the various systems of examination conducted by the Government, by the Universities, and other public bodies. I recall your attention to this fact because I feel that anyone comparing the number of candidates at our examinations with those going in for the examinations of the Science and Art Department and the Local Examinations of the Oxford and Cambridge Universities, might be tempted to undervalue the influence of the Society's action, and to imagine that it could fairly be measured by the present number of candidates actually coming forward. Such an estimate would be erroneous, for in attempting justly to appreciate the extent to which the Society has influenced the testing of knowledge by examination, it will be only fair to recollect that very soon after its examinations were established, a similar movement was inaugurated by the Universities, and by the Science and Art Department, and thus a large amount of the ground that would otherwise have been occupied by the Society was covered by other influential bodies, who followed the example set by it. I say that it is only by taking a general view of the examinations of all the bodies I have mentioned that we can attach the really adequate value to the educational movement begun by the Society.

In referring, however, to the work done by other bodies, and while allowing that much of the ground that would have been occupied by the Society has been covered by them, I am not prepared to admit that there is any other public body that exactly supplies the wants of the students at mechanics and similar institutions, the proof of this being that in spite of the immense facilities afforded by other examinations, those of the Society have actually not only maintained their position, but have made a decided advance upon last year. The tables show that in 1873 the number of candidates examined was 1,052, of whom 880 obtained certificates, while this year there were 1,073 examined, of whom 908 were successful. The increase in the number of papers worked is more remarkable, for while last year there were only 1,359, this year there have been 1,452, an increase of nearly 100. When we allow for the serious discouragement given to the institutions the year before last by the publication of the resolution of the Council, abolishing the examinations altogether (a resolution afterwards rescinded in deference to the strongly expressed wish of several large and influential institutions), I cannot but feel surprise as well as pleasure in being able to inform you of the advance that I have just referred to.

The proportion of those who have succeeded in obtaining certificates has been increasing for the last two years, for while in 1872 it was only 81 per cent., and last year 83 per cent., this year the ratio has risen to nearly 85 per cent. The number of prizes awarded is the same as last year.

I may draw attention to the marked increase in the number of candidates coming up in Modern Languages. In French last year there were only 177, while this year there are 227; in German last year there were only 41, the number this year being 61; while in Spanish the proportionate advance is much more considerable, for last year there were only 9 candidates, and this year there have been no less than 26. It is satisfactory to find that the study of a language so largely used in commerce is increasing in this country.

The Prince Consort's Prize of twenty-five guineas, graciously placed by Her Majesty at the Council's disposal each year, has been awarded to Alexander Gibson, of the Manchester Mechanics' Institution, who obtained in the last four years no less than ten first-class certificates and six prizes, only one less than the highest number ever obtained by the fortunate student to whom this great distinction has been awarded.

I am happy to announce that this year the Council has felt justified in awarding the Council Prize for Female Candidates, which had not been taken for some years. It has been gained by Mary Elizabeth Martin, of the Birkbeck Institution.

I ought not to omit to mention the remarkable success of the students from this institution at the last examination. It sent up 118 candidates, of

whom 107 were successful, gaining 72 first-class, 38 second-class, and 36 third-class certificates, while the number of prizes they carried off was no less than 21, or very nearly half the total number gained this year. Such a success must be regarded as highly creditable to the institution, and is an evidence of what great results may be secured by a well-organised system of teaching. One of our examiners, in his reports upon the papers submitted to him, has more than once drawn attention to the remarkable fact that the best as well as the worst papers are generally found in groups, showing that the results of the examinations are almost absolutely determined by the quality of the teaching.

The vivâ-voce examinations in Modern Languages, as proposed in the memorandum furnished by Mr. Hyde Clarke, have been held this year at four institutions, the subject taken being French, and the local examiners have reported four candidates as having satisfactorily passed, to whom certificates of proficiency have been awarded. I cannot but repeat my expression of regret that this branch of the examinations does not command more attention.

The prizes for Writing from Dictation, for Writing and Manuscript Printing, and for the best specimens of Handwriting, as shown in the papers generally, have all been awarded, and the report of the examiner this year is most favourable as to the improvement in the handwriting of the candidates generally. He states that "the specimens of bold, well-formed, legible writing are more numerous," and that "the candidates to whom prizes have been awarded have shown a sustained excellence through long papers." Anyone who has passed through the ordeal of an examination will remember how difficult he must have found it to keep a high standard of legibility in writing examination papers, when the attention is naturally painfully concentrated upon the answers themselves rather than upon the mode of writing them.

With reference to the examinations for next year, Dr. John Yeats, a gentleman long and honourably known in connection with education, in presenting a valuable set of text-books and charts to the Society, has made a suggestion for the addition of a new subject, or subjects, to the examinations. His proposal will best be explained in his own words. He writes :—

"I beg leave to remind the Council that during the present year there has been considerable discussion in the *Times* and elsewhere relative to the superiority which the Germans are said to be gaining over Scotchmen and Englishmen in different markets of the world, and that this superiority has been ascribed to the higher commercial training customary in Germany, and, as a natural consequence, to the greater business aptitude developed there than in England and Scotland. Hence it is that the production of a series of works designed for the improvement of commercial instruction amongst us by an old member of the Society, and one warmly welcomed already by German, Scotch, and English critics, seems to me a matter of interest to the Council. Perhaps, too, it may warrant me in making a very few suggestions as to the utilisation of this set of books and charts consistently with the aims of our Society.

"Briefly, they are text-books for trade students, or for teachers, and meant to be equally useful in counting-houses or in class-rooms. As yet, however, there are not many such students or teachers; but the number would probably increase, were a taste for commercial literature stimulated by occasional reviews of standard works in the Society's *Journal*, by the organisation of provincial lectures and discussions on commercial topics, by the promotion of trade museums in our manufacturing towns, and, also, by the addition of the following to the Society's programme of subjects for examination, in the course of another year, or as soon as possible :—

"(*a.*) Trade geography, or a knowledge of the localities in which raw materials are found; the conditions of their production, preservation, &c.

"(*b.*) Growth of the industrial arts, or a knowledge of the principles by which industrial progress has hitherto been mainly determined; of the practices peculiar to certain countries, or to particular classes of producers, &c.

"(*c.*) Trade history, or a knowledge of the origin and the development of local and distant traffic in civilised countries, with the characteristics of each.

"(*d.*) International commerce and competition, involving a consideration of comparative industrial enterprise, financial burdens, legislative policy, and educational efficiency.

"To me it seems that the Society already exercises most of the functions of a Chamber of Commerce, and that it might supplement these with the influence, if not with the authority, of a trade university, were it to extend its operations in the directions above-named, especially were it to obtain for successful candidates after examination trade certificates or trade testimonials from the City guilds and companies associated with the Society."

This proposal is under the consideration of the Council, who will, I feel sure, be happy to receive suggestions upon it from representatives present.

I may also call attention to a suggestion made by Mr. J. H. Levy, of the City of London College. He proposes "that studentships be established for the encouragement of the highest proficiency in certain groups of subjects, the reward being given in the shape of certain scholastic advantages, and not in money or books. The object to be attained is to guide and concentrate study, and to reward a modicum of success by giving facilities for future study."

I venture to put forward both these proposals as interesting subjects for discussion by the Conference.

Having reported upon what are now called, for the sake of distinction, the General Examinations, I pass to the new system carried out this year for the second time—the Technological Examinations, which I need hardly remind you were inaugurated at a Conference held in 1872, presided over by H.R.H. Prince Arthur. On this occasion the Council put forward the outline of a scheme for these examinations, proposed by one of their members, Major Donnelly, R.E. You will remember that in last year's programme there were five subjects—Cotton Manufacture, Silk Manufacture, Paper Manufacture, Steel Manufacture, and Carriage Building, but in only three of them did candidates appear. In my last report I mentioned that there were six candidates, and I quoted from the examiners' reports, which were generally favourable. I did not, however, mention the candidates' names, as the returns from the Department of Science and Art as to their success or failure in the science subjects were not in my hands, and thus I was unable to say how many of them were entitled to certificates. For a list of these candidates, with

the certificates obtained, I must refer you to the *Journal* for September 5th, 1873, but I may mention that all but one were successful.

It will be remembered that last year her Majesty's Commissioners for the Exhibition of 1851, in a letter to Major Donnelly, stated that, "with the view of encouraging persons to present themselves for the examinations in technology, which have recently been established by the Society of Arts, they have resolved to offer to grant three studentships, of fifty pounds each, to be awarded to the persons who shall distinguish themselves the most in the subjects of Steel, Silk, and Carriages respectively at the examinations in the present year. These scholarships are to be awarded on the condition that the recipients go for a year to some place of scientific instruction, such as the Royal School of Mines, the Royal College of Science in Dublin, Owens College, Manchester, or the English, Scotch, or Irish Universities, or other school approved by her Majesty's Commissioners, or travel abroad for the purpose of improving themselves in their trades." No candidate appeared in Silk Manufacture, but the other two studentships were awarded; that in Steel to W. H. Warren, who obtained a first-class certificate in the Honours Stage, and complied with the conditions by going for study to Owens College, Manchester; that in Carriage Building to T. F. Mullins, who obtained a first-class certificate in the Elementary Stage, and complied with the conditions by going to Queen's College, Cork.

This year the five subjects I have already enumerated have been retained, with the addition of Cloth Manufacture, Glass-making, Pottery and Porcelain, and the manufacture of Gas, and I am glad to be able to announce that there have been no less than 36 candidates examined, the numbers being as follows:—

Cotton manufacture	10
Paper "	0
Silk "	0
Steel "	14
Carriage building	3
Manufacture of Pottery and Porcelain	0
Gas manufacture	7
Glass "	0
Cloth "	2
	36

You will see that in only five of the nine subjects have candidates appeared, and that although Paper Manufacture and Silk Manufacture have now been two years in the programme, no candidate has come forward in either of them.

With regard to the examiners' reports, I am glad to say that they are, on the whole, most favourable. Only one candidate has failed in these technological subjects, but, as last year, I am unable to give the names of the candidates until I receive the returns from the Science and Art Department as to their success in the science subjects.

When these examinations were first inaugurated it was at once felt that an attempt should be made to enlist the aid of the great city companies or trade guilds in this movement, and in my last year's report I mentioned that many of these bodies had responded to this appeal. I cannot but draw special attention to the liberality of the Worshipful Company of Clothworkers, who, in the present year's examinations, offered a scholarship of one hundred guineas, to be awarded to the best candidate in Cloth Manufacture, presuming that in the opinion of the Council he reaches a sufficiently high standard. The conditions laid down were that the candidate who obtains this scholarship must spend at least one year in some place of scientific instruction, to be approved by the Council of the Society of Arts and by the Court of the Clothworkers Company. I am at present unable to say whether this scholarship will be awarded, but it is remarkable that only two candidates have appeared in the subject to which it refers.

On the whole I cannot help feeling that the Society may fairly be congratulated on the success of this new system of examinations. The increase this year certainly exceeds my expectations, for although every effort has been made to make the system known amongst the skilled artisans whose knowledge is to be tested, it will, I feel sure, be years before it is really understood and appreciated by them. Even the temptations held out by the prizes, and by the especially munificent offer I have just referred to, made by the Clothworkers' Company, will not succeed in attracting many candidates, until they really understand what the nature of the examination is, and how far success is likely to aid them in their future career. When, however, the advantages of the system become generally known, and when one of the first questions asked by an employer of a workman applying for a situation shall be, "Have you the Society of Arts Certificate in the technology of your craft?" we shall find the number of our candidates increase manifold, and the Society's Technological Examinations will exercise as wide an influence, and extend over as wide a sphere as the General Examinations have done.

The Technological programme for next year will be issued as soon as possible. The nine subjects in the present year's programme will be retained with the addition of several others, the details of which are not yet quite determined. I believe, however, that they will include Agriculture, Silk and Woollen Dyeing, Calico Bleaching, Dyeing, and Printing, and Alkali Manufacture, most of which may be described as subjects the knowledge of which can, without difficulty, be tested by examination.

I have the honour to be, Gentlemen,
Your obedient servant,
CHARLES CRITCHETT,
Educational Officer.

APPENDIX.

EXAMINERS' REMARKS.

The Examiner in *Arithmetic* speaks of the papers being an improvement on those of last year.

The Examiner in *Political Economy* says he desires to express his sense of the merit of the answering generally, and the excellent quality of that of those candidates who are awarded first-class certificates.

The Examiner in the *English Language* says:—"The papers will, on the whole, fairly bear comparison with those of any previous year. The number of those whom I have been enabled to place in the first-class appears to me to be satisfactory. Of those who are in the third-

TABLE I.

RESULTS OF THE GENERAL EXAMINATIONS OF 1874.

NAME OF LOCAL BOARD.	No. of Candidates Examined at Previous Examination by Local Board.	No. of Candidates who Passed Previous Examination by Local Board.	No. of Candidates Examined at Final Examination.	No. of Candidates who Passed at Final Examination.	No. of Papers Worked at Final Examination.	No. of First-class Certificates awarded.	No. of Second-class Certificates awarded.	No. of Third-class Certificates awarded.	No. of Prizes awarded to Candidates.	No. of Unsuccessful Candidates.
Aberdeen	52	41	33	32	36	3	12	20	...	1
Aldershot and Farnham...	...	...	9	8	23	2	6	7	...	1
Ashby-de-la-Zouch	3	3	5	3	5	...	2	1	...	2
Ashford	3	3	3	3	3	...	...	3	...	...
Bacup	60	50	26	15	35	2	3	15	...	11
Birmingham...	34	32	46	44	63	19	17	24	2	2
Bolton, Church Institute	...	...	11	6	25	...	1	14	...	5
,, Mechanics' Institution	10	10	2	2	2	...	...	2	...	...
Bow and Bromley	7	6	4	3	4	1	2	...	...	1
Bromley (Kent)	...	...	1	1	2	1	...	1	...	...
Burnley	...	...	10	8	13	3	1	7	...	2
Carlisle	17	16	24	23	32	5	12	14	3	1
Carmarthen	4	4	3	3	9	2	4	3	1	...
Cork	17	17	13	11	20	...	2	15	...	2
Devonport	5	5	6	6	10	4	3	2	...	...
Dublin	10	10	5	4	7	...	1	4	...	1
Dudley	8	8	7	5	8	...	2	3	...	2
Dundee	...	...	26	20	29	1	3	17	...	6
Edinburgh	7	7	4	4	6	1	2	3	...	...
Farsley	...	...	2	2	4	...	...	3	...	...
Freetown	...	...	3	3	3	...	1	2	...	...
Glasgow, Andersonian University Popular Evening Classes ...	48	45	54	51	57	15	18	20	1	3
,, Athenæum	42	38	44	36	44	11	5	20	...	8
,, Mechanics' Institution	30	30	26	22	28	5	6	13	...	4
Halifax, Mechanics' Institution	...	...	3	...	5	...	...	...	...	3
,, Working Men's College	16	14	27	24	40	1	10	22	...	3
Hertford	...	...	5	3	9	...	...	5	...	2
Huddersfield	7	5	6	6	7	...	...	6	...	...
Hull, Church Institute	25	25	18	16	18	6	5	5	...	2
,, Young People's Institute	28	28	47	30	56	7	6	24	...	17
Hyde	3	3	2	2	3	...	3	...	...	...
Ipswich	14	12	13	13	16	6	4	5	...	...
Leeds, Church Institute...	...	...	2	2	4	1	2	...	1	...
,, Young Men's Christian Association ...	...	...	12	9	14	2	3	6	...	3
Leicester	...	...	16	12	20	...	...	16	...	4
Lichfield	...	...	1	1	1	1	...	...	...	...
Liverpool	30	30	14	14	19	7	5	6	1	...
Lockwood	3	3	5	4	7	...	...	4	...	1
London, Birkbeck Literary and Scientific Institution	106	103	118	107	160	73	39	36	21	11
,, City of London College	111	102	125	100	183	34	61	52	6	25
,, Polytechnic Institution	22	20	32	31	41	6	11	20	3	1
,, Quebec Institute	...	...	2	1	7	...	2	1	1	1
,, St. Stephen's (Westminster) Evening Schools	8	8	14	10	23	1	4	11	...	4
,, Tonic Sol-fa Teachers' Association...	15	15	11	11	11	3	8	...	...	...
,, Walworth Literary and Scientific Institution	...	...	1	1	1	...	...	1	...	...
Lynn (King's)	24	24	19	14	25	4	5	8	...	5
Manchester	110	95	80	76	112	37	23	42	2	4
Mossley	...	...	10	10	12	2	2	8	...	...
Newcastle-on-Tyne	1	1	3	3	4	2	2	...	1	...
Oldham	5	3	7	5	10	1	...	5	...	2
Paisley	...	...	2	2	2	...	2	...	...	...
Pembroke Dock	7	7	6	6	7	2	3	2	...	...
Penzance	9	9	10	8	13	2	2	6	...	2
Rotherham	2	2	3	3	9	...	...	4	...	...
Rugby	5	5	8	5	30	...	2	11	...	3
Salford	80	65	26	20	32	5	5	16	...	6
Sheffield	...	...	3	2	6	2	...	1	...	1
Stamford	17	10	1	1	1	...	...	1	...	...
Stockport, Mechanics' Institution	...	...	8	8	9	...	2	6	..	...
,, Sunday School Improvement Society	...	...	5	2	9	1	1	2	...	3
Stourbridge	...	...	4	4	4	...	...	4	...	...
Sunderland	15	15	10	9	20	2	6	10	...	1
Swindon	...	...	5	3	6	2	1	1	...	2
Wakefield	7	...	8	4	9	...	2	3	...	4
York	17	13	14	11	19	...	3	10	...	3
Totals	1,044*	949*	1,073	908	1,452	285	327	573	43	165

* These returns were incomplete.

NUMBER OF LOCAL BOARDS, 65.

N.B.—Seventy-four Candidates came forward in Writing from Dictation, and Sixteen in Writing and Manuscript Printing, but, as Certificates are not given for those subjects, they are not included in the above Table, but the prizes awarded in both these subjects, and also the prizes awarded by the Council for Handwriting generally, are included in the list.

TABLE II.—Number of Papers Worked in each Subject in the Four Last Years, with the Result for the Year 1874.

SUBJECTS.	1871.	1872.	1873.	1874. No. of Papers Worked.	1874. No. of First-class Certificates.	1874. No. of Second-class Certificates.	1874. No. of Third-class Certificates.	1874. No. of Papers in respect of which no Certificate was awarded.
Arithmetic	546	431	430	404	36	57	222	89
* Metrical System	30	56	..	..	..	..	..	..
Book-keeping	295	254	265	290	95	102	80	13
* Mensuration	74	48	..	..	..	..	..	..
Floriculture	5	6	9	6	4	2	..	..
Fruit and Vegetable Culture ..	6	7	10	7	4	2	..	1
* Domestic Economy	29	13	..	..	..	..	..	..
Political Economy	31	23	28	34	7	15	9	3
* Geography	103	91	..	..	..	..	..	..
English History	105	103	93	111	17	32	40	22
English Language	170	174	183	162	24	40	68	30
Logic	23	30	21	8	1	2	3	2
* Latin	21	16	..	..	..	..	..	..
French	175	213	177	227	17	21	107	82
German	30	60	41	61	24	11	13	13
Italian	3	3	2	4	1	..	2	1
Spanish	19	6	9	26	15	7	3	1
Theory of Music..	87	109	93	112	40	36	26	10
* Elementary Musical Composition	59	46	..	..	..	..	..	..
Totals	1,811	1,689	1,359	1,452	285	327	573	267

* Examinations in these subjects have been discontinued.

class, a considerable proportion would have done better had they not ambitiously attempted to answer the questions intended only for those aspiring to first-class."

The Examiner in *Logic* says:—" I am sorry to say that there is a distinct falling off, not only in the number of candidates, but in the quantity and quality of the answers. Most of the candidates seem to have no notion how to apply their reading of logic to practical examples, without which power the knowledge of a few technical terms is of comparatively little value."

The Examiner in *French* says:—" I am on the whole much pleased with the papers. I am able to recommend for certificates no less than 145 candidates out of a total of 227. Seventeen candidates have secured a first-class certificate, including seven for Commercial Correspondence. Of the best I cannot speak too highly. Such papers would do credit to the highest form or division of any public school or college. The contrast, however, between those papers and the rejected ones is really too great. What makes it the more striking is the fact I thought it right to bring under your notice last year, viz., that both the bad and the good papers come in groups. This, I think, is a remarkable feature, which points to a great difference in the quality of the teaching that different localities are able to secure."

The Examiner in *German* says:—" It gives me great pleasure to be able to state that I consider the result of the last examination in German, on the whole, very satisfactory, both as regards the number of candidates and the quality of their work. Not less than sixty-one candidates presented themselves this time for the examination in German. Three of these have done both the papers for the Commercial and the Literary Examination; we may therefore consider the number of candidates as having quadrupled since the time when I was first honoured with the task of conducting the German examination. This increase evidently proves the great usefulness of the examination work carried on by the Society, and likewise that the new feature of Commercial Correspondence supplies an actual want in the educational system of this country. The answers of the candidates who took up the literary subjects were, in general, very satisfactory, and the total failures in German have for a long time not been so few as on the present occasion. Twenty-four candidates have very creditably passed first-class; eleven are entitled to a second-class, and thirteen to a third-class certificate. I cannot help, however, repeating the advice which I gave some time ago to intending candidates, viz., to make themselves first thoroughly well acquainted with the theory of German grammar, and to avoid as much as possible the so-called "practical methods," the phrases and expressions of which are not actually used in colloquial German, and the theoretical part of which is neither systematic nor founded on the principles of modern German grammar. As regards the result of the examination in German Commercial Correspondence, I have to state, that those candidates who were not successful in obtaining a certificate, chiefly failed from want of practice and a current knowledge of commercial phraseology. Nearly all of them have a very good chance of attaining their object in view, if they will properly apply themselves for another year to the practice of writing and copying off German commercial letters. At the same time, I cannot refrain from calling the attention of the successful candidates to the fact, that if they do not keep up a constant practice in German commercial correspondence, they will, after a short time, be quite incapable of filling the situation of a German correspondent. The certificate which they now receive only testifies to their present knowledge of the subject in question; but their future employers are sure to require of them, after a lapse of time, undeniable proofs

that they have not lost their qualification by want of practice."

The Examiner in *Spanish* says:—"Some of the candidates have acquitted themselves to my entire satisfaction. But the greater number, miscalculating their efficiency, have elected to come up for first-class without being properly qualified, thus throwing away the opportunity of obtaining a certificate in a lower class. This injudicious eagerness to pass in the highest class, when not warranted by their actual knowledge, has damaged the prospects of not a few of the candidates; and I fear that this will be the case with others in the future, unless they calculate better their strength, and are less self reliant than the present ones. Some others went even the length of answering the three classes, in none of which have they shown a practical acquaintance with the fundamental rules of the language."

The Examiner in *Writing* says:—"The papers this year manifest very considerable improvement. The specimens of bold, well-formed, legible writing, are more numerous, and the candidates to whom prizes have been awarded have shown a sustained excellence through long papers. It may be repeated here that the advantage of a painstaking and correct formation of letters, a proper spacing between letters and words, and a general aspect in writing of extreme legibility, cannot be too strongly impressed upon the young. Rapidity will come later, as well as those little individualities of style partaking of the character of the writer, but it should be remembered that the first thing to do is to write a clear plain hand which can be read without the smallest difficulty."

The Examiner in the *Theory of Music* says:—"There is a slight increase this year in the number of papers worked, and a large increase in the number placed in the first-class. Some of the latter are of, I think, unprecedented excellence. Only ten of the whole number of candidates have 'not passed.'"

COMMITTEE ON THE MEANS OF PROTECTING THE METROPOLIS AGAINST CONFLAGRATION.

THE MEASURE FOR THE CONSTANT SUPPLY OF WATER AND THE PREVENTION OF FIRES IN THE METROPOLIS.

The scheme and principles enclosed in Colonel Beresford's Bill, for the constant supply of water and for the better prevention of the spread of fires in the metropolis, have met with very general acceptance. Only alterations in detail have been officially proposed to it. The acceptance expressed to the committee by the shareholders of the companies has been so wide as to lead to the belief that, if it were left to their determination, it would be carried by the assent of a majority. It received also the assent, unofficially, of such a number of directors as well as of the officers of the companies, as to warrant an expectation that it might pass without serious opposition. At a meeting of the directorates, however, it was determined to oppose the Bill—not on the merits, but on the standing orders—and a petition to that effect was presented, with the result of staying the progress of the Bill for this session. The avowed ground of the opposition was, that the terms of compensation proposed were insufficient. It was fully recognised that the days of the system of supply by the separate trading companies were numbered. But it was represented that by delay the incomes of the companies and their dividends might be improved, and the compensations to which they consider themselves entitled augmented.

The committee have received the expressions of competent opinions that in this respect the directorates will be deceived, that is to say, if they put their works as promised in a condition to meet fully the constant supply, they must necessarily incur an amount of extra expense to the shareholders, which will frustrate the expectation of any material increase of their dividends.

Meanwhile, as consequences of the delay for the future, as it has been for the past, there will be continued vitiation of the qualities of the supplies, by the methods of delivery, especially to the poorer classes; continued destruction of property and of life, to the extent of three-fourths of that which is of regular occurrence; and continued waste of water and of establishment charges, which, if stayed, would serve as the means of obtaining sanitary improvements of a high order.

Occupiers of the higher class in the metropolis, who derive their water from covered cisterns, can have no conception of the bad condition of the supplies of the poorest classes. The following extract from a report to the Shoreditch Vestry by Dr. Sutton, illustrates this:—

"Any one acquainted with the houses of Shoreditch—especially those of the poorer classes—can hardly have failed to notice that the present intermittent supply, necessitating as it does the keeping of the water in butts and cisterns, which are generally found unclean, is unsuitable, and the inhabitants, in consequence, are supplied with unwholesome water.

"The cisterns are usually found in a cleaner condition than the butts, but many of them are so coated with dirt that their internal surface can with difficulty be seen; comparatively few of these cisterns are properly covered, and they are situated either near the sink or dust-bin, or, still more commonly, on the top of the water closet. There is generally a pipe extending from these cisterns to the closet pan, and it supplies the closet with water; and another pipe from the cistern supplies water for drinking and other purposes. Not only is the water in these cisterns liable to be fouled by dirt and by the absorption of impure air, but it is well recognised that this communication between the cistern and closet is attendant with danger, for sewage gases may ascend up the pipe and pollute the water.

"In the smaller premises—and these form a large portion of the parish—the water is for the most part stored in butts, which are generally found dirty, and very many of them are totally unfit for persons to drink out of. The inner surface I have generally found covered with a dirty brown or green slimy substance, and in not a few, slimy vegetable matter, inches long, growing from the side and bottom of the butts, and floating in the water. And frequently the bottom of the butt is covered with dirt, pieces of broken bricks, broken pots, old tin cans, pieces of tobacco pipes, and such like substances. Many of these water butts are very small, holding only about thirty to fifty gallons of water, which quantity is the total daily supply for two, or even three families. Some of these butts have no taps, and the only way by which the water can be withdrawn is by dipping a pail, which is often dirty, into the water itself. Further, these butts are nearly always found uncovered, or very badly covered, situated near a sink, and either close to or within a few feet of the uncovered dust-bins. The result is, the water is liable to be fouled by matters carried to the sink, by sewage gases escaping from the sink, and the wind blows the dust on the water; and I have seen again and again the water covered with dust. Moreover, these butts are frequently situated in small, close, confined yards, and the water, exposed as it is, must absorb, in greater or less quantity, this smoky air. These butts are rarely painted—even in their best form they are pitched inside, and very often their exterior is much decayed, and almost black with smoke and dirt. Observing all this it is evident that the water in such premises is presented to the inhabitants in an offensive and unwholesome form. Far from these persons being induced to drink water, the repulsive state of their receptacles must tend to make them avoid it, hence they must almost of necessity become habitually prejudiced against an article which,

in some form or other, is not only essential for health, but it is one of the largest and most important ingredients of man's food.

"Seeing the condition of these water receptacles, it excites no surprise when it is said that many of the labouring and other classes drink little or no water. One can readily understand that they would drink anything rather than the water from these dirty butts and defective cisterns; and a faulty water supply probably, indirectly, causes much more injury than is at first sight suspected. Those who are anxiously endeavouring to prevent injurious drinking, perhaps, do not sufficiently estimate the effects of this and other conditions; and in trying to remove that evil, they over-estimate the value and effects of mere prohibition, and they do not adequately bear in mind that this destructive habit cannot be cured until the conditions are removed, which directly or indirectly are incentives to, if they do not actually necessitate, deleterious drinking.

"I am led to make these remarks whilst reflecting on the very large part that water occupies in man's system. Everyone knows that in some form or other it is indispensable, but comparatively few are aware how immensely man is dependant on water alone. To be convinced of this it is only necessary to know that even the solid textures of the body contain only about one-fourth solid matter—the rest is water; and four-fifths of the nutritive fluid, the blood, is water.

"Whenever the constant supply be introduced, the owners of houses must of necessity incur more or less expense; but in making alterations which give increased comfort and promote health, they are raising the value of their property. Moreover, after the first outlay, the cost of maintaining the supply will be less with the constant than with the intermittent system. The owners of small tenements will probably be not a little inconvenienced by the cost at the outset, but afterwards they will be especially benefitted, for they are now responsible for the unclean state of their butts, and they are repeatedly, to their great annoyance, required to have their butts cleansed, re-pitched, and not unfrequently renewed, which recurring expense will not occur with constant supply."

It is to be repeated, that all these expenses and incumbrances, which have been aggravated to prevent the change of system, have been removed by the legislation and administration proposed in Colonel Beresford's Bill.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

The Indian Court at the International Exhibition is now ready, and was opened to the public on Saturday last. It is under the direction of Dr. Forbes Watson, Dr. Birdwood, and Lieutenant Royle. The purchases and work of collecting have been done in India by Mr. Rivett-Carnac, secretary to the Indian Committee, assisted by a number of local secretaries, amongst whom the services of Lord Ralph Kerr have been very valuable. It is, properly speaking, a fine arts court which has been now added to the exhibition, the fine arts being a sufficiently elastic class to allow of the display of Indian carpets, shawls, metal work, jewellery, silk and cotton fabrics, and other Indian art manufactures. The general appearance of the court is at once gorgeous and tasteful. The walls are hung with magnificent carpets, the best of which are exhibited by Messrs. Farmer and Rogers, Messrs. Watson and Bontor, and Mr. Vincent Robinson. The side court of the latter represents with fidelity of detail and rich general effect an Egyptian house, with reception-room handsomely fitted in Oriental style. The same exhibitor has a Malabar carpet, conspicuous by its bold design and harmonious colours. Messrs. H. S. King and Co., the publishers, have, as usual, a side court, which may be termed the intelligence department of the section, it being supplied with books, pictures, newspapers, and maps, illustrating the geographical, commercial, and political features of the country. In other parts of the court may be seen the embroideries of Delhi, Scinde, and Kutch; the muslins of Dacca, a trophy case of native saddlery, specimens of native bookbinding, models of native houses, collections of arms, a rich case of metal work (including the silver work of Lucknow, Cashmere, and Kutchboog), choice ware, Scinde pottery, ivory and pith ornaments, and a collection of lace made by natives. In a future number of the *Journal* it is intended to give a more detailed account of this court, as well as of the other two annexes devoted to the exhibits from France and Queensland.

EXHIBITIONS.

YORKSHIRE EXHIBITION OF ARTS AND MANUFACTURES.

In 1837, the Committee of the Leeds Mechanics' Institution organised an exhibition of an attractive character, and realised a profit of one thousand pounds. Since that period, Yorkshire has had many similar exhibitions in various towns; in almost every case there has been a handsome surplus, and the exceptions were caused by conditions that ought not to have existed.

After long consideration the Committee of the Leeds Mechanics' Institution and Literary Society and Schools of Art and Science have resolved to accede to a generally expressed wish, that they should organise a Yorkshire Exhibition of Arts and Manufactures, to be opened in Leeds, on the first day of May, 1875. Alderman Marsden, the Mayor of Leeds, presided at the first meeting of the Committee of Management held in the Council-room of the Directors of the Leeds Mechanics' Institute, on Monday evening, when the general principles upon which the exhibition is to be organised and the rules for its management were agreed upon. The object of the exhibition will be to promote the Fine Arts and Art and Science as applied to Manufactures, and the surplus funds will be applied to the liquidation of the debt now remaining on the Leeds Mechanics' Institute.

Subject to the necessary limitation of space, all persons, whether designers, inventors, manufactures, or producers of articles, will be allowed to exhibit, but they must distinctly state the character in which they do so. Prices may be affixed to the articles exhibited, and sales effected, but articles once deposited in the building will not be permitted to be removed without written permission from the Building and Space Committee, which will not be given except in exceptional cases, before the close of the exhibition.

The classification of the exhibition will be as follows:—

Department 1.—Arts and Manufactures.—Substances used for food. Animal and vegetable substance used in manufactures. Chemical substances and products, and pharmaceutical processes. Minerals, metals, and their compounds. Civil engineering, architectural, and building contrivances. Machines and tools employed in various manufactures. General machinery. Process of manufactures. Machinery in motion. Carriages. Sanitary appliances. Philosophical instruments, and processes depending on their use. Horological instruments. Musical instruments. Works in precious metals and their imitations, and Jewellery. Fabrics. Clothing. Fur, feathers, and hair. Artificial flowers. Furniture, paper-hanging, and decora-

tion. Iron and general hardware. Glass and pottery. Stationery, printing, and bookbinding. Educational works and appliances. Geological and botanical illustrations. Miscellaneous.

Department II.—Fine Arts.—Paintings in oil and water colours, and drawings. Sculptures, models, die sinking, and intaglios. Etchings and engravings. Antiquities. Photography.

In addition to the Exhibition of Arts and Manufactures, a Fancy Fair will be held in the Albert-hall. Stall-holders will be charged rent for their stalls, and will be at liberty to deliver to purchasers any article sold therefrom.

In order to secure the confidence of exhibitors, and to provide against a possible, but not probable, deficiency, the General Committee of Management will raise, immediately, a guarantee fund of not less than ten thousand pounds. It has also been thought advisable, in order to meet the wishes of gentlemen who do not approve of becoming guarantors, but who desire to aid important public objects, to organise a special donation fund. Donations to the fund will be placed to a separate account, and kept distinct from the exhibition accounts. In the case of a deficiency, one-half of this fund will be applied to its liquidation.

The Committee of Management will at once receive applications from intending exhibitors, and as several manufactures have announced their intention to prepare special articles for the exhibition, it is important that no delay should occur in the arrangements, so that disappointment may not arise on the ground of want of space.

At the close of the exhibition, it is intended to hold a bazaar on a more extended scale than any yet attempted, and to introduce therein novelties of an unusual kind.

SANITARY AND EDUCATIONAL EXHIBITION.

The third exhibition of sanitary, educational, and domestic appliances in connection with the Social Science Congress will take place from the 30th of September to the 10th of October next, in the Drill-hall, Burnbank, Glasgow. The success which attended the two previous exhibitions, namely, at Leeds, in 1871, and Norwich, last year, encourages the Managing Committee to look forward to a very large and valuable display of scientific and useful appliances coming within the range of its operations.

The object of the exhibition is to bring under the notice of the public generally, and particularly those who are interested in social, sanitary, and educational questions, the latest scientific appliances for improving the public health and promoting education. These will be classified as follows:—

1. Warming, ventilating, and lighting, which will comprise grates, stoves, flues, furnaces, boilers, hot air and water processes of warming, systems of ventilation, lamps, gaseliers, jets, reflectors, &c.

2. Cooking and domestic appliances and economic apparatus, to consist of stoves, ranges, and ovens (heated with gas or otherwise), for roasting, baking, or boiling, &c., food manufacturing machines, culinary utensils, and articles of domestic utility and household economy.

3. Sanitary architecture and appliances, for outward and interior ornamentation, including lavatories, baths, closets, filters, fountains, ornamental bricks, tiles, cements, concretes, slag, stoneware, and clayware.

4. Sanitary engineering and disinfectants for all things connected with the supply of water, drain-pipes, tubes, sinks, taps, traps, troughs, closets, urinals, filters, sewage and drainage contrivances, disinfectants, deodorants, antiseptics, &c.

5. Food and clothing, specimens of food and confectionery of all descriptions, condensed fluids, preserved meats, fruits, vegetables, and other articles of general consumption, beverages, and specimens of adulteration in various forms. Articles of dress and clothing, bedding for tents and hospitals, belts, and other mechanical contrivances for protection of life at sea.

6. School furniture and educational apparatus, comprising models and plans of school buildings, school desks and furniture, gymnastics, maps, drawings, books, and other articles used in teaching.

These classes are intended to contain all sorts of utensils and appliances appertaining to the advancement of sanitary science, the improvement of health, and the promotion of education.

The management of the exhibition, as heretofore, will be under the superintendence of a committee. A small charge will be made for space and admission, to cover the costs of making the necessary arrangements and defraying the working expenses, and the whole will be undertaken subject to certain regulations and conditions.

ENTOMOLOGICAL EXHIBITION AT PARIS.

A singular exhibition, says the *Academy*, is to be given in the Palais d'Industrie, at Paris, from September 15 to October 11, under the auspices of the Société Centrale d'Agriculture et d'Insectologie, of all the useful insects and their products, and of the noxious insects and the depredations they commit. This is the fourth exhibition of the kind, the last having been held in 1872 in the Luxembourg Gardens. The first division consists of useful insects arranged in six classes: each species should be shown in its several stages of egg, larva, chrysalis, and the perfect insect. First among these are the silk-producing insects, then those producing honey and wax, among which are the honey-bearing ants, of which one species has been long known in Mexico, and its honey utilised. Next follow the insects yielding colouring matter—cochineal, gall, &c. The fourth class comprises the edible insects: the water-bug (*Notonecta* and *Corisa*), whose eggs are converted into bread, and under the name of "haulté" sold in the markets of the cities of Mexico, and particularly in the capital, where the eggs are gathered from aquatic insects found in the lakes, more especially in that of Tezcuco; then follow the grugu worm, or eatable caterpillar of the cabbage palm; the locusts of America and Australia, crickets and grasshoppers, white ants (termites), the eatable spiders (*Epeira edulis*) of Polynesia, &c. The fifth class comprises the insects used in medicine, cantharides, &c.; the sixth, those used as ornaments, as the phosphorescent insects, beetles, &c. The second division (the noxious insects) include those that are injurious to the cerealia, the vine, oleaginous plants, textiles, medicinal and ornamental plants; those hurtful to forest trees and to building timber, which destroy wool, horsehair, and feathers; parasitic insects, &c. The exhibition promises to be one of great interest, and likely to be productive of useful results.

Philadelphia Exhibition.—The correspondent of the *Times* writes that "Congress has at length passed the resolution authorising the President to invite foreign nations to the Centennial International Exposition. Originally passed by the House, it lay in the Senate for months, and finally, on the 27th inst., that body passed it with a proviso that the United States should be under no 'liability for the expense.' This economical amendment the House will concur in and the long struggle in Congress be ended. The General Government will not invest any money in this enterprise, though many Philadelphians still cling to the hope that it may. Work in preparing the ground for the buildings at Fairmount-park is going on energetically, and we will have an attractive exposition on the money already subscribed, whether Congress helps or not."

EGYPTIAN COTTON.

A deputation representing the spinners of this cotton in Lancashire, introduced by several members of Parliament, waited on Lord Derby, at the Foreign Office, on the afternoon of Thursday, the 11th inst. The object of the deputation was to obtain his Lordship's assistance in forwarding a memorial to the Khedive of Egypt relative to the cultivation of cotton in that country. The memorial pointed out that for some years the quality of the Egyptian cotton crop had been gradually deteriorating; it is now irregular in length, and is mixed with white and short cotton, which materially diminishes its value. The memorialists attribute this change in the quality of the cotton to the fact that very little care is taken as to the kind of seed sown. The large ginning factories, where cotton of different qualities is ginned, supply the seed, which is sown without sufficient care being taken to separate the good from the bad. This system, they maintain, is very injurious to the interests of every one, and they submit to the Khedive the necessity of adopting measures to counteract this evil. As a remedy they suggest that the cotton be supplied by the Egyptian Government, and that the ginning factories be forbidden to sell the seed for agricultural purposes. The memorial reverts further on to the subject of deterioration, which is said to date from the period when an attempt was made to cultivate American cotton. In conclusion, attention was drawn to the necessity of carefully examining the quality of the seed before it is sown. The views expressed in the memorial were supported by Messrs. Hugh Birley, M.P., W. R. Callender, M.P., and C. L. Clare (Manchester), &c. At the termination of the conversation which ensued, Lord Derby suggested that they should write him a letter detailing the extent to which the memorialists were interested in the matter; meanwhile the memorial could be left.

CORRESPONDENCE.

THE PATENT LAWS.

Sir,—It appears to be the fashion of the present day with certain people to agitate for the abolition of the patent laws. The objections urged against their utility are generally conspicuously impracticable, but I have seldom met with more groundless objections than those enumerated by your correspondent, Mr. H. W. Reveley, in the last issue of your *Journal*.

He states that no attempt was made by Mr. Weldon to prove that patent law rights "offer the slightest advantage to consumers," but I fail to see by what course of reasoning he arrives at that conclusion. No one can possibly deny that inventions are beneficial to the whole community. The question in dispute, therefore, is whether inventions are encouraged and developed by a patent law; and on this head Mr. Weldon certainly made a very decided attempt at proof, as admitted even by your correspondent.

He next alludes to the "fact" that "our patent laws in their present form must inevitably be a lottery, because the value of a new invention cannot be ascertained until its merits are proved by public approval and a verdict passed in its favour." Granted that the latter assertion is true, then, instead of its being an argument against the utility of our patent laws, it is a powerful one in their favour, for is it not the special province of those laws to encourage inventions and facilitate their development by giving the inventor a "temporary property in his ideas, and thus enabling him to tempt the capitalist to supply him with the means of carrying them into practice, thus obtaining the public approval?"

Mr. Reveley says, that "ninety-nine out of one hundred patents sealed do not pay their expenses." This estimate of successful inventions I know from my own personal experience to be greatly below the true proportion, but however this may be, it is exceedingly unlikely that the useless inventions would have been more successful without the patent laws, whilst the success of the one, representing a distinct advantage to the whole community, may be owing entirely to the operation of those laws, as, for example, the case instanced by Mr. Weldon.

Your correspondent next combats the imaginary assertion that our patent system is the "sole" cause and promoter of invention, urging that it is "a mere idle fancy." Well he may do so, for most certainly it must have originated with himself. No one in his senses would assert that without a patent law there would be no invention. It is contended solely that the patent laws tend largely to stimulate invention by holding out an inducement, and to the ready and thorough development of invention by placing inventors in a position to tempt capitalists to their aid.

Whatever may be the defects of our system of patent laws (and undoubtedly they are many), there are other ways of improving those laws than the system displayed by your correspondent only to be by him set down as impossible, though (as he is apparently unaware) that system is even now in practical use abroad,—in Prussia for example. Time and experience will disclose the real defects (if not already known to the initiated), as also the remedies to be applied; but there can hardly be a doubt that on the whole the operation of the patent laws is highly beneficial to the community at large. What the defects are, and what the remedies to be applied, I will not trespass on your space by discussing here.

The last paragraph of your correspondent's letter I leave to others to deal with.—I am, &c.,

John W. Gray.

16, Southampton-buildings, W.C., June 11, 1874.

ANTIQUITIES OF CAMBODIA.

Sir,—Under the above title, Mr. H. Epps has endeavoured to discourage the work of eminent archæologists regarding the antiquities of America. One of the false assumptions in his communication is that the present Indians are the direct descendants of the highly civilised Mexicans and Peruvians about whom so much has been said by Prescott and others, in total ignorance of the true ethnic relationship of the present people of Peru and Mexico with the ancient pre-Columbian inhabitants. Seeing that there are thousands of mounds yet to be explored, countless legends to be recorded, and oral traditions to be correlated, it does seem passing strange to assert that the Americans (?) had no knowledge of navigation. Is Mr. Epps aware of the cyclopean remains of Mitla, the accurately made forts all over North America at least, the due observance of zodiacal measurements (multiples of twelve) in the construction of many of the pre-historic forts? Surely a knowledge of astronomy on land ought to lead us to the hypothesis that nautical astronomy, or a means of navigating by the sun, moon, and stars, was known to the people who lived in the era in which these extraordinary structures were raised. As regards the Sumerian hypothesis mooted by Mr. Hyde Clarke, it requires the careful study of those who have made a speciality of American and Asiatic archæology before discarding it. I believe from what knowledge I have gleaned from a careful study of the antiquities of America, that my friend Mr. Hyde Clarke has discovered something worth attention, and would be extremely glad to know what the Rev. A. H. Joyce has to say about the true position of Akkad. I do not think it is really necessary to premise the monogenistic theory of mankind, in considering the recondite questions of archæology, but if it should be found to be correct, and the discovery lighted upon collaterally

in the research, then we might continue the work relieved of one incumbrance,—the dreaded incursions of the outraged orthodoxy of the non-students in society. Primitive culture is now becoming the adopted child of men of science, and well may they be proud of their choice; and by your excellent Society encouraging them in their work, true knowledge will be acquired, and mere empiricism discarded. It will, however, be many years ere we shall fully understand the whole of the problem presented to us in America.—I am, &c., J. Jeremiah, Jun.

2, Fife-villas, Kingston-on-Thames,
June 12, 1874.

GENERAL NOTES.

French Colonial Products.—The French colonial products lately in the Vienna Exhibition have been placed with those of Algeria in a wing of the Palais d'Industrie, and a report on them has just been issued by the Marine and Colonial Office. From a perusal of this publication, it appears that sugar, cocoa, coffee, vanilla, obony, sandal-wood, and gums, rank among the chief exports. Particular attention has been paid to the production of vanilla in the island of Réunion, and since the exhibition of 1867 the price has risen from 32 to 200 francs per kilogramme. Black tea also bids fair to thrive there, as some specimens sent by M. de Chateauvieux, a proprietor in the island, to the Vienna Exhibition, were ranked as equal to the finer sorts of Chinese. Ebony, which fetches no less than 250 francs per cubic mètre, abounds in some of the French colonies; and a substitute for boxwood for engraving purposes, which is getting scarcer and scarcer every day, has, it is said, been just discovered. These and other products will find a place in the forthcoming exhibition of foreign produce which will be held in connection with the approaching Paris Geographical Congress.

Peruvian Guano.—Commander Cookson, of H.M.S. *Petrel*, has lately furnished the Admiralty with a somewhat remarkable report on the guano deposits of Peru. He estimates the entire quantity in the districts which he visited, viz., Huanillos, Punta de Lobos, and Pabellon de Pica, at 7,400,000 tons. The question of how long a time was taken to form these enormous deposits is a very interesting one, and very difficult to solve. No doubt sea-lions and seals have contributed largely to many of them, as in working the guano a great quantity of bones of seals are found, but the deposits of "white guano" are formed solely by birds. From information gathered by Commander Cookson, he is disposed to think that these deposits have not necessarily taken the enormous period of years in being formed which is commonly supposed. A native resident at Pabellon de Pica for more than forty years told him that when he first came there the whole promontory was covered with birds in countless numbers; but that about twenty-six years ago a plague visited them, and they died literally by millions. Since that time they have almost disappeared from the locality; they were chiefly pelicans, gannet, and a species of tern. It is a common remark on the coast that all birds are rapidly becoming scarce.

Coffee in Ceylon.—A correspondent of the *London and China Telegraph*, writing from Kandy (Ceylon), says:—"The changes that have taken place in the matter of coffee cultivation within the last three years are simply marvellous. New districts, formerly despised, have risen up like magic. Whole country sides of primæval forest have given way to the axe of the cultivator, and districts whose only inhabitants were the elephants, the chetah, and the elk, are now flourishing plantations of coffee." The writer observes that the leaf disease, for which no cure has been discovered, has been very troublesome. "It is a fungus that attaches itself like a miniature mushroom to the lower side of the leaf of the coffee tree, and appears to extract its vitality, for the leaf withers and dies. It has now been among us for four years, and has done an incalculable amount of mischief." The long drought which has had such a disastrous effect in India, has also unfavourably affected the Ceylon coffee crop this year.

British Museum.—A return to an order of the House of Commons for "Abstracts of Accounts expended on the British Museum up to the 31st day of March, 1873," and the number of visitors in each year, continuative of former returns, 1847, 1860, and 1863, has been issued. From this, it appears that the total cost of maintaining the Museum since its foundation in 1753, to March 31, 1873, has been £3,452,863 8s. 9d. Also the amount expended for purchases in each department (1863-4 to 1872-3), with the total of each year is given. The total for the period in question is £334,197 11s. 6d. The same since the foundation of the Museum, as above, is £991,343 16s. 11d.

West of England College.—It is proposed to establish a College for the study of Science, Languages, and Literature with a view of providing for the special requirements of the West of England and South Wales. Its principal purpose will be to give advanced instruction to those who are anxious to continue their studies after their usual school age. Two Oxford Colleges, Balliol and New, have resolved to contribute the weight of their influence and name, and subscribe £300 a year each for five years, merely stipulating that the claims of liberal education of all kinds be duly considered, and that they themselves share in the management. The central position of Bristol makes this city the natural site for such a college; and the authorities of the local Museum, and of the Bristol Library, which has lately been united with it, have expressed a willingness to associate the proposed college with their institution. Another local source of strength is the promised co-operation of the Bristol Medical School, the faculty of which, having formed the design of erecting new buildings, are ready to unite in a joint undertaking.

Cotton Supply.—A correspondent of the *Manchester Guardian*, having estimated the whole supply of cotton in Europe during 1874 at 5,450,000 bales (2,850,000 American, 1,300,000 East Indian, and 1,300,000 other kinds), proceeds to calculate the number of bales in the ports of Great Britain at the end of this year. After deduction from the whole supply (5,450,000) the amount indispensable for the Continent, 2,418,000 bales, there remains for Great Britain, according to this authority, 3,032,000, to which, adding the stock of 1st of January, 778,000, our supply is raised to 3,810,000 bales, equal to 73,200 weekly, our actual consumption being estimated at 64,000. The customary increase later on in the consumption of our light bales of cotton, with the usual decrease in American, will raise the number of bales to 65,000, and bring us to the 64,500 average of the year required to give an estimate of 111,000 bales weekly as the total consumption of Europe during 1874. But the total supply of Great Britain being equal to a weekly average of 73,200 bales, and the consumption to only 64,500 per week, there is an excess of 8,700, which will give a stock of 452,000 bales in the ports of Great Britain at the end of this year, against the 778,000 at the end of 1873; assuming that the trade hold no more than they did at the end of last year.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Mon. ...Royal United Service Institution, Whitehall-yard, 8½ p.m., Mr. J. K. Laughton, "The Scientific Study of Naval History."
Asiatic, 22, Albemarle-street, W., 3 p.m.

Tues. ...Royal Society for the Prevention of Cruelty to Animals, 10 a.m. (At the House of the Society of Arts.)
Anthropological Institution, 4, St. Martin's-place, W.C. 1. Mr. Robert Dunn, "Ethnic Psychology." 2. Mr. Rooke Pennington, "Relative Ages of Cremation and Contracted Burial in Derbyshire in the Neolithic and Bronze Ages." 3. Miss A. W. Buckland, "Mythological Birds Ethnologically considered"

Wed... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 4 p.m. Annual General Meeting.
Geological, Burlington House, W.C., 8 p.m.
Royal Society Literature, 4 St. Martin's-place, W.C., 8 p.m. Mr. W. S. W. Vaux, "On the Commerce of Ancient Rome with the East."

Thur....Antiquaries, Somerset House, W.C., 8½ p.m.
Association of Diocesan Inspectors, 11. (At the House of the Society of Arts.)
Royal Society Club, Willis's Rooms, St. James's, S.W. 6½ p.m. Annual Meeting.

Fri.......Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m. Prof. Bentley, "On the Reproductive Organs of Plants."
Quekett Club, University College, W.C., 8 p.m.
New Shakspere Society, University College, W.C., 8 p.m. Rev. F. G. Fleay, "On the Authorship of the Three Parts of 'King Henry the Sixth.'"

Sat......Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

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FRIDAY, JUNE 26, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ECONOMICAL USE OF FUEL.

A meeting of this Committee was held at the Testing Houses, Western Annexe, International Exhibition, on Saturday, 20th inst. Present—Capt. D. Galton, C.B. (in the chair), Dr. Mann, and Major Webber, R.E., with Mr. S. W. Davies.

REVOLUTION INDICATOR.

A meeting of this Committee was held on Saturday, the 20th inst. Present—Major-General F. Eardley-Wilmot, R.A., F.R.S. (in the chair), Mr. T. Brown, Mr. W. Froude, F.R.S., Capt. E. P. Nisbet, Mr. J. R. Ravenhill, Vice-Admiral A. P. Ryder, and Mr. Seymour Teulon.

PROCEEDINGS OF THE SOCIETY.

ANNUAL GENERAL MEETING.

The Annual General Meeting, for receiving the report from the Council and the Treasurers' Statement of Receipts, Payments, and Expenditure during the past year, and also for the Election of Officers, was held, in accordance with the Bye-laws, on Wednesday last, the 24th of June, at four p.m., Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman of the Council, in the Chair.

The Secretary having read the notice convening the meeting, the minutes of the last Annual General Meeting, and of the subsequent Special General Meeting, were read and signed.

The Chairman then nominated Mr. William Botly and Mr. John Homersham as scrutineers, and declared the ballot open.

The Secretary then read the following

REPORT.

The following is the report of the Council, showing the action taken by the Society during the past session :—

Meetings and Lectures.

The Society has this year entered upon extended Sectional action, following the example set of the successful establishment of the Indian Section a few years since. If we consider the largely increasing numbers of the members of the Society, who include among them every variety of pursuits and interests, it becomes at once manifest that Sections which could take up special subjects connected with Arts, Manufactures, and Commerce, would be likely to attract to them the attention of those interested in each subject, and the Society would thus secure enlarged opportunities for promoting the objects for which it was founded. Looking at the interest which Africa is just now exciting, whether as regards our new relations with the West Coast, Sir Bartle Frere's mission to Zanzibar, the travels of Livingstone, or the Cape Colony, to whose progress so great an impulse has been given by the discovery of the Gold and Diamond Fields, the Council felt that the establishment of an African Section could not at the present time be otherwise than of great value.

Again, the important part which Chemistry now plays in so large a portion of our industries, and the number of persons who are interested in the science and its applications, induced the Council to form a Chemical Section. These three Sections, Indian, African, and Chemical, have been actively at work during the session. On the whole, including the Ordinary Meetings, Cantor and other lectures, and the Sectional Meetings, 63 evenings and one morning have been devoted to lectures and meetings.

Indian Section.

The Indian Section has met seven times, and papers of deep interest connected with the prosperity and condition of our Eastern dependency were read and discussed. Sir Bartle Frere opened the Section with a paper on the famine which now afflicts a portion of the Empire, and on more than one occasion this has formed the topic for discussion. Sir Bartle Frere's paper was a masterly exposition of the subject, dealing with it as an existing calamity and the best means for mitigating its severity; while Sir Arthur Cotton's no less important paper took up the question in another aspect, suggesting the practical means for the prevention and the recurrence of these visitations in the future. Sir Bartle Frere's paper was subsequently published in a separate volume. "Indian Art" and "The Races of Dardistan" formed the staple of discourses by Dr. Zerfi and Dr. Leitner respectively. Mr. Kennedy brought forward the interesting and novel subject of "The Ruins of Cambodia." Our Indian tea trade was also practically treated, by Dr. Campbell. Altogether the Section has continued to grow in interest as well as utility.

African Section.

This Section met six times, under the presidency of Vice-Admiral Ommanney, C.B., F.R.S., chairman of the African Committee, a committee on which the Council have been fortunate to secure the active services of the leading African merchants of the City of London, as well as others taking interest in that continent. The Section was inaugurated by a valuable opening address by

Sir Bartle Frere. Papers have been read, followed by discussions on several important African subjects. Mr. Swanzy entered largely into the question of the condition of the West African Trade, with and without British protection; while Dr. Mann read a Paper on the Diamond fields of South Africa, and the prospects of that colony generally were brought before the Section by Col. Gawler. By these and other discussions not only has public interest been maintained as to West, East, and South Africa, but new opportunities have been afforded for organisation and mutual co-operation.

Chemical Section.

This Section has also held six meetings, and at its opening meeting, Dr. Odling, F.R.S., President of the Chemical Society, who took the chair on that occasion, delivered an inaugural address on the importance of industrial chemistry. At these meetings, papers, also followed by discussions, were read on the "Paraffin Industry," "Anthracene and Alizarine," "Soda Manufacture," "Pyrites as a source of Sulphur, Copper, and Iron," "Sugar Refining," and "The Manufacture of Chlorine."

Wednesday Evening Meetings.

These meetings have been well attended, and papers of an interesting character on a variety of subjects have been brought before them and discussed. The report of these meetings, as well as of those of the various Sections above referred to, have been given in the Society's *Journal.*

Cantor Lectures.

Three courses have been delivered, the first, consisting of two lectures, by Mr. J. Norman Lockyer, F.R.S., "On Spectrum Analysis as aided by and aiding the Arts;" the second of seven, "On the Chemistry of Brewing," by Dr. Charles Graham, of University College, London; and the third of seven, "On Carbon and certain Compounds treated in reference to Heating and Illuminating Purposes," by Professor Barff. All these lectures were of a highly practical character, and the crowded audiences by which they were attended testify to the deep interest which they excited.

In addition to the foregoing lectures, a juvenile course, for the children of members, was given during the Christmas holidays, by Mr. Frank Buckland, M.A., H.M. Inspector of Salmon Fisheries. The course consisted of two lectures, "On the Structure and Habits of Beasts, Birds, and Fishes, as showing Beauty and Design." So great was the popularity of these lectures that the issue of tickets had to be restricted, and many were unable to gain admission. Subsequently, however, Mr. Buckland gave a further lecture, in continuation of the subject, at his Fish Museum at South Kensington, and in Easter week he gave a fourth lecture at the Brighton Aquarium, a special train having been provided by the Brighton Railway Company to take the members and their children there on that occasion. The Aquarium Company made admirable arrangements for the comfort and convenience of the party, which consisted of nearly four hundred persons. The members are greatly indebted to Mr. Buckland, not only for the first two lectures he was engaged to deliver, but for the two subsequent lectures he so liberally volunteered for the instruction and amusement of his juvenile audience.

National Training School for Music.

The progress made in this direction, and the action taken by the Society, have been from time to time brought before the members in the Council's reports to the Annual General meetings, and on the present occasion the Council may congratulate the members on the very substantial advance the project has made. It will be remembered that a Committee was appointed so long back as 1865, to inquire and report in reference to musical teaching at home and abroad. This Committee got together a large amount of information, and in their first and second report pointed out the importance of a national establishment where such training could be given, as is the case in nearly every country in Europe, and they laid down the broad general principles on which such an establishment should be founded in this country.

It appears from the evidence taken before the Committee that the Royal Academies of Music of Paris, Brussels and Naples furnish instances of highly successful institutions, on an extensive scale, and present specially useful suggestions. At Paris, above six hundred outdoor students, selected from all parts of France, are educated, and at Naples between two and three hundred students are trained. In both cases the education is gratuitous to the students, the expenses being paid by the State. At Brussels there are above 500 students, whose expenses are defrayed partly by the State and partly by the municipalities. The Committee were of opinion that a National Academy for the United Kingdom, its colonies and dependencies, should provide for the instrution of a certain number of students, supported by public funds; and as our colonies and India send many young persons to this country for general education, it might reasonably be expected that they would be induced to send persons having musical gifts for musical education, if the training were as efficient as it might be made. Looking at the support which foreign Musical Academies receive from their respective governments, the Committee considered that adequate Parliamentary funds, with ministerial responsibility for their expenditure, were essential to the establishment and maintenance of a National Academy of Music worthy of its object. They considered that a National Academy should afford gratuitous education to a limited number of persons having great musical gifts, who, after proper training at the public expense, would engage to devote their talents to the service of the public as professors of the art of music, and that the form in which Parliamentary assistance could be best afforded would be by scholarships, which should be held by candidates who, in open competition, had proved that they were endowed with the gift of musical ability. It is hoped that the Cathedrals and various corporations will aid in this direction by providing the means of sending young persons of musical genius from their respective localities to the Academy.

Although it appears from the reports of the Science and Art Department that the question of a State Training School was at one time under the consideration of the Lords of the Committee of

Council on Education—Earl Granville being then Lord President—the Department of Science and Art up to this time has not taken any active steps towards its establishment. The Council therefore decided to take the initiative, and establish a training school by voluntary effort, with the full intention that it should, and under the confident hope that it will, eventually, be transferred to the responsible management of the State. The fundamental principal and the primary object of the school is the cultivation of the highest musical aptitude in the country, in whatever station of society it may be found. In order to carry out this principle to the fullest extent, admission to the school will be obtained by competitive examination alone. As the gift of musical ability is found in all grades of society, and frequently among persons of very limited means, it is evident that in a large number of cases the student must not only receive gratuitous instruction, but also be supported during the period of his or her training. To provide for this it is proposed to establish at least 300 scholarships, for which the most influential support has already been promised, and further support is solicited.

The proposed scholarships will be of two kinds, the one to afford free instruction by paying the students' fees, the other to give such free instruction with a maintenance allowance in addition. It will be open to any county, town, public body, or private individual to establish one or other of these kinds of scholarships for competition under given limitations. Should there be more accommodation in the school than is requisite for the instruction of these scholars, students paying their own fees will be admitted by competition to fill the vacancies, care being taken that they show sufficient aptitude. The school fee without maintenance, it is estimated, will be between £35 and £40 a year. The maintenance allowance for the support of the scholar will be in addition to this fee, and independent of the school. Such a training school as now commenced, on the basis of free instruction given by public competition, occupies a field of action wholly distinct from that of any existing institution. The Royal Commissioners for the Exhibition of 1851 have granted a plot of ground immediately adjoining the Albert Hall for a building to supply suites of practising and lecture-rooms, and have granted a lease of the same to Mr. C. J. Freake, a member of the Council, who has munificently undertaken, at his own cost and risk, to erect the necessary buildings thereon, and to offer them for the free use of the school for five years.

The first stone of the building was laid on the 18th December, 1873, by H.R.H. the Duke of Edinburgh, K.G., Chairman of the Committee of Management of the School. The Council of the Royal Albert Hall have devoted certain rooms, including a lecture theatre, to the use of the school at a nominal rental. This assistance is estimated to be worth about £1,000 a year. The Royal Albert Hall supplies unrivalled accommodation for any large audiences in connection with the training school. It is therefore contemplated to connect the building with the Albert Hall, by means of a bridge, and to have an arcade from the Kensington-road, giving a passage under cover to the school. The new building, divided into 20 class-rooms, professors' rooms, and offices, has been designed expressly to meet the requirements of the school. The design has been made and presented by Lieut. H. H. Cole, R.E., and is in the English style of the early sixteenth century. It will, as already mentioned, have the use of the great amphitheatre and of an adjacent moderate sized theatre; it will have libraries and professors' rooms, and a number of small rooms for instruction. During the construction of the building the Society will continue to enlist public support for scholarships. The success which has hitherto attended the efforts of the Society gives promise that the nation will support the Society in this movement. The erection of the building and government of the school itself is under a Committee of Management consisting of two members appointed by the Royal Commissioners for the Exhibition of 1851, two members appointed by the Council of the Royal Albert Hall, and three members appointed by the Council of the Society of Arts; at present the Committee thus formed consists of H.R.H. the Duke of Edinburgh, K.G., Chairman, H.R.H. the Prince Christian, K.G., Admiral the Right Hon. Lord Clarence Paget, K.C.B., Sir William Anderson, K.C.B., Major-General Eardley-Wilmot, R.A., F.R.S. (or the Chairman of Council of the Society of Arts for the time being), Mr. Henry Cole, C.B., and Major Donnelly, R.E. His Royal Highness the Duke of Edinburgh, on the evening of the 18th December, on the occasion of the Conversazione at the Royal Albert Hall, announced that H.M. the Queen, H.R.H. the Prince of Wales, and himself were each prepared to found a free scholarship in the school. During the erection of the building the Society hopes to obtain public support sufficient to establish 300 free scholarships for a period of five years.

A considerable amount of support, in the way of subscriptions, in aid of the foundation of free sholarships, has already been promised. Manchester has been visited, and has formed an influential committee. A deputation from the Council, accompanied by Mr. Lionel Benson, to whom this business has been entrusted, visited Birmingham in the month of March last, and at a meeting of the inhabitants, presided over by the Mayor, brought the subject before them; and the Council have the pleasure of stating that the project was well received, and a subscription of £1,200 to provide five scholarships for five years was at once announced; while there is every reason to believe that this will be largely increased. The Council propose to send a deputation to other towns with the same object; and they have authorised a sum of £250, to be expended during the ensuing session, in promoting the foundation of scholarships. In addition to the scholarships promised by the Queen, the Prince of Wales, and the Duke of Edinburgh, the following may be named:—The Mercers' Company provide a scholarship of £50 yearly. The Fishmongers' Company two scholarships, each of the value of £25. Sir Titus Salt gives £1,000 for the endowment of a "Saltaire" scholarship, to be competed for by the Town of Bradford. The Duke of Westminster subscribes £15 a year, towards the scholarship fund, for Cheshire. Sir John Hawkshaw subscribes £25, for five years, for Sussex. Mr. Frank

Morrison subscribes £250 for a "Morrison" scholarship, in Inverness. Mr. Henry Arthur Hunt gives a donation of £100, towards a scholarship for girls. Mr. Minton Campbell, M.P., will provide a scholarship of £50 for five years, for the district of North Staffordshire.

It is desirable that about 300 free scholarships, of the value of £40 each a year, independent of the students' maintenance, should be founded during the next twelve months. They will be awarded by public competition. It is proposed that these scholarships, as a general rule, shall be held for five years, and that public support shall be obtained for at least five years, to enable the objects of the school to be fully developed. To enable all grades of society to assist, the lowest subscription proposed to be taken is five shillings a year, payable for five years. If convenient to the giver, it will save trouble if this subscription be paid in one sum.

It is hoped that the members generally will give their aid in their several localities to further this great national work.

Museums and Public Galleries.

During the year this subject has been under the consideration of the Council, with a view to extend the usefulness of such institutions in an educational point of view, and more particularly in the direction of technological instruction. A Committee, based on the following resolutions of the Council, was formed, which has received a very large amount of support from members of both Houses of the Legislature, Chairmen of Art and Science Schools throughout the country, and others.

All museums and galleries supported or subsidised by Parliament to be made conducive to the advancement of education and technical instruction to the fullest extent, and to extend their advantages to the promotion of original investigations and works in science and art.

To extend the benefits of national museums and galleries to local museums of science and art which may desire to be in connection, and to assist them with loans of objects.

To induce Parliament to grant sufficient funds to enable such objects to be systematically collected, especially in view of making such loans.

For carrying out these objects most efficiently, to cause all national museums and galleries to be placed under the authority of a Minister of the Crown, who should be a member of the Cabinet, with direct responsibility to Parliament, thereby rendering unnecessary, for the purposes of executive administration, all unpaid and irresponsible trustees, except those who are trustees under bequests or deeds, who might continue to have the full powers of their trusts, but should not be charged with the expenditure of Parliamentary votes.

To enter into correspondence with all existing local museums and the numerous schools of science and art, including music, now formed throughout the United Kingdom, and to publish suggestions for the establishment of local museums.

Also to cause the Public Libraries and Museums Act (18 and 19 Vic., c. lxx.) to be enlarged, in order to give local authorities increased powers of acting.

Under the auspices of this Committee, a public meeting was held in the Room of the Society, on Wednesday, the 20th of May, with the Right Hon. Lord Hampton in the chair. At this meeting the following resolutions were passed:—

Moved by Mr. J. Chamberlain, Mayor of Birmingham, seconded by Mr. Philip H. Rathbone, Chairman of the School of Art and Science, Liverpool—

"That in the opinion of this meeting all museums and alleries supported or subsidised by Parliament should be made conducive to the advancement of education and technical instruction to the fullest possible extent, and that special Parliamentary funds should be granted to assist local and provincial museums in the acquisition and loan of objects, and with building grants, and thus extend their usefulness."

Moved by Captain Starey, chairman of the Museums Committee, Nottingham, seconded by Dr. Barrington Chevallier, Mayor of Ipswich—

"That in the opinion of this meeting, all national museums and galleries should be placed under the authority of a Minister of the Crown, with direct responsibility to Parliament; thereby rendering unnecessary for the purposes of executive administration all unpaid and irresponsible trustees, except those who are trustees under bequests or deeds, who might continue to have the full powers of their trust, but should not be charged with the expenditure of money voted by Parliament."

At the request of the meeting, these resolutions were communicated to the Prime Minister by Lord Hampton. Mr. Lyon Playfair brought the subject before the House of Commons on the 15th inst. Many petitions have been presented to Parliament, and there is promise that, owing to the labours of the Society, improvements will be made in our public museums tending to connect them with public instruction.

A deputation from the Council waited on Lord Selborne when he was Lord Chancellor, to bring to his notice the condition of the Patent-office Museum. His lordship, as principal Commissioner of Patents, promised that the matter should receive attention, and Lord Cairns, who shortly afterwards became Chancellor, also concurred in the views expressed by his predecessor.

Committee on the Prevention of the Spread of Fires and the Constant Supply of Water to the Metropolis.

The calamitous fires at Chicago and Boston drew the attention of the Council to the condition of this metropolis in anticipation of a large fire taking place, and to the means at command for preventing its spread with the like disastrous consequences; and a committee was appointed by the Council to consider and report on the best means for rapidly extinguishing fires and for preventing spread of conflagrations in the metropolis. This Committee has elicited information from various sources, and has been fortunate in securing evidence from men having a large experience as regards the extinguishing fires, as well as on the subject of the better supply of water for the metropolis. The Committee have issued a report with the evidence appended, and they recommend that in order to obtain a ready and sufficient volume of water it is absolutely necessary that the supply should be constant and at high pressure, with hydrants at frequent intervals in the streets available by the ready application of hose to throw a jet of water for the extinguishing of a fire. They also urge that such constant and ready supply is only attainable by a consolidation of the eight several water companies now supplying the metropolis, and placing the whole under one public management.

The proceedings of the Committee have been fully given in the *Journal*. It is due to the Committee to state that it has bestowed considerable labour on the legislative and administrative questions involved in it, and that it has done so on expectations publicly held out that it would receive very serious and willing official attention.

There is reason to believe that this expectation will yet be realised in time for the next session of Parliament. The question of the constant supply of water under unity of management on a public footing for domestic consumption had been settled and prepared for legislation by Commission after Commission. But the large and distinct subject of the means of applying a constant supply of water for the prevention of fires had to be examined and based upon definite conclusions, for which a special Commission would have been needed. This work, however, was accomplished by the Committee, together with preparations for legislation, and a Bill embodying these principles in a practical form was brought into the House of Commons by Colonel Beresford, the member for Southwark, with the support of Sir Charles Russell, the member for Westminster, Mr. Forsyth, the member for Marylebone, and Mr. Ritchie, the member for the Tower Hamlets. It is apprehended that the occupation of the Local Government Board with the new and increasing functions charged upon it, and with which, as respects local works, it is known to be in arrears, would have prevented it making the requisite examinations for a complete measure without a considerable further delay. As already stated, the Bill in its main features has met with extensive acceptance. There was, indeed, reason to believe, from the terms of compensation proposed, that it would not be opposed by the companies, but it was unexpectedly and successfully opposed, not on the merits, but on the standing orders. It is believed, however, that the main ground of opposition was the alleged insufficiency of the terms of compensation offered, to which it is right to state that a number of shareholders had expressed assent. The measure, therefore, stands over until the next session. It is greatly to be regretted that a discussion was not obtained for it in the House of Commons, when the insufficiency of the grounds of opposition, and the strength of the support it has received, would have been displayed. The Council will not fail to press the matter forward, remembering the attention that has been generally acknowledged by impartial authorities to be due to it.

Encouragement of Thrift.

In December last a deputation from the Council waited on the Postmaster-General to urge the extension of facilities offered by the Post-office to encourage savings.

Among other points urged were the following:—

1. The opening of the Post-office Savings' Banks in the evening, particularly on Fridays and Saturdays.
2. The abolition of the restriction that whole shillings alone can be paid into Post-office Savings' Banks.
3. The reduction of the minimum deposit now fixed at one shilling.
4. The abolition of the following rules:—

(a) That no depositor may pay in more than £50 in any one year.

(b) That no depositor may have more than £150, exclusive of interest, in the Post-office Savings' Bank.

(c) That no depositor in the Post-office Savings' Bank may be a depositor in any other savings' bank.

5. The greater ease and readiness of withdrawing money both by depositors and after the death of the depositors.
6. The introduction of some plan of providing in all small villages where a post-office is established a Post-office Savings' Bank, to be open periodically.
7. The adoption of the suggestion of making rural postmen collectors of savings.
8. The making known more systematically than has hitherto been done the advantages offered by the Post-office.
9. The establishment of Post-office Penny Banks in workshops, schools, &c.

The then Postmaster-General (Mr. Lyon Playfair), in his remarks to the deputation, held out not a little promise that several of the points raised by the Society would be favourably considered. No doubt the change of Ministry has retarded any measure for the present this Session; but there can be no doubt but that the public would support and be glad to hear of extended legislation in the provident schemes of the Post-office.

On the 11th of May a deputation from the Council waited on the Chancellor of the Exchequer to urge the adoption of some scheme to enable the masses to become holders of public funds by purchases of small sums at a time. A scheme for doing this through the Post-office was submitted to the Chancellor at the same time.

The only objection raised was the fear of overloading the Post-office. This argument, however, only strengthens the case in favour of the idea, for it is obvious that if it would involve heavy work to the office carrying it out it would meet a crying want. From the almost unanimous opinion in favour of the scheme expressed by the Press in all parts of the kingdom, there can be but little doubt that before long some plan will be adopted for enabling all classes to become possessors of the English funds by small purchases at a time through local agency.

Last year Sir Joseph Whitworth placed one hundred pounds at the disposal of the Council to be offered as prizes for essays "On the Advantages that would be likely to arise if Railway Companies and Limited Companies generally were each to establish a Savings' Bank for the Working Classes in their employ." The prizes offered were £70 for the best, and £30 for the next best essay. Fifty-four essays were sent in for competition, and the decision of the judges will shortly be made public.

Medals and Premiums.

The Society's Gold Albert Medal has this year been awarded to Mr. C. W. Siemens, D.C.L., F.R.S., "For his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvements in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to Manufactures and the Arts." Another worthy name is thus added to the list of distinguished recipients.

The Society's Medal under the head of the Stock Prize, offered to "Female artists for the best Cameo designed and executed on any of the shells ordinarily used for that purpose," has been awarded to Miss Emily Addis Fawcett.

It will be remembered that Mr. Streeter placed at the disposal of the Council a sum of twenty guineas for the best "Essay on the Hall Marking of Jewellery, with Suggestions for an Improved System for carrying out that object." Seventeen essays were sent in, but the Committee to whom they were referred for consideration reported that none of them possessed sufficient merit to receive the prize offered. They, however, recommended that, with Mr. Streeter's sanction, the offer should be renewed with some further detailed conditions. The Council, acting on this report, will again offer the prize for competition.

The prizes offered by the Society to promote the economical consumption of fuel—£500 having been placed in the hands of the Council to promote this object by a gentleman who desires that his name shall not be published—have not yet been awarded. In consequence of the invitation put forth, 104 competitors have appeared, and all the various appliances are exhibited in the International Exhibition at South Kensington. In order to arrive at a reliable result it became necessary to build rooms in which each stove might be tried, and accordingly six rooms have been built for this purpose on ground belonging to her Majesty's Commissioners for the Exhibition. A considerable number of the grates and other apparatus have been carefully tested, under the direction of the Society's Committee, and the results accurately recorded. It is expected that the labours of the Committee will shortly be concluded, when a report will be issued, stating the conclusions at which the Committee have arrived. As may be readily imagined, the labour of testing these numerous and varied appliances has been of no light character. Mr. S. W. Davies, a distinguished student of the Royal School of Mines, to whom the actual work of testing, under the direction of the Committee, has been entrusted, has been unremitting in his attention, and the members of the Committee, in addition to their regular meetings, give frequent personal supervision to the work as it proceeds.

Until the whole of the appliances have been tested, no intimation can be given as to the result, but whatever it may be, it is confidently predicted that a vast amount of important information will have been collected, which the report of the Committee will place at the disposal of the public.

It will be remembered that the Council offered a Gold and Silver Medal to be awarded in each of the Classes of the International Exhibition at South Kensington. These prizes are now under the consideration of a Committee of Judges.

The Society offered last year prizes for improved Cabs, and a considerable number were shown in competition at the 1873 International Exhibition. The Committee, presided over by the Duke of Beaufort, selected four as worthy of favourable notice and especially deserving of reward; and they recommended the Council to divide the total amount offered in prizes, viz., £120, to be divided equally between these four, viz.—

Two-Wheelers.

C. Thorn, Norwich	£30
Forder and Company, Wolverhampton	30

Four-Wheelers.

Lambert, 66, Great Queen-street	£30
Quick and Norminton, 8, Netherwood-street, Kilburn	30

Both the latter carriages admit of being used open or shut.

The offer of the Society's Gold Medal or £20 for the best "Revolution Indicator which should accurately inform the officer on deck and the engineer in charge of the engine what are the number of revolutions of the paddle or screw per minute, without the necessity of counting them," has produced 84 competitors. A committee is now engaged in investigating the merits of the several inventions.

The method of lighting our railway carriages has long been the subject of complaint, and the Council, after consultation with parties connected with some of our principal railway companies, have determined to offer a prize for an improved railway lamp. They offer the Society's Gold Medal, or Twenty Guineas, for an improved lamp or means of illumination, suitable for railway passenger-carriages, that shall produce a good, clear, steady, durable, and safe light. It must be simple in construction, and capable of being readily cleaned and repaired. In judging the merits, cost will be taken into consideration. Specimens in a condition suitable for trial to be sent in to the Society's House not later than the 1st of November, 1874. The Council reserve to themselves the right of withholding the medal or premium offered, if, in the opinion of the judges, none of the articles sent in competition are deserving of reward.

Swiney Prize.

The award of the Silver Cup and £100, directed by the will of the late Dr. Swiney to be presented on "every fifth anniversary of his death to the author of the best published treatise on Jurisprudence," has this year been made in favour of the Right Honourable Sir Robert J. Phillimore, judge of the High Court of Admiralty, in respect of his work entitled "Commentaries on International Law."

Food Committee.

The Committee have seen with pleasure the successful result of an experiment in the importation into this country of fresh uncooked meat and fowls preserved in ice. Some enterprising gentlemen in the city made arrangements to receive from Transylvania, packed in boxes surrounded with ice, both meat and fowls, which arrived in this country, after a transit of three weeks, in excellent condition. One of the boxes, containing about one hundred weight of provisions thus packed, was opened in the presence of the Society's Secretary, who, having been permitted to take away some samples of the contents, practically tested their quality by having them cooked, and he reports most favourably of them. The success which has attended these trials on a small scale may, it is hoped, lead ultimately to the adoption of the system on a large and commercial basis, and lead to an increase in the supply of food for the people.

Examinations.

The General Examinations of the Society are just concluded for the present year, and show an increase in the numbers taking advantage of them.

Last year it will be remembered that the Society

instituted in addition to the above a system of Technological Examinations, the scheme having been inaugurated at a meeting held in the Society's rooms, over which H.R.H. Prince Arthur presided. These examinations have this year been extended so as to include an additional number of trades, and these it is proposed still further to extend, so as to embrace all the leading manufactures of the kingdom. The numbers taking advantage of these examinations, though an increase on last year, is still small, but it is hoped that as the subject becomes more widely known a larger number of candidates will ultimately avail themselves of the system. The details with reference to both systems of examination will be found in the Educational Officer's report read to the Conference on Friday last, and printed in the last number of the Society's *Journal.*

FINANCE.

The Council append hereto the accounts for the year, which are of a satisfactory character. It has more than once been brought to the notice of the Council that some inconvenience arises from the bye-law which renders it imperative to change the treasurer, so that no one treasurer has a longer period of service than two years at the utmost. In order to avoid the inconvenience of such frequent change, the Council recommend that this bye-law should be altered so as to admit of a treasurer serving five years, and with this object a resolution will be submitted to the meeting.

Dr. John Anderson had great pleasure in moving the adoption of the report, and alluded, in doing so, to the breadth of the Society's labours.

Mr. Seymour Teulon, in seconding the report, said that the Council had always been ready to lend the use of the rooms for various meetings, but during the present year the Society's own business had left but little time for the exercise of this hospitality. Amongst other points mentioned in the report, he was specially pleased to see the offer of a prize for a new railway lamp. He concluded by noticing that in numbers and wealth, the Society had never before been so prosperous.

Mr. Saywell considered it a matter for regret that the attendance was so small, and he thought that this was caused by the fact that the meeting was in the afternoon. He considered that the balloting list should be made out in a more convenient form, and should give more information.

The Chairman explained that the hour for the general meeting was fixed by the bye-laws.

Mr. Hale thought that it would be better if the annual meeting could take place at a later and a more convenient time. He then proceeded to make some general suggestions which he would put forward for the good of the Society. He considered that a catalogue of the library should be printed, and that the advantages of the reading-room should be increased.

The motion was carried unanimously.

The Chairman then proceeded to move the alteration in the bye-laws, according to notice given, as follows:—"That Bye-law 99, regulating the preparation of the Balloting List, so far as it relates to the Treasurers, be altered, and that in lieu of the words 'Provided that one of these shall not have served the office of Treasurer during the current year,' there be inserted the following words, 'Provided that neither of them shall have served the office of Treasurer for the five previous consecutive years.'"

The motion having been duly seconded, was put to the meeting and carried unanimously.

Mr. A. Cassels moved, and **Dr. Anderson** seconded, a vote of thanks to Major-General F. Eardley-Wilmot, the Chairman of the Council, for the able manner in which he had performed the duties of Chairman during the year, which was carried unanimously.

Mr. Saywell alluded to the proposal for an anniversary dinner, and **Mr. Hall** supported it; but **Mr. Cassels** and the **Chairman** deprecated the idea, and the subject dropped.

The ballot having remained open one hour, and the scrutineers having reported, the Chairman declared that the following members had been elected to fill the several offices. The names in *Italics* are those of members who have not, during the past year, filled the offices to which they have been elected:—

COUNCIL.

PRESIDENT.

H.R.H. the Prince of Wales, K.G.

VICE-PRESIDENTS.

H.R.H. the Duke of Edinburgh, K.G.	*C. J. Freake.*
F. A. Abel, F.R.S.	Captain Douglas Galton, C.B., F.R.S.
Thomas Brassey, M.P.	*Wm. Hawes, F.G.S.*
A. Cassels.	*Vice-Admiral Erasmus Ommaney, C.B., F.R.S.*
Edwin Chadwick, C.B.	Admiral the Right Hon. Lord Clarence Paget, K.C.B.
Henry Cole, C.B.	Samuel Redgrave.
Sir Daniel Cooper, Bart.	Rev. W. Rogers.
Right Hon. W. F. Cowper-Temple, M.P.	Seymour Teulon.
Major Donnelly, R.E.	E. Carleton Tufnell.
Major-General F. Eardley-Wilmot, R.A., F.R.S.	

ORDINARY MEMBERS OF COUNCIL.

G. C. T. Bartley.	Robert Rawlinson, C.B.
Sir George Campbell, K.C.S.I.	*E. J. Reed, C.B., M.P.*
Lord Alfred Churchill.	*C. W. Siemens, D.C.L., F.R.S.*
Hyde Clarke.	Lieut.-Col. A. Strange, F.R.S.
Colonel A. Angus Croll.	*T. R. Tufnell.*
James Heywood, F.R.S.	
Edwin Lawrence.	

TREASURERS.

Ed. Brooke.	*John Murray.*

AUDITORS.

I. Gerstenberg.	*J. Oldfield Chadwick.*

SECRETARY.

P. Le Neve Foster.

FINANCIAL OFFICER.

Samuel Thomas Davenport.

The Chairman proposed a vote of thanks to the scrutineers for their services, which was carried.

At the conclusion of the General Meeting a Special Meeting was held, when the following candidates were balloted for and duly elected members of the Society :—

Arnold, Henry R., Rose-villa, Henry-road, New Barnet.
Birch, R. W. Peregrine, C.E., 5, Westminster-chambers, Victoria-street, S.W.
Black, J. M., 26, Bedford-place, Russell-square, W.C.
Bull, William, F.L.S., F.R.G.S., King's-road, Chelsea, S.W.

Chambers, Edward, 4, Mincing-lane, E.C.
Cooper, Septimus, 58, Piccadilly, W.
Cotton, Major-General F. C., R.E., Athenæum-club, Pall-mall, S.W.
Donkin, William F., 4, Museum-terrace, Oxford.
Dunbar, John, M.P., 4, Garden-court, Temple, E.C.
Gamble, Lieut.-Colonel David, Windlehurst, St. Helen's, Lancashire.
Gibson, John, 7, Guilford-street, W.C.
Grayson, Henry H., Liverpool.
Hankey, Henry Alves, The Garden-house, Queen Anne's-gate, St. James's-park, S.W.
Keats, John, Rye-bank-cottage, Newcastle-under-Lyne.
Kitto, Charles W., 55, Gracechurch-street, E.C.
Knowles, Sir Francis C., Bart., F.R.S., Mayfield, Ryde, Isle of Wight.
Koch, Walter Edward, F.G.S., F.C.S., Universities Club, Jermyn-street, S.W.
Kynaston, Josiah W., St. Helen's, Lancashire
Liveing, G. D., M.A., Cambridge.
Lloyd, J. H., Ph.D., 24, Anglesea- street, Dublin.
Maynard, G. P. H., Grosvenor-hill, Wimbledon, Surrey.
Oxland, Dr. Robert, 8, Portland-square, Plymouth.
Page, Frederic James M., 8, Lisle-street, Leicester-square, W.
Piesse, Charles H., 303, Strand, W.C.
Prange, Francis G., Liverpool.
Price, Dr. David S., 26, Great George-street, S.W.
Richards, James George, 93, Lancaster-road, Notting-hill, W., and 33, Spital-square, E.
Richman, Henry John, 46, Clanricarde-gardens, W.
Rolfe, Charles Spencer, C.E., 20, Highbury-place, N.
Rowden, Aldred, 39, Woburn-square, W.C., and 25, Old square, Lincoln's-inn, W.C.
Scott, Gilderoy Wilson, 31, Montague-place, Russell-square, W.C.
Seligman, Leopold, Hereford-house, West Brompton, S.W.
Thomas, John B. Dawson, 21, John-street, Adelphi, W.C.
Thomson, Patrick J., 3 and 4, Great Winchester-street-buildings, E.C.
Walmisley, Arthur Thomas, C.E., 5, Westminster-chambers, Victoria-street, S.W.
Wood, Alfred H., gas engineer, Hastings.

ANNUAL CONFERENCE.

The Twenty-third Annual Conference between the Council of the Society and the representatives of Institutions in Union, took place at the Society's House, on Friday, the 19th inst. Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman of the Council, presided.

The following is a list of the Institutions and Local Educational Boards represented at the Conference, with the names of the representatives nominated by them:—

Aberdeen, Mechanics' Institution	Mr. James W. Barclay, M.P.
Birmingham and Midland Institute	Mr. C. J. Woodward.
Bromley (Kent) Literary Institute	Mr. George H. Payne.
Bromsgrove Literary and Mechanics' Institute	Mr. John Corbett, M.P. Mr. A. F. Godson.
Burnley Mechanics' Institution	Mr. Robert Shaw, M.P. Mr. U. J. Kay-Shuttleworth, M.P.
Carlisle Mechanics' Institute	Major Ferguson, M.P.
Crewe Mechanics' Institution	Mr. R. C. Stapley.
Croydon Literary and Scientific Institution	Mr. Lanchester. Mr. Howard Martin. Mr. G. N. Price. Mr. Steele.
Dublin Statistical and Social Inquiry Society	The Lord Emly. The Lord O'Hagan. The Right Hon. Hugh Law, M.P.
Faversham Institute	Mr. J. A. Anderson, Jun.
Glasgow Mechanics' Institute	Dr. Cameron, M.P. Mr. G. Anderson, M.P.
Hammersmith Spring Vale Institute	Mr. E. Haynes. Mr. John G. Liversidge.
Hoddesdon and Broxbourne Mutual Improvement Society	Rev. R. W. Morice.
Huddersfield Mechanics' Institution	Mr. William Marriott. Mr. John Sugden.
Hull Church Institute	Mr. C. E. Blundell. Mr. J. G. W. Willows.
„ Young People's Christian and Literary Institute	Mr. H. J. Atkinson, J.P.
Lancashire and Cheshire Union of Institutes	Dr. R. M. Pankhurst. Dr. J. Watts.
Leeds Young Men's Christian Association	Mr. Henry Thorne.
Lichfield Working Men's Association	Dr. William Browne.
Macclesfield Useful Knowledge Society	Mr. Joseph Wright, J.P.
London, Birkbeck Literary and Scientific Institution	Mr. George Chaloner. Mr. Thomas Lyle. Mr. G. M. Norris.
„ City of London College	Mr. John Husband. Rev. R. Whittington.
„ Quebec Institute	Mr. J. W. Pattison. Mr. F. Pope. Dr. Saunders. Dr. Stockes.
„ St. Stephen's Evening School, Westminster	Mr. W. H. Baker. Mr. W. Davis.
„ Tonic-Sol-fa Teachers' Association	Mr. W. R. Bourke. Mr. E. G. Hammond. Mr. H. Taylor.
„ Walworth Literary & Scientific Institution	Mr. J. S. Noldwritt. Mr. Frederick Wood.
Penzance	Mr. Councillor W. H. Rodd.
Rotherham Literary and Mechanics' Institution	Mr. G. B. Willis.
Scarborough Mechanics' and Literary Institute	Mr. W. Blenkin. Mr. W. J. Watson.
Watford Public Library	Rev. Newton Price. Mr. G. Tidcombe, Jun.
Yorkshire Union of Mechanics' Institutes	Mr. Frank Curzon.

The Educational Officer read his Report to the Council, which appeared in the last number of the *Journal*.

The Chairman having invited discussion upon it,

Mr. Frank Curzon (Yorkshire Union), who said he represented 140 institutions in the North of England, said he thought the report was admirably clear and concise, and he had no criticism to offer upon it; indeed, he thought the Society's action described in it had been of great value to the institutions. At the same time he could not but feel that a great deal more might be done for the district he represented, not perhaps by the Society of Arts, but by the authorities at South Kensington, who, he was sorry to say, did but little for the advancement of art and science in connection with the large and important industries in the North. There was not one single museum or gallery by visiting which the art student could check his own work or be encouraged to persevere in his career; not a model to which he might be directed as an incentive and guide to his exertions. He hoped something would be done in this direction, and that the Society would bring its influence to bear

in the proper quarter to remedy this state of things. Whilst thanking the Society for their examinations, he was glad to say that in his district not only had there been an increase in the number of the candidates, but also in their proficiency, a much larger proportion having passed than on any previous occasion. He hoped, therefore, the Society would be encouraged, not only to continue their examinations, but to extend them, especially if possible in the direction of Art. In conclusion, he begged to repeat that in his opinion the provinces had a fair claim on the resources of the State, especially considering that by the development of manufactures and commerce in the north of England, in many districts the produce of taxation was at least six times what it was thirty years ago.

The Chairman then invited discussion on the first of the subjects suggested.

The proposed addition of certain subjects to the General Examinations as follows:—

(*a*.) Trade geography, or a knowledge of the localities in which raw materials are found; the conditions of their production, preservation, &c.

(*b*.) Growth of the industrial arts, or a knowledge of the principles by which industrial progress has hitherto been mainly determined; of the practices peculiar to certain countries, or to particular classes of producers, &c.

(*c*.) Trade history, or a knowledge of the origin and development of local and distant traffic in civilised countries, with the characteristics of each.

(*d*.) International commerce and competition, involving a consideration of comparative industrial enterprise, financial burdens, legislative policy, and educational efficiency.

Mr. Atkinson (Hull Young People's Institute) said that, as an ex-president of the Hull Young Men's Institute, which had 1,600 or 1,800 members, he was requested by the committee to attend and thank the Society for the manner in which their operations had been carried on, and the efficient support they had given to local efforts. He was very glad to see the proposed additions to the list of subjects, especially those marked *a*, *c*, and *d*. These would be of the greatest interest to Hull, which was a port of transit rather than a place of manufacture. He believed, therefore, this idea would be very popular, and result in great good to all the institutions who took it up. He might mention that at the institution which he represented, they always made a great feature of the distribution of prizes received from the Society of Arts, and very interesting facts sometimes came out upon those occasions; for instance, on one occasion, a working gardener who had to come into town week after week, and to walk back nine or ten miles to his home, being too late for the last train, had attended classes so regularly and so successfully that he had received not only several prizes, but the gold medal.

Mr. G. Chaloner (Birkbeck Institution), referring to the paragraph in the report which expressed a hope that the time would come when certificates of having passed technological examinations of the Society of Arts would be asked for by employers, said that if that day were ever to come they must not only educate the workmen, but also the masters. His experience of masters had been rather extensive, and he was obliged to say with regret, that most of them whom he had known did not care very much whether their workmen were educated or not, so long as they could make something out of them. He had on several occasions been obliged to give up attending classes which he had joined, owing to what he considered the abominable system of overtime; not that he objected to it when necessary, but it often existed to a much larger extent than was generally supposed, and really it altogether prevented many young men and apprentices from joining evening classes. If it were necessary he could give many details to prove this statement. He was confident, therefore, that if any step could be taken which would bring these matters under the personal attention of masters, and show them that the education of workmen would be beneficial to themselves, as employers, great good would be effected.

The Chairman said the great object of the Society was to educate the whole country. He was sorry to hear that there were masters who took the view which had been stated, but he was also happy to think that there were many of a different character, who were glad to encourage their workmen to educate themselves in every possible way.

Mr. Norris (Birkbeck Institution) was much pleased to see the proposal for adding trade geography to the list of subjects, because he was one of those who looked upon the withdrawal of geography as a mistake. It was done, no doubt, in consequence of the Science and Art Department holding examinations in physical geography, but there was a great difference between that subject and such a knowledge of geography as would be likely to be of use in commerce.

A resolution was then passed in favour of adding the above subjects to the Examination Programme.

The **Chairman** then invited discussion on the second subject, namely:—

"The desirability of establishing studentships for the encouragement of the highest proficiency in certain groups of subjects, the reward being given in the shape of certain scholastic advantages, and not in money or books. The object to be attained being to guide and concentrate study, and to reward a modicum of success by giving facilities for future study."

Mr. Critchett said he regretted to find that Mr. J. H. Levy, who had suggested this subject, and intended to speak upon it, was not able to be present from ill-health.

Mr. Norris said he had not seen Mr. Levy for two or three weeks, and was not aware he intended to bring this matter forward. He apprehended, however, that his intention was to introduce some such prizes as were given both by the Birkbeck and by the City of London College. Thus at the former institution they gave one prize or scholarship for mathematics, another for languages, another for natural science, and so on. When it spoke of scholastic advantages he apprehended that meant giving passes to attend certain lectures at a college or university, but he rather doubted if this would be so useful a mode of rewarding the student as that of furnishing him with a sum of money. His experience had been that it was more valuable for a student to receive money, which he could apply in the method best suited to his own circumstances and opportunities, either by making additions to his library or attending important courses of lectures.

Mr. Curzon said that in some parts of Yorkshire these scholarships were established; at Keighley, for instance, they had a most perfectly organised system at the Mechanics' Institute, by which they could take a boy from the normal school and bring him up, by a series of gradations, until he was prepared for either of the Universities. In fact, every part of the human material might be said to be economised, so that whatever the boy might be best fitted to become he was trained and prepared for. He himself thought the system of scholarships much better than that of money prizes.

The Chairman inquired how the funds for these scholarships were provided.

Mr Curzon said they had no difficulty in providing funds in the North of England. At the place he had mentioned, in consequence of the work which that school had done, the Endowed School Commissioners had granted them £180 a-year for the purpose of training girls, though that did not touch the work he had been particularly alluding to.

In reference to the next question, viz.:—

The subjects to be added to the Technological Programme next year:—Agriculture, Silk and Woollen Dyeing, Calico Bleaching, Dyeing, and Printing, and Alkali Manufacture,

a conversation took place, in the course of which it was observed that when these subjects were added the Society's list would have nearly covered the whole range of trades in which a system of examinations in technology could easily be applied. Regret was expressed that the country generally did not seem to take much interest in these examinations, for, except the few prizes offered by some of the City companies, the trades themselves had not come forward, and until that was done they could not expect these examinations to achieve very great success.

Mr. Curzon said that in reference to the financial question, there was in Yorkshire a pretty general understanding that it was a Christian duty whenever they met with a capitalist to "bleed" him as far as possible; the usual result of this process was that he felt much gratitude for being enabled to make such judicious use of his wealth. He was sure there were many employers who would be interested in this work if it were brought under their notice. He much regretted that so few candidates came forward at these technological examinations, and he believed if they were better prepared many more would present themselves.

The Chairman then invited discussion on the fourth suggested subject:—

"How far the institutions can (for a certain number of years, and until the recently-instituted system of primary education becomes general), by means of intermediate classes, prepare students for availing themselves of Technical Instruction."

Mr. Curzon said what was wanted, especially in Yorkshire, was an arrangement of classes in which young men should prepare themselves for working at technological instruction. The great majority of them were utterly unaccustomed to composition, and not trained to think logically, and they therefore shrank from these examinations. He believed it would be 20 years before the School Board system had removed this difficulty, and in the meantime there was in every town at least one-sixth of the population, viz., those from 13 to 21, who required such facilities as were here pointed to. He therefore hoped the Council would recommend the establishment of classes in elementary physical geography, English history, English composition, &c.

Mr. Norris thought that in every well-organised large institution such classes as had been referred to were already in existence. At the Birkbeck Institution they had had such classes for years, and the Society in offering prizes had, he thought, done as much as could be expected of them in the matter. He believed that any institution in a large town which obtained the services of fairly competent teachers would find these classes become in a very short time self-supporting.

Mr. Curzon said they were not so far advanced in the North as in London, and wanted to exchange some of their energy for metropolitan culture. For that reason they wanted the fostering hands of the Society to assist them. He would therefore beg to move:—

"That it be a recommendation to the Council that they should appeal to various institutions in union to institute intermediate classes for the preparation of students for the work of technical instruction."

Mr. Norris said he should have much pleasure in seconding the resolution, though he did not think the matter required so much fostering care as was imagined.

The resolution was carried unanimously.

The Chairman then invited discussion on the fifth subject, namely—

"The establishment of District Museums and Galleries, and the best means of making them available for Art and Science Instruction. How far these objects could be promoted by holding, under the auspices of the Society of Arts, local exhibitions."

Mr. Noldwritt (Walworth) asked if that referred to the provinces only or to the neighbourhood of London also.

The Chairman said he supposed it referred to any district where such museums were found desirable.

Mr. Atkinson said that in Hull, the Literary and Philosophical Society had taken steps in this direction. For some years they had a museum which had been open to the members of the society, and to which they could also introduce strangers, but in addition to that some of the scientific members of the council of the institute had lately established a system of lecturing to the working classes and young people generally on Saturday afternoons, taking up subject after subject in connection with the specimens in the museum. They made a nominal charge of a penny for admission, and he was glad to say that these lectures had been very largely attended. He thought something of this sort, if recommended by the Society, could be just as easily done in other towns.

Mr. Curzon said he was pretty well acquainted with all the large towns in Yorkshire, and he was sorry to say that all the museums in the north of England were miserably insignificant. In Yorkshire—which was so rich in minerals, fauna, flora, and matters of archæological interest—there was no museum worthy of the name, whilst the galleries of art were still worse. In fact, there was no place to which any student could go to compare his work with that of the great masters. He thought the monopoly of such works by London was most unfair. Everything was concentrated in the metropolis, but throughout the whole country, from one end to another, there was not a single museum. Not one-twentieth part of the money contributed for the purposes of science and art in the country returned to the provinces, which he considered not only unjust but very impolitic, because if galleries and museums were established in different counties, London would be enriched in return by the articles of taste and art which would be produced in consequence. Unfortunately they were rather too far off in Yorkshire for their voices to be heard, and therefore he hoped that the Society would lend them its assistance and influence. If anyone came down from South Kensington to the country all he did was to find some runic cross, some extraordinary stone, or some wonderful relic of the past, which he straightway carried off with him and did nothing in return. He did not know very much of the Hull museum, but was quite content to believe it was doing good. He would, however, make one suggestion, namely, that they did not want merely Saturday afternoon lectures, useful as they might be, but quarter of an hour lectures should be given by some competent person to all visitors to the museums in order that their specimens might be properly utilised.

Mr. Atkinson said they had only lately subscribed several thousand pounds in Hull to pay off the debt on the museum, and shortly before that they had put up galleries around it. They were, therefore, doing something substantial; and he ventured to hope that in some other towns also the state of the museums was not quite so bad as Mr. Curzon had represented.

Major Ferguson, M.P. (Carlisle), said it was too much the case that provincial collections generally were mere assortments of odds and ends, of no value whatever for any continuous instructive purpose. He thought, therefore, some well-assorted collections, exhibited in different places of the country, would be of very high value.

Mr. Noldwritt thought one reason why some of the provinces had not been able to have good collections or museums was that so many private collectors were bent on establishing small collections of their own, the result of which was that these collections were so small as to be of very little practical service. If several of these little collections were united together in some important central town, every one would be benefited. The same remark applied to a certain district round London. He did not think it at all desirable to multiply museums in

London, believing that one of every kind was quite sufficient. Of course there could be no compulsion in this matter, but he thought it would be well to recommend the amalgamation of small collections in the way he had suggested. He might also mention one fault he had frequently noticed, both in the country and in London, that very little care was taken in describing specimens, even the names seemed to be put down at hap-hazard. If a museum were established at all, it was indispensable that care should be exercised in giving proper names and descriptions to the objects.

Mr. Robert Rawlinson, C.B., was much surprised to hear Lancashire and Yorkshire described as being so destitute of museums. He believed Liverpool had a good museum; he knew York had, and Manchester also, though he was not prepared to say they were all they ought to be. He quite agreed, however, that provincial museums often became deadly-lively sort of places. Collections might be got together, but it took a great deal of money to keep them up and in good order, and that probably accounted for their falling somewhat out of favour. It would scarcely be possible to bring together in every town of Lancashire and Yorkshire even a collection of ancient and modern art, and they must therefore be contented with something less. It was possible in such districts to get occasionally, if not every year, loan collections of the very finest specimens of art, for there were many gentlemen in these districts who possessed magnificent works; and he believed that if appeals were made to them, they would, for three or four months each year, lend these collections, which would be of enormous assistance to local genius. He could not think, however, that the expenditure of large amounts for the establishment of so-called permanent museums would be followed by any adequate practical good.

Mr. Norris thought it a very valuable suggestion that the Society should seek by its influence to obtain such loan collections as had been suggested. He quite agreed that it would be impossible to establish museums in all large towns. Where was the money to come from? It would be absolutely absurd to expect the Government to find the enormous amount which would be necessary for such a purpose; and with regard to South Kensington, although they had large collections there, it must be remembered that they constantly received numerous applications, the whole of which it was impossible to comply with. No doubt the Christian duty of bleeding wealthy men might be carried out to a considerable extent, and by that means, with the assistance of loan objects, a great deal of good might be effected.

Mr. Curzon said occasional exhibitions were utterly inadequate to supply the want he spoke of. An exhibition once in ten years, to which the noblemen and gentlemen of Lancashire and Yorkshire contributed, would be utterly useless for all purposes of study. Why should there be three copies of the same work at South Kensington when they might be distributed throughout the kingdom? In large towns, like Leeds or Sheffield, a halfpenny rate would produce £1,500 a year, and if the Government would come forward and assist, something might be done towards establishing really useful permanent collections. This itinerating study, which was to make an artist by chance once in a course of years, was a most absurd mode of dealing with the art of the country. He had also to complain of the way in which science and art were generally taught in England. As a rule, art masters cared nothing for art, but were merely teaching machines, very often quite incompetent, and science teachers were merely crammed in order to get their certificates, and were utterly unprepared to understand or to convey really sound knowledge. No doubt there were admirable men amongst teachers, grand exceptions to the rule; but whilst all that was necessary to a teacher was, that he should in the most convenient and rapid way cram for a certificate, and the mere holding of a certificate was presumed to be evidence of competency to teach, it was not to be wondered at that such poor results were obtained. How could students, who only looked upon a collection of pictures once in ten years, for a few weeks or months at a time, compete with those in London, who could study from day to day the noblest works of ancient and modern artists. The money which supported these collections came from the whole country, and he contended that part of it ought to go back again for the establishment of galleries of art, which, in their turn, would form the nurseries of a new generation of artists.

Mr. Noldwritt remarked that works of art by great masters, whether sculpture or paintings, were but limited in number, and therefore could only be placed in two or three places at the utmost. Even with all the money in the world at command, and with every disposition to allow the bleeding process which had been spoken of to go on, it would be impossible to place in all these provincial museums, one specimen of the various masters, so as to place them on an equality with London.

Mr. Curzon said there were numerous examples of Wilkie at South Kensington, and many of Landseer, and not one in any museum in the country. Not long ago, he was at Selby, which had received a contribution from South Kensington of fifteen or sixteen works, but only two of the number were at all fit to be placed before students as models for imitation. Where there were duplicates and triplicates of really good works, he thought they ought to be distributed, and that it would be a good investment to do so.

Mr. G. Tidcombe, jun. (Watford), agreed with the last speaker that it would be very desirable indeed to have works of art distributed through the country. They were establishing a museum at Watford, and he should be most happy to receive one of Sir Edwin Landseer's pictures.

Mr. Norris remarked that the number of towns in England of the size of Watford must be very great, and therefore it would be a difficult matter to decide how even 20 of Landseer's pictures were to be distributed. They must, after all, come back to the principle of loan exhibitions.

Mr. Noldwritt remarked that there were already two institutions at Hertford, each possessing a small museum, and if they established another at Watford that would be three in the same county. In his opinion it would be very much better for such institutions to amalgamate.

Mr. Tidcombe, on the other hand, thought it would be better to distribute works of art throughout the country, rather than to have so many beautiful eggs all carried in one basket.

The Chairman said there was one preliminary question to settle, and that was, what was the object of these museums? If it was to educate a great number of persons, the more they were multiplied the better; and for any purpose of technical education it was necessary to have a certain collection of specimens, though it need not be called a museum. There was one difficulty, however, which had not been alluded to, but which had been practically brought under their attention, viz., that if they attempted to introduce anything of the sort into large towns such as had been described, the inhabitants would be likely to take offence, and resent what they might consider undue interference. As Mr. Curzon had said, they had plenty of money and energy, and might not like the Society of Arts intruding upon them. In Manchester, for instance, there was abundance of wealth, and if such a thing were really desired, before very long they might possess a museum rivalling any in London. His own view was that the great requisite was not merely museums, but competent persons to lecture and instruct those who visited them.

Mr. Rodd (Penzance) said he could not quite agree that if a museum was small, it must necessarily continue small, nor did he see how it was to grow to be a large one, unless it was small at first. He could only say that in his neighbourhood they would be very glad if the Society would urge the necessity of instituting district museums and galleries in the provinces. On his return from France, four years ago, he was so struck with the necessity for such an institution, that he offered to become one of ten gentlemen who should contribute a thousand pounds towards founding a nucleus for the establishment of a museum of art. The matter, however, had not yet taken shape, and he did not know what it might grow to. With reference to the observations of Mr. Curzon with respect to the teaching of art, he might say that for the last twenty years they had in their town a school of art and science, and the master first appointed still continued at the head of it. His unwearied exertions had been rewarded by considerable success, and as a proof he might mention that from their school students had gone out who had become the chief masters of schools of art in the provinces. Their experience as to the efficient teaching of science was equally satisfactory; they were under the Science and Art Department, and their classes in mineralogy, botany, physical geography, and so on had proved very successful. With regard to the holding of local exhibitions, he would remind the Conference that in towns where there were schools of science and art, the Department always felt great pleasure in rendering assistance for such a purpose. About once in three years they had a very creditable exhibition in Penzance.

The Chairman said no doubt there were many difficulties in the way of establishing museums; but most of the gentlemen present represented important places, and might, he thought, do good service by bringing their influence to bear upon the members representing their districts in Parliament. The matter had already been brought before the Government, several suggestions had been made, and if a little pressure were brought to bear, it might lead to the establishment of museums and galleries in places where they were most urgently needed.

Mr. Curzon then moved the following resolution:—

"That the Council of the Society of Arts be requested to appeal to the Government and to the authorities of South Kensington to aid in the establishment of district galleries of art and public museums in all the great centres of the kingdom."

He thought it a mistake to suppose that provincial towns would be jealous of the intervention of the Society, believing that they would always be glad of their assistance, and at any rate in his own district he could assure the Society that they were always most glad to welcome any of its officers or representatives, and wished they could see them oftener.

Mr. G. Tidcombe seconded the resolution, which was carried unanimously.

A vote of thanks to the Chairman was then moved by **Mr. Norris**, seconded by **Mr. Noldwritt**, and carried unanimously.

CONVERSAZIONE.

The annual conversazione of the Society was held, as usual, by the kind permission of the Committee of Council on Education, at the South Kensington Museum, on Friday, June 19th.

The Art Library, the Raphael Cartoons, the Sheepshanks and the National Gallery's Picture Galleries were open, and the visitors were able to make the tour of the Art-Schools both on the first and second floors. The courts and corridors of the ground floor were also open, including the new Architectural Courts at the south end of the building. The reception was held in the South Court, by Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman, assisted by the following Vice-Presidents and Members of Council:—Mr. G. C. T. Bartley, Mr. Andrew Cassels, Mr. Edwin Chadwick, C.B., Mr. Hyde Clarke, Colonel A. A. Croll, Mr. C. J. Freake, Mr. I. Gerstenberg, Mr. James Heywood, F.R.S., Mr. Robert Rawlinson, C.B., Lieut.-Colonel A. Strange, F.R.S., Mr. Seymour Teulon, and Mr. E. Carleton Tufnell.

A Promenade Concert was given by the Band of the Grenadier Guards in the North Court, of which the following was the programme:—

March	"The Maid of Orleans"	Cowen.
Overture	"Le Lac des Fécs"	Auber.
Valse	"Doctrinen"	Strauss.
Selection	"Reminiscences of Benedict"	Benedict
	Solos for Cornet—Mr. Ellis; Clarinet—Mr. Spencer; Euphonium—Mr. Siddons, &c.	
The Preobajenski March	The March of the Russian Guards	Composed in the 17th Century.
	Arranged by D. Godfrey.	
Selection from the popular Russian Opera	"Life for the Czar"	Glinka.
	Arranged by D. Godfrey.	
Valse	"Isidora"	D. Godfrey.
Cornet Solo	"The Summer's Coming"	Saqui.
	Mr. Ellis.	
Fantasia	"La Fille de Madame Angot"	Lecocq.
Gavotte		Louis the 13th.
Selection	"Chilpéric"	Hervé.
March of the Russian Horse Guards		Beethoven.
	"God Save the Queen."	

A Vocal Concert, consisting of glees, by the London Glee and Madrigal Union, directed by Mr. Land, was given from 9 to 11 o'clock, with intervals, in the Lecture Theatre. The programme was as follows:—

From 9 to 9.30.

Madrigal (5 voices)	"Who is Sylvia?"	Ravenscroft and Morley, 1570. Arranged by Sir H. Bishop.
Glee (male voices)	"By Celia's Arbour"	W. Horsley, M.B.
Four-Part Song	"Oh! hush thee"	A. Sullivan.
Madrigal	"O! who will o'er the downs"	R. L. Pearsall.

From 9.45 to 10.15.

Glee	"Where art thou, beam of light?"	Sir H. Bishop.
Glee	"My dear mistress"	Spofforth.
Glee	"At her fair hands"	James Elliott.
Humorous Old May-pole Ditty	"Strike it up, neighbour"	From T. Weelke's "Ayrs or Phantastic Spirits," A.D. 1608.

From 10.30 to 10.45.

Glee	"Here in cool grot"	Lord Mornington.
Catch	"Would you know my Celia's charms"	S. Webbe.
Madrigal	"Oh! by rivers"	Wilson and Saville, A.D. 1667. Arranged by Sir H. Bishop.

All the other arrangements were as usual. There were in all 3,659 persons present.

Mr. Charles Jordan, an ironfounder, at Newport, Monmouthshire, has taken out a patent for a novel method of preventing railway accidents. He proposes to make the up and down main lines without the usual switches, turnouts, and crossings, the lines being continuous from end to end, and to work such road by transferring a train or trains at stations, or where shunting is necessary, or at junctions with other railways, from the main line to the adjacent siding, by lifting the train bodily from one line to the other by hydraulic apparatus.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

FOREIGN WINES.

To give an elaborate account of all the multifarious descriptions of wines that have been collected for the Exhibition would at once occupy too large a space, and be of little value when complete, unless indeed it could include a careful analysis of each particular wine, such as there has been neither means nor opportunity of procuring. Then again, the relative merits of the different wines are so entirely dependent on and decided by individual taste, that a mere expression of opinion is of little value, especially when it is remembered that a taste that has been educated for wine of one character is often entirely at fault with reference to wine of another sort; indeed, it might be difficult to find any judge of wine whose opinion on each and every sort could be accepted with equal readiness. For these and other reasons there are many difficulties in the way which hinder the preparation of any account suitable for this *Journal* of the Foreign Wine Department of the Exhibition. Inasmuch, however, as it is hoped to publish in these pages a series of articles that may serve to put on record as complete a description of the Exhibition as possible, it is necessary to devote some attention to a department of such importance as that forming the subject of this article.

That the collection is of considerable interest cannot be denied. Never before has it been possible to bring together into so limited a compass such a variety of sorts of wine. The necessities of trade generally compel our wine merchants to devote themselves each to one or two classes of wine, and those houses which make a speciality of new or little-known wines are naturally just those where we can least expect to find the older and more popular wines with which we should be glad to compare the fresh claimants for popular favour. In the cellars of the Albert Hall there are ranged side by side the produce of—it may safely be said—all the vine-producing countries of the world, and an opportunity for comparison is thus given to *connoisseurs* and the general public, such as has never before been afforded at any exhibition or any establishment whatever. It remains to be seen what will be the result of this action of the Commissioners—whether any real impulse will be given to the importation of new wines, or if the already existing tendency to the consumption of "natural" instead of "manufactured" wines will be increased. That a considerable amount of knowledge on the subject will be publicly disseminated is certain, and it is also likely that the growing popular taste for light drinking wines will be largely and rapidly augmented.

Looking at the Exhibition as a whole, it is impossible not to be struck with the immense variety of wines shown, both of comparatively fresh sorts and of different classes of well-known and long-established wines. Taking the old wine countries of Europe alone, France, Spain, and Germany, the three which up to a quite recent period may be said to have produced all the wines consumed in England—even from these three countries alone there comes an almost infinite variety of vintages—and when to these are added the various wines from Italy, Hungary, Greece, Sicily, Australia, and even America, the number becomes almost bewildering. That any of these last mentioned countries can even pretend to rival in their produce the wines of the wine countries *par excellence* it would be absurd to say, but it would be almost as unwise to assert that in a few more years they may not do so. There can be no speciality of climate and soil common to the three first-mentioned countries and to them alone, nor is it possible to suggest any reason why, when once viticulture is sufficiently established elsewhere, and the produce of other countries sufficiently known, the monopoly so long enjoyed should not be overthrown. That the present Exhibition may do much towards this end, by directing public attention to fresh sources of supply, is more than probable, and such a result would be an undoubted gain, for however ample the resources of existing vineyards, it is certain that they cannot keep pace with the constantly increasing demand produced by the rapid growth of our wealth and its accompanying habits of luxury.

In glancing over the contents of the vaults below the Albert Hall—for this is all that can be attempted here—the most convenient course will be to follow the arrangement of the catalogue, which, in its main classification, is drawn up according to the countries from which the wines come. Inasmuch, however, as in many cases the same exhibitor shows the produce of different localities, a strictly geographical arrangement has not always been adhered to.

Beginning with the West Side, Cellar No. I, the first exhibits are those numbered 6,701, and consist of different wines produced from the raisins of Corinth, and shown by the Achaia L. Company, of Patras, Greece. Next comes a considerable variety of wines exhibited under the supervision of the Catalonian Commission. There are here twenty-eight exhibitors (Nos. 6,702 to 6,729), all from Catalonia or Barcelona, and all of course showing one or other variety of Spanish wine.

The eight exhibitors who follow have little in common. No. 6,730, H. Gerke, appears to be the solitary representative of the United States. He sends over specimens of Californian wines, made by himself from his own grapes. The wines sent are of four sorts. 1. "Gerke White Wine," dry and light. 2. "Muscat," from the Muscat of Alexandria grape, also dry, and of a peculiar and special flavour. 3. "Bosquejo." 4. "Angelica." Both the last are sweet wines. All the specimens are of the 1868 vintage, and from grapes grown on an estate situated on the Foot-hills, in the county of Tahama.

No. 6,731 is Haig and Co., whose exhibits are of a general character, and include just those wines which may be taken as forming the stock-in-trade of a London wine merchant. As a sign of the tendency of popular taste towards light and unfortified wines, it may be noticed that Haig and Co., whose experience must have enabled them to gauge with tolerable exactness the changes of the public likes and dislikes, make a special point of what they call "unbrandied" Sherries, *i.e.*, Sherries that are imported in a natural condition.

Hastings and Hughes (No. 6,732), under the title of "Sociedad de Almacemistas," show various descriptions of Spanish wines. In all, the number of their specimens amounts to fifty. Amongst these the exhibitors say that those known as Vino Jerezano, Vino de Pasto, and "Exhibition Sherry," have proved most popular among the tasters visiting the Exhibition. H. Hunter and Son (No. 6,733) show Rhenish and Moselle wines. No. 6,734 is the stall of Ingham, Whitaker and Co., who show Marsala wine from Sicily. This as exhibited is in three separate qualities. It is a cheap wine, stated by the growers to be of a pure and natural character.

C. Kinloch and Co., (No. 6,735) show a great variety of wines, including Spanish, Portuguese, French, Sicilian, Australian, and Greek. Most of these wines are low-priced, but they are recommended by the growers for purity and freedom from added spirit. Among the specialities of this firm are Catalan, both red and white, a wine introduced to England by them fourteen years ago; Tarragona, recommended for its extreme cheapness as "a strong, but agreeable Spanish Port;" "Spanish Red Burgundy," described as a natural wine just over 26, without the addition of any brandy whatever; this is a new wine to this country, as it is

only this year that it has been imported. There are also some wines described as "Virgin" Ports and Sherries, very slightly brandied, and sold at moderate prices; some Greek and some Australian wines, besides Champagnes, Chablis, &c.

The remaining exhibits in this cellar are those of the Spanish and Servian governments (numbered 6,736), who show various wines of their respective countries. The next division is termed the "West Corridor, No. I." The first number here is 6,737, Luigi Calabria (Naples), who shows Posilipo, Capri, Bianco, and Rosso wines. Next is B. Rainford (No. 6,738), who shows a considerable variety of Sicilian wines, both red and white. These in general are of a rather rich, sweet character, though they vary considerably in this respect. Santa Venera, Mastrissa, and Monto Ziretta are red wines; Cavallaro resembles brown Sherry; Nacarrela Albanello, Latte d'Oro, and Alcanbara, are of a lighter character. There are also, in the same part of the cellars, some French and Spanish wines, shown under number 6,739.

In the West Cellar No. II. are five exhibitors, all of French wines. No. 6,740, French Commission; No. 6,741, J. Lagrave and Son, exhibiting Bordeaux wines; No. 6,742, De Lossy and Co., who show high-class Champagnes, guaranteed as grown in the immediate neighbourhood of Reims, and without any admixture of wine produced elsewhere. It is of three qualities, and there is also a "Select Cuvée Specialité" and a "Red Sparkling Champagne" as dark as claret and rather sweet. These last two wines are shown as specialities by this firm. Then are Ressie and Rubat (No. 6,743), and Regnault (No. 6,744), both of whom show samples of Burgundy.

In the West Corridor No. II. are seven exhibitors. Aloys Bursio (No. 6,746) shows some Sauterne; the Marquis de la Cenia some Spanish wines; Caillier and Lalanne (No. 6,748), Bordeaux; Fenwick De Constans et Cie (No. 6,749), Champagne; and M. Hue (No. 6,750), Chateau-Lavergne. J. L. Pfungst and Co. (No. 6,751) exhibit high-class Ay and Epernay Champagnes. These wines are described as being remarkably pure and of excellent quality, and it is understood that the liqueur with which they are flavoured, according to the degree of sweetness required, is quite free from spirit. The Champagnes shown at the next stall, that of Parkinton and Co. (No. 6,752), are of a different sort; while put forward as equally pure, their chief recommendation is considered their cheapness. The wines are shipped by Doupanloup et Cie, and are known as the "Mitre" Champagnes. They are offered as supplying the demand for a genuine wine at the lowest possible price.

In the Central Corridor various French wines are shown by the French Commission (No. 6,753).

In the East Cellar No. III. six exhibitors show Ports, Sherries, and Madeira—Agreda (No. 6,754). H. Holl (No. 6,755) shows Port and Sherry. Of the latter there are fourteen varieties of the "Fino" type, of the former six sorts. Both wines were shipped from the bodegas of Messrs. Silva and Cosens, the one from Jerez de la Frontera, the other from the Alto Douro, and in both cases they have been removed direct from the docks to the Albert Hall without their having left the charge of the Customhouse officer. The exhibitor thus considers that he is able to offer to English buyers a wine that is genuinely the produce of its reputed country, untampered with since its arrival. A. Seguin (No. 6,756) exhibits samples of Sherry, and at No. 6,757 is another set of Spanish wines, shown under the direction of the Spanish Government. W. J. Trafford (No. 6,758), besides a collection of white wine from Jerez, shows "Specimens of earth from vineyards in Jerez, and earth used for fining wine." In the same part of the cellars the firm of Welsh Bros. show samples of their Madeira.

The only exhibits in the East Corridor No. III. are those of the Societa Enologica Astigiana di Asti (No. 6,760).

The East Corridor No. IV. is entirely devoted to wines exhibited through the Austro-Hungarian Commission. Here there are no less than 78 exhibitors (Nos. 6,761 to 6,839).

In the East Cellar No. IV. are some Valencian wines, shown under the authority of the Valencian Commission (No. 6,840).

The East Cellar No. VI. is occupied by J. Denman, who shows Greek and Turkish wines (No. 6,841), and the Victorian Commission (No. 6,842), exhibiting wines from that colony. Greek wines have now been before the public since 1861, so that they have had plenty of time to become well known here. They offer considerable variety of character, but are all strong wines. The principal are St. Elie, a fully-fermented dry wine, said to keep for a long period and improve, though without added spirits, and under 26; White Patras, a wine somewhat like Hock, but stronger; and White Kephisia; also the sweet wines, Ambrosia, Vinsanto, and Lachryma Christi. These and many others, some of which are now familiar enough to English consumers, are exhibited.

In the East Cellar R. Allen, Viscondi di Villar (No. 6,843) shows some Port, and the Portuguese authorities show various wines of the country (No. 6,844. Sampaio and Co. (No. 6,844) also show Madeira.

The East Corridor No. V. is devoted to the exhibition of Australian wines. Sir Daniel Cooper (No. 6,845), P. W. Burgoyne (No. 6,846), and Auld, Burton, and Co. (No. 6,847) are the exhibitors. As an exhaustive account of Australian wines and vines was given by Mr. Fallon, in a paper read before the Society, the 3rd of December last, and published at p. 39 of the present volume, there is the less necessity for discussing them at length. It appears certain that the wines of Australia are rapidly improving, whether from the greater maturity of the vines, the increased skill of the producers, or from other causes. Their alcoholic strength is so high, up to 32, that doubts have been expressed by European experts as to the natural character of the wines. That such doubts were unfounded may now be taken as certain, and it can only be concluded that the Australian climate is calculated to produce a grape from which a wine can be made of this strength. For some time to come it is probable that the colony could consume all the wine it could produce, but it is understood that Australian viticulturists are sufficiently sanguine to hope for an ultimate production which may require more than the home consumption to utilise it. The wines shown by Sir Daniel Cooper are mainly from his own cellar. P. W. Burgoyne shows some sent over by the Australian Vineyards Association; and Auld, Burton, and Co. exhibit their "Auldana" wines, red and white, grown on the vineyards of that name in South Australia.

Such are the principal features of this department of the Exhibition, and though no attempt has been made to estimate the merits of the different exhibits or compare their respective values, it is at least hoped that the description may serve as a guide to the contents of the vaults, and enable those who visit them to obtain with readiness a general idea of the very various classes of wine that are to be found therein.

The following is the return of admissions for the last two week:—Week ending June 13th—Season tickets, 1,215; payment, 10,707; total, 11,922. Week ending June 20th—2,526; payment, 13,572; total, 16,098.

The increase in the mileage of railways in the United Kingdom between 1850 and 1873 was 9,000 miles, and the number of locomotives, 9,500. In India and the Colonies there are upwards of 12,300 miles open. There are 3,374 miles of submerged cable wire in the United Kingdom, 83,408 miles of public telegraph wire, aud 4,311 miles of private wire. There are in India and the British Colonies upwards of 65,000 miles of wire.

EXHIBITIONS.

PHILADELPHIA EXHIBITION.

The following recent decision of the American International Centennial Commission and Finance Committee is given in *Iron* :—

1. Bids are to be opened for contracts for the erection of an art gallery and museum on May 26th, and it is expected that the work will be begun a few days after. The building is to cost 1,500,000 dols., of which sum there has been appropriated for that purpose by the State of Pennsylvania, 1,000,000 dols., and by the City of Philadelphia, 500,000 dols. The building will cover over one-and-a-half acres of ground.

2. The immediate erection of a conversatory hall, at a cost of 200,000 dols., and for this purpose an appropriation has been made by the City of Philadelphia, without any other instructions than the requirements that the money shall be expended for this building. The plans cover a space of one-and-a-half acres of ground.

3. A machine hall, estimated at a cost of 800,000 dols., which has been provided for by a direct appropriation by the City of Philadelphia, free from all restriction, and entirely available for the purpose. Work on this building will begin some months' hence, but in ample time to have it completed for use by the commission. It will cover ten acres of ground, at a cost not to exceed 80,000 dols. per acre.

4. The erection of the main exhibition building will be begun as soon as the plans are perfected. This can probably be accomplished by the last week in June. This building is to cover a space of about twenty acres, at a cost not to exceed 100,000 dols. per acre; say a total of 2,000,000 dols. To this work subscriptions to stock are applicable, which, making due allowances for losses, now amount to about 1,800,000 dols., leaving but 200,000 dols. yet to be provided for this purpose.

5. An agricultural hall to be provided for, to cover about five acres of ground, and cost about 250,000 dols.

6. Grading, draining, water, and railroad connections, &c., say 1,000,000 dols.; general administration, say 500,000 dols.; for errors in estimates and for contingencies, say 875,000 dols.; total expenditures, exclusive of art gallery and museum, 5,625,000 dols., of which the City of Philadelphia has appropriated, direct and without reservation, except in designation of the particular buildings upon which the amount shall be expended, 1,000,000 dols.; actual subscriptions, 1,800,000 dols.; total to be provided for, 2,825,000 dols., which amount the Board of Finance have no doubt of being able to raise from the people and from the General Government. The statements heretofore submitted by the Board of Finance were based on buildings of a character which was indicated by the commission, but under the present circumstances the committee deem it wise that the buildings should be of a simple character, and on that basis this report is submitted.

Industrial Art Exhibition, Brussels.—Doubts having been expressed whether the great central market buildings would be ready for the promised exhibition of industrial art, the architect and engineers of this remarkable building have formally assured the Burgomaster that the preparations for the proposed exhibition may be commenced on the 15th of July, and that the opening may take place on the day fixed—the 1st of September. The exhibition is expected to be very brilliant; nearly the whole of the producers of artistic manufactures having responded warmly to the appeals of the Commission.

Travelling Industrial Exhibition.—The idea of ambulatory exhibitions has been adopted and put into practice in Russia, at the cost of the Government. It includes the means of instructing the people, by the exhibition of the best processes, illustrated by experiments and explanations, in all kinds of industries and arts applied to industry and agriculture. This exhibition is now making the tour of Moscow, Nijny, Kazan, Saratoff, Orel, Vilna, and Riga, and it will in succession visit all the towns in the Empire.

SANITARY PROGRESS.

At home considerable progress has been made during the past twelvemonth by the Local Government Board, in devising and executing (both in urban and rural sanitary districts) works of main-sewering, house-draining, water supply, and street improvements, under the powers of the 44th section of the Public Health Act, 1872. The Public Works Loan Commissioners have in many cases advanced the amounts of the estimates for main-sewering, &c., at 3½ per cent., repayable in thirty years. This has been, and will continue to be, a great incentive to progress, the results being increased comfort, with relieved death-rates and lessened poor-rates. The Colonial Government has had before it during the past year plans of sewerage and of water supply for Trinidad, Singapore, Hong-Kong, Freetown, Sierra Leone, and other of the colonies. English engineers have also been consulted as to works of sewerage and water supply for Odessa, for St. Petersburgh, and for Pesth. The Army Sanitary Committee continues to receive and to analyse reports and returns from British India, as to outbreaks of zymotic diseases, and also to advise as to works of prevention. The question has arisen in Australia as to efficiently sewering Melbourne and Sydney, so that the world generally is beginning to appreciate the necessity there is for attention to sanitary questions and works which shall be conducive to good government and to health.

The six largest steamers in the world, says the *American Manufacturer*, are the *Great Eastern*. owned by the International Telegraph Construction and Maintenance Company, 674ft. long, 77ft. broad; the *City of Pekin*, lately launched on the Delaware River, Pacific Mail Steamship Company, 6,000 tons, 423ft. long, 48ft. broad; the *Liguria*, Pacific Steam Navigation Company, 4,820 tons, 460ft. long, 45ft. broad; the *Britannia*, White Star, 4,700 tons, 455ft. long, 45ft. broad; the *City of Richmond*, Inman, 4,600 tons, 453½ft. long, 43 beam; and the *Bothnia*, Cunard, 4,500 tons, 425ft. long, 42½ broad.

According to the latest official returns, there were registered as belonging to the United Kingdom, in 1873, 3,852 iron steam-vessels of 1,711,767 aggregate tonnage. In the same year no fewer than 63,000 British steam-vessels of both kinds, measuring 50,388,055 tons, entered with cargoes at ports in the United Kingdom from foreign countries and the coasting trade—a marvellous increase from the 104,680 tons in 1850.

According to *Iron*, Mr. Gerhard, of Bradley, near Bilston, has invented a new process of making iron from flue cinder. The particulars are as yet a secret, but it is stated that the invention has a practical value which will especially recommend it to the North of England districts, where the material proposed to be utilised is at present regarded as mere waste.

A series of Popular and Educational Lectures on the History and Philology of Assyria and Egypt, on the plan followed by the Continental professors, will probably soon be originated under the sanction of the Council of the Society of Biblical Archæology.

The *Annalen der Physik und der Chimie* states, on the authority of Herr August Kundt, that gutta-percha and caoutchouc become dichroic by stretching, and exhibit a dark brown tint in one direction, and a straw yellow one in another.

An announcement from Calcutta says that the first bridge built over the Ganges in that city has been opened for traffic.

GENERAL NOTES.

Sericiculture.—The committee of the Lyons Geographical Society has offered prizes for the successful treatment of the following among other subjects:—A map, on which are marked by certain signs the districts producing silk cocoons, and also the markets of each district for inland as well as for export and import trade. This chart must be accompanied by a memoir containing clear and exact statistical notices. Map and memoir are to be sent in before March 31, 1875, to the secretary of the society, Quai de Retz. The prize for the successful treatment of the work is a medal of the value of 500 francs.

Coal Mining in Russia.—Coal mining has taken a great development in Russia of late years, and notably with regard to the bituminous coal-fields of Ekaterinoslov. At first these were worked in a very primitive and unscientific fashion, but latterly this has been improved, capital having been introduced into the work. For household use it may be noticed that the bituminous coal is not liked in South Russia, where it is chiefly produced, and anthracite alone is burnt. The extent of the coal-fields in the Government of Ekaterinoslov and the Cossack territory cannot be exactly stated, but it is estimated that there are about 30,000 square miles of land, containing very rich seams of bituminous coal, anthracite, and half-anthracite. In one estate in this district two shafts have been examined, one has been sunk sixty yards in depth, and the other 120. Six different varieties of coal were found—from coking coal to steam and superior household. The good seams commence at a depth of about 180 feet from the surface, while the greatest depth to which borings have as yet been made is about 500 feet. At some parts coal is found close to the surface, but the quality of such coal is not good, whereas at 200 feet from the surface a good steam coal is found, burning with a bright flame, and giving little slag.

Emigration to the United States.—According to a report published not long since by the statistical bureau at Washington, it appears that the total number of emigrants that landed in the United States from the 1st July, 1872, to 30th June, 1873, was 459,803, of whom 275,762 were males, and 184,011 females; it appears also that 567 died during the voyage; the number of emigrants under 15 years of age was 104,672; between 15 to 40 years of age 288,272; over 40 years of age 66,859. Of this number 307,334 emigrants landed at New York; 58,917 at Huron; 31,676 at Boston; 20,917 at San Francisco; 17,897 at Baltimore; 6,304 at New Orleans, and 4,524 at Portland. Respecting the different nationalities of these emigrants, the greatest number, viz., 166,793 were from Great Britain and Ireland; 149,671 from the German Empire; 5,765 Austrian subjects; natives of Sweden, 14,303; from Norway 16,247; Danes 4,931; 3,811 from the Netherlands; 1,176 Belgians; 3,107 Swiss; 17,798 French; 541 from Spain; 8,715 Greeks; 1,347 Hungarians; 1,560 Russians; 3,338 Poles; 20,292 Chinese; 31,711 Canadians; 3,919 from Nova Scotia; 1,161 from the Azores, and 1,130 from Australia.

Algeria.—The French Government has recently voted the sum necessary for the formation of a great inland sea in Algeria, 190 miles long by 36 broad, to the South of Biskra. It is thought by the *Revue des Deux Mondes*, that the result of this measure will be a great improvement in the climate of the interior, a great addition to the facilities for inland transport, and the introduction of commerce and civilisation into the very heart of Africa. The Chott Mal-Rir (*Chott* implying the bed of a lagoon), the proposed site of this inland sea, is found to be at least 27 mètres below the Mediterranean; while the Chott Sellem, with which it communicates, which lies between it and the sea, is 13 mètres lower still. A chain of Chotts, of smaller area, but equal depression, extends thence to within 18 kilomètres of the Gulf of Gabès, and a canal connecting the nearest Chott with the sea would admit the waters of the Mediterranean, and convert the desolate region of Chott Mel-Rir into a great inland sea. The estimated cost is only fifteen millions of francs, and the engineering difficulties, after tho experience gained during the construction of the Suez Canal, would be inconsiderable. A full account of the project is given in the first June number of the *Revue*.

Leather from the United States.—The shipments of leather from America to Europe, from the 1st of January to the end of March this year, amounted to 258,038 half hides of sole-leather, of which 232,799 came from New York, and 25,239 from Boston. The value of upper leather and split hides shipped from Boston in the same time amount to 38,334 dollars. The value of the sole-leather, at the average rate of four dollars per side, is above a million dollars. More than half of the quantity came to Liverpool, to be distributed thence over England and tho Continent. The export from New York has increased. That city sent 45,880 sides of sole-leather to Hamburg, 19,436 to Bremen, 131,045 to Liverpool, and 14,220 to London, besides a quantity to other ports.

Wages in Belgium.—The annual report of the Provident Society of Mons gives some information relative to the wages of the miners of the Hainault district. It appears that the proprietors of the mines paid during the year 1873 37,000,000 francs to 32,000 individuals for 10,300,000 days' work, which gives an average of 3 fr. 61 per diem, or 60 centimes above the rate of 1872 for men, women, and children taken in the aggregate. With such low wages the work-people subscribed to the funds of the society, from 1841 to 1873, the sum of 3,700,000 francs, and received nearly twice that amount in the shape of pensions and assistance, the balance being paid by the state and the employers. There were 3,006 pensioners in 1873, or 324 more than in 1872; the average of the pensions was only equal to £5 10s. per head.

NOTICES.

SUBSCRIPTIONS.

The Midsummer subscriptions are due, and should be forwarded by cheque, Post-office order, or Cheque Bank cheque, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

A Gazetteer of the Province of Sindh. Compiled by A. W. Hughes, F.S.S. Presented by the Secretary of State for India in Council.

The Complete Works of Count Rumford. Vol. II. Published by the American Academy of Arts and Science. Presented by the Academy.

Tables of British Commerce, showing the relative value of our Colonial Trade, with Map, by C. W. Eddy. Presented by the Author.

A Practical Handbook of Dyeing and Calico-printing, by William Crookes, F.R.S. Presented by the Publishers, Messrs. Longman.

Enquête sur l'Exploitation et la Construction des Chemins de Fer. Publiée par ordre de son Excellence le Ministre de l'Agriculture, du Commerce, et des Travaux Publics. Presented by the Marchioness of Clanricarde.

Enquête sur les Moyens d'Assurer la Régularité et la Sûreté de l'Exploitation sur les Chemins de Fer. Publiée par ordre de son Excellence le Ministre de l'Agriculture, du Commerce, et des Travaux Publics. Presented by the Marchioness of Clanricarde.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Tues. ...Statistical, 12, St. James's-square, S.W., 3½ p.m. Annual Meeting.

Wed. .. Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.

Fri. ......Geologists' Association, University College, W.C., 8 p.m.
Archæological Institution, 16, New Burlington-street, W., 4 p.m.
Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m. Professor Bentley, "On the Reproductive Organs of Plants."

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,128. Vol. XXII.

FRIDAY, JULY 3, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

REVOLUTION INDICATOR.

A meeting of this Committee was held on Friday, the 26th ult. Present—Vice-Admiral A. P. Ryder (in the chair), Mr. T. Brown, Capt. E. P. Nisbet, Mr. J. R. Ravenhill, Mr. Seymour Teulon, and Mr. T. R. Tufnell.

ENDOWMENT FUND.

The following subscriptions have been received towards the establishment of an Endowment Fund for the Society:—

	£	s.	d.
G. T. Saul	5	0	0
W. R. Spicer	5	0	0
Colonel A. Angus Croll	20	0	0
G. W. Hart	2	2	0
Charles H. L. Woodd, F.G.S.	5	0	0
John E. Evans	2	2	0
Sir Walter E. Trevelyan	50	0	0
E. T. Blakely	1	1	0
W. R. Sandbach	50	0	0
Thomas Dixon	1	1	0
W. Atkinson	50	0	0
John Noble	20	0	0
James Bentley	20	0	0
J. Jonas	1	1	0
Samuel Jackson	5	5	0
Charles Goding	20	0	0
F. Mocatta	10	10	1
Jonah J. Wells	10	10	0
Charles Downes	2	2	0
G. T. Saul	2	2	0
Mrs. Charlotte Holmes	10	0	0
John Knowles	25	0	0
Sir John Le Couteur	1	0	0
John Peckover	5	5	0
Frederick Braby	2	2	0
Decimus Burton, F.R.S.	5	5	0
Percy Rowlands	2	2	0
The Right Hon. Lord Hatherley	20	0	0
Colonel John Thomas Smith, R.E.	2	2	0
Ardaseer Cursetjee, F.R.S.	5	0	0

IMPROVED RAILWAY LAMP.

The Society's Gold Medal, or Twenty Guineas, is offered for an improved lamp or means of illumination, suitable for railway passenger-carriages, that shall produce a good, clear, steady, durable, and safe light.

It must be simple in construction, and capable of being readily cleaned and repaired.

In judging the merits, cost will be taken into consideration.

Specimens, in a condition suitable for trial, to be sent in to the Society's House not later than the 1st of November, 1874.

The Council reserve to themselves the right of withholding the medal or premium offered, if, in the opinion of the judges, none of the articles sent in competition are deserving of reward.

ANNUAL INTERNATIONAL EXHIBITIONS.

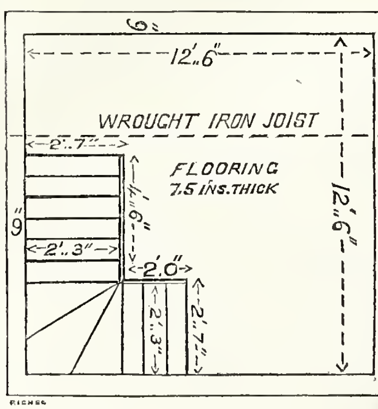
[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

BUILDING IN CONCRETE.

By W. C. Homersham, C.E.

In the portion of waste ground near the machinery room, known as the Western Annexe, there are four firms exhibiting buildings of concrete in course of erection. As it is intended to carry on the process of building during the next few months, it is only possible to describe the erections as they now are, and it must be remembered that they are from day to day continually changing.

One exhibitor, Mr. Drake, is building a two-story house 12ft. 6in. square in internal dimensions, with walls nine inches in thickness throughout. The walls are at present carried up a few feet higher than the level of the first floor, which is finished off, as also are the stairs leading thereto. The steps are very neatly moulded in concrete, and have much the appearance of having been worked out of sandstone. The concrete in the walls of this building is composed of a compound of Portland cement and selenitic lime, gauged one part of the compound (one-third Portland cement, two-thirds selenitic lime) to seven parts of gravel containing a suitable proportion of sand. The stairs and first floor are made of concrete gauged with pure Portland cement and gravel, in the proportion of one part of the former to five of the latter. In the construction of the first floor one light wrought-iron rolled joist was embedded in the concrete in the position on plan shown in the figure.



Another exhibitor, Mr. Tall, has a house 17ft. 6in. by 16ft., on the plan, in internal dimensions, in about the same stage of erection as the one already re-

ferred to. In this structure there are no stairs or means of communication internally between the ground and upper floors. The upper floor is completed, and covers the entire space enclosed by the walls. The underside of the upper floor, that is the ceiling of the ground floor room, is slightly domed. The walls, which are twelve inches in thickness, and the flooring, are composed of Portland cement concrete, gauged in the proportion of one part of cement to seven parts of hard lumps of burnt clay, technically termed "burnt ballast," mixed with sand, for the former, and in the proportion of one to five of burnt ballast and sand for the latter.

There are also a set of six concrete rooms, erected by Mr. Nichols for the purpose of testing the stoves sent in for the Society's prizes. Though these were not built specially for purposes of exhibition they may be regarded as giving with the other buildings specimens of this mode of construction. It must be borne in mind that the walls have not been faced, but remain in the rough state in which they have left the mould.

A fourth exhibitor, Mr. Lish, is showing a material he calls "Tilo-concrete." In this case a single room with door and window is being built, and the material is concrete faced with tile and terra-cotta mouldings. The tiles are arranged in a supporting frame in their proper position, and concrete filled in behind. They are formed with a dove-tail or feather behind, round which the concrete sets and holds them fast. The effect is thus produced of a smooth tiled wall. The cost is stated to be about the same as that of the best brick-work. A principal feature of this exhibit is the method of construction employed. At the commencement of the work "guide screws" (in place of the external uprights now in use) are set in the foundation trenches and "plumbed," when the concrete for foundations is filled in round them; after this material has set, these "guides" are screwed up to receive cross-heads, from which the wall panels are suspended. For building ordinary concrete walls plain wooden panels are used, but when the work has to be faced with tiles a skeleton iron panel is employed with rebated bearers to retain the tiles accurately in position until each day's work has set. When one portion is sufficiently set, by means of the screws the panels and the platform which rests on them, and serves instead of a scaffolding, are raised, and the work continued as before.

There is one fact noticeable in all the exhibits in a greater or less degree, and that is the ignorance shown by the constructors of the great strength of concrete to bear strains, tensile and other. There can be no doubt that the insertion of the wrought-iron rolled joist in the flooring, of which a plan is given in the figure, is a source of weakness rather than of strength. Portland cement concrete will not adhere to a surface of iron with anything like the same amount of force that the particles of which it is composed hold to each other. In that building also, which is entirely covered with a domed ceiling in concrete, a mistake appears to have been made. Are walls twelve inches in thickness, and nearly as many feet in height, adapted to take the thrust at the top of a very flat arch? Would not a floor of uniform thickness and containing less material (concrete) have been the stronger? To enable the reader to form an opinion for himself on the subject of the latter question, some facts will be hereafter given concerning the strength of Portland cement concrete. A thorough examination of the structure, of which a plan of the first floor is given in the figure, must alone convince the most sceptical on the point of the great value of concrete in Portland cement as a building material, not only for the walls, but for the flooring of every storey and the roofing of houses of every description. The overhanging corner of the flooring at the well for the stairs, marked A, in no way supported from below, is quite firm and free from vibration when walked upon, or even when jumped upon by two youths of an aggregate weight of over 2 cwt. The floor is seven and a-half inches in thickness.

From the results of experiments made some years since, it can safely be affirmed that the staging necessary for carrying a concrete floor, in the green or wet state, of a room say twelve feet six inches in width, by twenty-five feet or any other dimension in length, may be struck in a week after the completion of the floor if the concrete be only six inches in uniform thickness, and gauged in such proportions that every cubic yard when in *situ* contains four bushels of cement and six bushels of clean, sharp, silicious sand. One month after the concrete has set, the floor would be capable of sustaining an equally distributed load of one hundred-weight per foot superficial, and twelve months after, an equally distributed load of four hundred-weight per foot superficial. If the thickness of the flooring be increased to twelve inches, and the concrete be gauged as above, a room nineteen feet six inches in width by forty feet or any other dimensions in length, may be covered, with the results as to strength the same as those given for the room twelve feet six inches in width.

The roof of a room twelve feet six inches in width may be formed with a layer of concrete four inches in thickness, and that for a room twenty feet in width need not exceed nine inches in thickness. Concrete in Portland cement is admirably adapted for the construction of roofs of buildings; concrete is far less pervious to water than the best brickwork, and when its surface is rendered with a thin coating of compo gauged one of Portland cement to one of sand, it is perfectly impervious to damp, though it be kept covered with water. The fact may not be generally known that Portland cement compo has not that tendency to peel off when on concrete in cement, which impairs its efficacy as a facing for brickwork. This is accounted for partly by the surface of concrete (being rough) forming a capital key for the compo, but principally by the far more important fact, that there is no damp in Portland cement concrete after it has thoroughly set. Brickwork absorbs and retains moisture, which, being acted upon by frost, swells, and lifts the plaster from the smooth surface of brickwork. Such cannot be the case with concrete.

Not only is a coating of Portland cement compo valuable on the top surface of the layer of concrete forming a roof, as a protection against damp, but it forms an excellent surface for the flooring of a building. A surface of Portland cement compo resists the action of the tread quite as well, if not better, than some of the superior sorts of stone used for making steps.

The public might here derive great advantage from the practical manner in which the four exhibitors have explained their respective ideas on the subject of building in concrete. The houses they are in the act of constructing will doubtless do much during the season to convince many a visitor that it is possible to construct not only cottages but mansions the most extensive in concrete. A structure composed solely of concrete in the stairs, floors, and roof, as well as walls, is practically monolithic, and not only perfectly water and damp proof, but as nearly as can be conceived proof against the ravages of that all devouring element—fire. By forming the division walls between the various rooms, of Portland cement concrete, each room will be rendered sound-proof, concrete being an excellent nonconductor of sound. The concrete for the walls of buildings need not contain more than three bushels of Portland cement and six bushels of sand per cubic yard. In critically examining the structures in concrete being constructed in the Western Annexe, the visitor must not lose sight of the fact that the exhibits are made by firms desirous of calling the attention of the public to particular forms of apparatus for facilitating construction in concrete, and not by architects desirous of ventilating their professional abilities in the art of adapting a comparatively speaking novel material to building purposes. Had the case been otherwise, there is no reason to doubt there would have

been no drawback to the efforts made by the exhibitors in an architectural point of view, such as there is at present. The surfaces of the walls and ceiling of some of the structures are in the rough state, and exemplify the truth of that which has been stated above concerning the excellent key that can be left on the surface of concrete for a rendering of compo. The inner and outer surfaces of the walls, &c., of the building erected by one of the exhibitors are finished off, and have a very neat and clean appearance, though it must be owned the sight reminds one too much of our suburban builders' style of architecture. The writer has seen some very handsome face work on concrete made by embedding split flints therein, with the split face exposed. How many lovers of good architecture have walked miles to examine a particularly fine piece of flintwork, such as is to be seen at St. Augustine's Monastery, Canterbury, and in many other old buildings in that city? Why should not we of the present generation attempt at any rate to vie with our ancestors in this particular art, if such a use of the term may be permitted? In chalk countries where suitable flints are plentiful, field labourers are generally to be found who have been taught the knack of splitting flints. In places where such is the case, a facing of split flints exceeds but little in cost that of forming a face of compo.

For cottages and outhouses, &c., a very clean and neat face may be given to the walls and ceiling by placing a course of pebbles on the exterior surfaces. The pebbles, when their outer surfaces have been freed from any compo that may have passed between them during the time of the setting of the concrete, form a surface that is agreeable to the sight and capable of receiving any amount of relief or ornament in compo, the surface being so admirably adapted to key the same. Little more need here be said on the subject of embellishment in concrete, as there are many members of the engineering, and doubtless of the architectural profession also, who could and would design and build a structure wholly in concrete that would prove as pleasing to the great majority of persons of taste in such matters as if it were constructed with brickwork and stone.

Notwithstanding that the exhibits prove the great strength of Portland cement concrete, they present no data on which to calculate the exact strength of any particular piece of flooring or wall. Mr. John Grant, C.E., of the Metropolitan Board of Works, investigated the subject of the properties and strength of Portland cement, and has given the valuable and thoroughly reliable results to the world in papers read before the members of the Institution of Civil Engineers. The first paper was read by Mr. Grant in the session 1855-6, and will be found in the 25th volume of the Minutes of Proceedings of the Institution of Civil Engineers, and a second paper was read in the session 1870-2, and will be found in the 32nd volume of the Proceedings.

The following table gives the results of experiments made by Mr. Grant on the tensile strength of Portland cement, weighing 112 lbs. per imperial bushel, gauged neat, and also with various proportions of clean, sharp, silicious and other sand, after having been kept under water respectively one week, one month, and twelve months, the particulars of which will be found in the papers:—

Table of the Tensile Strength in pounds avoirdupois of Sections ($1\frac{1}{2}$ in. × $1\frac{1}{2}$ in. =) $2\frac{1}{4}$ inches in area of Portland Cement, when gauged with

In the Proportion of	Clean, Sharp, Pit Sand, after			Clean Thames Sand, after			Loamy Sand, after		
	One week.	One month.	One year.	One week.	One month.	One year.	One week.	One month.	One year.
Neat	445	680	1,076	—	—	—	—	—	—
1 to 1	152	326	796	97	309	700	114	275	645
1 to 2	64	166	607	52	123	458	53	130	533
1 to 3	44	91	424	27	58	321	21	68	358
1 to 4	22	71	318	—	32	222	—	60	244
1 to 5	—	49	216	—	21	122	—	31	166

From the same authority the materials are drawn for the following:—

Table of the Compressive Strength in tons of Surfaces (9 in. × $4\frac{1}{4}$ in. =) $38\frac{1}{4}$ in. in Area of

In the Proportion of	Portland Cement when Gauged with Clean, Sharp, Pit Sand, after		
	Three months.	Six months.	Nine months.
Neat	65	92	102
1 to 1	43	59	78
1 to 2	34	47	62
1 to 3	24	37	41
1 to 4	23	31	38
1 to 5	16	26	29

It is stated also in the same papers that the crushing weight of a good stock brick laid on the flat (area about 9 in. × $4\frac{1}{4}$ in. = $38\frac{1}{4}$ in.) is 34 tons, that of a wire-cut gault brick 33 tons, of a compressed gault brick 35 tons, of a brimstone Suffolk brick 44 tons, and that of a fire brick 63 tons. A fire brick, though it offers nearly double the resistance to a crushing force that stock brick does, is only as powerful to resist a compressive strain as is a similar brick of Portland cement gauged with double its bulk of sand, at the end of twelve months.

The transverse strength of fixed slabs of concrete in Portland cement may be calculated by the following formula, when the concrete has been made of first-rate materials and thoroughly incorporated with four bushels of cement of the first quality, and six bushels of clean, sharp, silicious sand, per cubic yard.

Let A represent the area of the transverse section of a slab, and D the thickness thereof, both in inches, L the length of the span in feet, and W the equally distributed load in cwts. that will cause a rupture in the concrete at the end of a week, after the concrete has been left to set, then

$$\frac{A\,D}{4\,L} = W.$$

The constant is 1·6 in place of 4 for the strength at the end of a month, and 0·56 for the strength at the end of a year.

Example.—What amount of uniformly distributed load will a slab of Portland cement concrete (gauged with 4 bushels of cement, and 6 bushels of sand per cubic yard), 15 feet in length by 1 foot in width, and 6 inches in thickness, bear at the end of a week, a month, and a year when fixed on bearings 13 feet apart.

$$\text{Area }(12\text{ in.}\times 6\text{ in.}=)\ \frac{72\text{ in.}\times 6\text{ in.}}{4\times 13}=8{\cdot}3\text{ cwts. at the end of a week.}$$

$$\frac{72\times 6}{1{\cdot}6\times 13}=20{\cdot}76\text{ cwts. at the end of a month.}$$

$$\frac{72\times 6}{{\cdot}56\times 13}=59{\cdot}34\text{ cwts. at the end of a year.}$$

The weight of the concrete itself often forms an important item in the amount of the load to be carried, particularly when the length of the span or opening is considerable.

Concrete varies considerably in density, but in calculating the amount of the weight as a quiescent load, it will suffice for all practical purposes to take the weight of a cubic foot at 1·2 cwt., which is equal to 0·1 cwt. per foot superficial for each inch in thickness of a slab of cement.

The weight of a six-inch slab of concrete, one foot in width by 13 feet in length (between the bearings) so calculated is (1 × 13 × ·6=) 7·8 cwt.

By the foregoing calculations it appears that such a slab after it has been made a week is capable of sustaining an uniformly distributed load of 8·3 cwt., or ·5 cwt. in excess of the quiescent load in the shape of the weight of the concrete itself. It follows that the supporting staging may be struck with safety at the end of a week.

At the expiration of one month the transverse strength of the slab is increased so greatly as to enable the slab to bear a uniformly distributed load of 20·76 cwt. in the gross or (20·76 — 7·8 =) 12·96 cwt., independent of the weight of the concrete. Again, at the end of a year the transverse strength is further increased, and the slab will sustain 59·34 cwt., uniformly distributed in total, or (59·34 — 7·8 =) 51·54 cwt., independent of its own weight. In other words, a six-inch slab of Portland cement concrete, one foot in width, spanning an opening of thirteen feet, is capable of sustaining, after it has been made twelve months, an uniformly distributed load equal to nearly four (3·96) cwt. per foot superficial. To attain uniformity in the strength of concrete, so essential in the construction of monolithic floors and roofing, it is advisable to adopt the French system of mixing, that is, gauging the cement and sand into a compo in the first instance, and then adding clean-washed shingle or burnt ballast, or a mixture of the two, in the proportion necessary, according to the nature of the work to be executed.

Great attention must be paid to the quality of all the materials used in making concrete in Portland cement, even to the water, which should be perfectly clean. The weight of the cement per imperial bushel should not exceed 116 lbs., or be less than 112 lbs., when dropped into the measure from a board fixed, say two feet above the top of the measure. The sand should be rather large-grained, sharp, silicious sand, and must be washed perfectly free from loam or other extraneous matter. The shingle also should be washed free from particles of sand as well of loam and other foreign matters. The thorough incorporation of the cement and sand is facilitated by mixing them dry under edge-runners for a period of five minutes for each portion of sand there is to one of cement before adding the water; thus, in the concrete for the floors, the writer would recommend the compo to be gauged one and a-half of sand to one of cement, therefore it should be mixed dry under edge-runners for ($5\times1\frac{1}{2}=$) $7\frac{1}{2}$ minutes. In the concrete for walls if the compo be gauged at two of sand to one of cement, the time of mixing dry should be ($5\times2=$) 10 minutes; and when the nature of the work to be executed is such as to permit of the compo being gauged three of sand to one of cement, then the time must be extended to fifteen minutes.

The prime cost of concrete varies considerably according to the site on which it is used and the nature of the work to be executed. Thick walls of a building in concrete, as in brickwork, are less expensive per cubic yard to construct than walls that are thin. Boundary or garden walls may be constructed with safety of concrete gauged in such proportions that each cubic yard contains only two and a-half bushels of Portland cement and seven bushels of sand.

The public have the advantage of seeing in the exhibits two distinct materials used to form the body of the concrete—gravel and burnt ballast. Both make equally good and strong concrete; but perhaps concrete of burnt ballast is to be preferred for the construction of flooring and roofs. It is both lighter and better adapted to resist the action of fire than concrete of gravel.

The first cost of cottages in concrete, with concrete stairs, floor, and roof, is from 30 to 40 per cent. less than a building of brickwork, with slate roof and timber floors. Besides first cost, the cost of maintenance has to be taken into consideration in determining the actual value of any property. This is entirely on the side of concrete as a building material. There have been many cases where far larger sums have been expended, and fairly expended, in breaking up a piece of good concrete in cement than it cost in making.

To enable the reader to form an approximate idea of the cost of Portland cement concrete *in situ* in a cottage or two-story building, it may be mentioned that the cost for labour of all kinds should not exceed 2s. 9d., but say, 3s. per cubic yard or £1 14s. per rod. The cost of Portland cement may be taken at 2s. 6d. per bushel delivered on to the works, including the cost of testing. The paper read by Mr. Grant before the members of the Institution of Civil Engineers (see 25th volume of the Proceedings) concludes with a most needful warning from the author against the use of Portland cement, by any engineer or architect who is not prepared to take the trouble and incur the expense of thoroughly testing every bulk of cement on its delivery on the site of the works.

First-class concrete for floors and roofs, as has been shown, requires 4 bushels per cubic yard, or $45\frac{3}{8}$ bushels per rod, making the cost for Portland cement 10s. per cubic yard, or £5 13s. 6d. per rod.

Concrete of the second class, for walls of buildings, contains 3 bushels per cubic yard, or 34 bushels per rod, the cost of which is respectively 7s. 6d. and £4 5s.

In garden walls and steps for stairs the cost of the cement is only 6s. 3d. per cubic yard, or a little less than £3 10s. per rod. Two and a half bushels per yard, or twenty-eight bushels and a third per rod, are thus all the cement that is required.

Should there be a pit of good clean gravel handy to the site of the works, to produce the necessary quantities of shingle and sand, the cost of the gravel to make one cubic yard of concrete should not exceed, say 15d., including carting, screening, and washing, that is, 14s. 2d. per rod. When the cost of getting first-class gravel on to the ground exceeds 3s. or 3s. 6d. for the quantity necessary to make a cubic yard of concrete, it may prove more economical to burn clay from the foundations of the buildings, &c., and make burnt ballast.

The minimum cost of burning ballast when clay fit for the purpose is found on the site of the works may be put down at 3s. per cubic yard, including the cost of labour in sifting and washing, but not of providing the necessary quantity of water. The quantity of water required for washing and soaking burnt ballast is about 20 gallons per cubic yard, or a ton weight per rod. One half that quantity will suffice for washing good gravel, containing

the proper proportion of clean sharp silicious sand; such only should be used in making concrete. The quantity of water requisite for gauging the compo is about three gallons per bushel of Portland cement and one gallon per bushel of damp sand.

The case will prove to be very exceptional where the cost of Portland cement concrete *in situ* in a building proves to be on the average less than 10s., or more than 16s. per cubic yard, *i.e.*, £5 13s. 6d., or £9 1s. 6d. per rod.

In Room 22 of the International Exhibition will be found samples of Portland cement and of blocks of compo thereof gauged neat, that have been tested, and when broken the amount of the tensile strain which broke it may be seen marked on each.

The "Testing machine for cement," exhibited in the same room (No. 5,719), is by no means satisfactory; it compares very unfavourably with the excellent, delicate, and well-adapted instrument used by Mr. Grant in making all the experiments of which he gives the particulars in his papers before referred to. In testing with an instrument of the pattern adopted by Mr. Grant, the block of compo cannot be subjected to any amount of jar or vibration, and the exact breaking weight to a pound is registered.

In Room 22 will also be found exhibits of the Selenitic Cement Company (Limited) and of that made by Alex. McClean and Company. They both deserve the careful consideration of any person interested in building operations, and particularly of those contemplating building in concrete. The "superfine quality" cement exhibited by the latter is very white, and takes a very high polish, as is exemplified by some of the articles in the exhibit.

The following is the return of admissions for the week ending June 27th—Season tickets, 1,177; payment, 13,099; total, 14,276.

CHANNEL PASSAGE.

The Bessemer saloon steamer is rapidly approaching completion. The vessel has been completely plated, and the fitting of her engines and boilers in place will soon be accomplished. This work will be done while the ship is on the stocks, so that when she is launched she may at the same time be sent upon her trial trip. She is 350ft. long at the water-line, and for 48ft. at each end the deck is only 4ft. above the line of flotation, so that in rough weather the sea will wash over these low ends. The decks on this portion of the vessel have a considerable curve, and the sides of the ship are rounded off so that the water may escape as speedily as possible. This form of end has been selected with a view to obviate any tendency to pitching. Above these low decks a breastwork is erected about 8ft. high. It is 254ft. long and all the width of the vessel. The whole of this breastwork deck is to be devoted to the use of the passengers, and that portion fore and aft of the paddle-boxes will be protected with stanchions. The vessel will be propelled by four paddle-wheels, and 90ft. of the space between the paddles will be occupied by the swinging saloon. Beyond this, and at each end, the space is occupied, nearest the saloon by the engines, and next by the boilers. At one end of the breastwork there will be accommodation for the crew of the ship, and beneath their quarters stowage room for passengers' luggage, &c. At the opposite end of the breastwork the space is fitted with cabins for the use of ladies, and below these cabins there is a saloon 52ft. long, and fitted with sofa seats all round. Along the sides of the breastwork deck, between the paddle-boxes, there are other cabins for passengers, besides smoke-rooms and refreshment-rooms. The Bessemer swinging saloon is making progress, and already a good idea of the principle may be obtained by an inspection of the work. The saloon proper is about 70ft. long, 26ft. wide, and very lofty. The weight of the saloon is borne by four large bearings, one at each end and two near the centre. The end bearings are fixed on iron transverse bulkheads, which are well-stiffened by fore and aft ways to prevent them buckling. The saloon is expected to be one of the most superbly-fitted apartments afloat. The top of it will form a promenade deck, and it will be fitted all round with seats. The ship will be supplied with two very large life rafts on the plan patented by Mr. Christie, and she will be steered and her capstans, &c., worked by hydraulic machinery. She was designed by Mr. E. J. Reed, C.B., M.P.; and Earle's Shipbuilding and Engineering Company at Hull, are both the builders and the engineers.

THE ROCHDALE SEWAGE SYSTEM.

A recent report of the Health Committee of the borough of Rochdale gives some instructive information about the system adopted in that town for the removal of house refuse and night-soil. This committee was appointed to carry out all the provisions of "The Rochdale Improvement Act, 1872," and the several Acts incorporated therewith in relation to the baths, the cemetery, the cleansing of the river, the removal of night-soil within the borough, and the manufacture thereof into manure and other similar matters; also to make such arrangements as might from time to time be considered necessary to promote the health of the inhabitants of the borough. Of all these objects the principal is, of course, the introduction of the special system adopted for utilising the sewage and refuse, and it is this with which the committee in their report principally deal. They consider that system to have proved a decided success, and think that the Rochdale experiments are conclusive as to the advisability of its introduction elsewhere.

The mode of collection is as follows:—The town is divided into six districts, and each privy is numbered consecutively in a district register, so that in case of any contagious or infectious disease arising in the town, the numbers of the privies in connection with the houses in which the disease exists can be communicated to the local authority, when arrangements can be made for the daily disinfection of the privies, and for the isolation of the excreta. All privies are emptied once a week, care being taken that none are passed over.

In collecting, no emptying or filling takes place, the privies being supplied at each collection with a fresh receptacle, in which is placed a disinfectant. To prevent any nuisance arising from the collecting van when passing through the streets on its return to the works, air-tight lids are placed upon each receptacle collected, and the doors of the van are firmly closed. The ash and refuse tubs are also emptied systematically, proper attention being secured to them by the weekly visits which are paid to the privies.

The process of manufacturing the manure is as follows:—Such of the house refuse as is not moderately dry is tipped from the carts on to drying floors, and when thoroughly dry, it is, with the other refuse, passed through a riddling machine worked by steam-power, which takes out the paper, shells, vegetable, and other refuse, and separates the cinders in two sizes from the ash; the ash is then removed to any part of the sheds, where required, and the cinders are removed and used on the works for generating steam, heating the drying floors for the engines, at the public baths, and for sale. All the saleable refuse, such as iron, &c., obtained by this riddling is disposed of, and the vegetable refuse is burnt and used in the manure. [The night-soil or excreta, upon its arrival at the works, is emptied into a trench formed by a banking of ash, which has previously been brought into the shed from the riddling machine, and when the trench is filled with night-soil, a quantity of ash is thrown upon the excreta, and the contents are treated with sulphuric acid, to cause the evaporation of the water, to

combine with the alkalies, and to retard the formation of free ammonia. The proportion in weight of the night-soil and ashes thus treated are equal. Trench after trench is thus formed and filled until the whole floor of the shed is covered, when at least seven days having elapsed since the formation of the first trench, the ash there used has become sufficiently dry to be again used as an absorbent, which is done by forming the trenches in tho banks of ash deposited to form the sides of the first trenches. In this case, as ashes are only required to cover the night-soil, and not to form the banks of the trenches, only 5 cwts. are used to 20 cwts. of night-soil. When this second course has passed through this shed, the first or ground-floor course is commenced in another shed, leaving the first shed resting 14 days, after which it is treated for the third and fourth times with the like quantity of night-soil and ash used in the second course. The total quantities treated have thus become 35 cwts. of ash to 80 cwts. of night-soil. The mass is then allowed to remain undisturbed for 14 days, after which it is turned over and allowed to remain another seven days, upon the expiration of which it is again turned over, and for the second time allowed to remain undisturbed for seven days. By this time the mass has become a powdery manure, free from smell, and in a condition to be bagged for sale.

It is stated that the manure thus formed has a ready sale, and is highly approved of by practical farmers who have made use of it.

The new system is as yet only partly at work, for the change to it from the old is only being gradually made. There are now 2,509 privies on the new system, and 1,800 on the old cesspool plan.

The following extract from the annual reports of the Health Committee shows the yearly progress and present state of the new system :—

Year Ending.	No. of Closets.	Collected. Excreta. Tons.	Collected. Ashes. Tons.	Manure. Made. Tons.	Manure. Sold. Tons.	Houses.	Mills and Work-shops.	No. of Persons using the Privies.	Gross Expenditure.	Manure Made.	Net Cost.
									£ s. d.	£ s. d.	£ s. d.
1870, March 31......	527	398	611	377	217	1,048	12	5,797	694 17 6	537 19 5	156 18 1
1871, "	1,070	846	1,521	1,059	699	2,944	31	11,770	1,538 7 11	1,380 14 3	157 13 7
1872, "	1,690	1,431	2,405	1,556	1,019	3,174	39	19,283	2,392 13 0	2,167 17 3	224 15 9
1873, "	2,509	1,989	3,413	1,989	412	4,560	69	26,984	3,463 6 11	2,826 15 1	637 10 10
1874, "	3,980	3,516	5,196	3,497	1,543	7,287	106	43,500	5,284 3 7	4,449 11 2	834 2 5

WHITWORTH GUNS.

It is well known that the Brazilian Government has been using the Whitworth guns for several years with success. A report has recently been made on the subject by the Committee on Artillery Studies, which, after nearly two years of consideration of the various systems of cannon, have pronounced definitely in favour of the Whitworth rifled cannon, as that which, from its material, the processes of manufacture, and the system, most nearly approaches perfection.

The committee emphatically condemn the French system, of cast-iron strengthened by wrought-iron bands, as unscientific and practically proved inefficient. The English system has been based on the French one. The Krupp gun, of Krupp cast-steel strengthened with bands, the committee consider unreliable, notwithstanding its fine material, chiefly owing to the uncertainty and irregularity of effect which, they say, always attend the action of the hammer, however ponderous, on masses of iron.

Finally, the committee consider the English Armstrong, Woolwich, and Whitworth cannon much superior in construction and strength to the best yet produced on the Continent. They regard the Woolwich an improvement on the Armstrong, and the Whitworth far ahead of either in the essential qualities of a good gun. This superiority of the Whitworth cannon the committee ascribe to the quality of the homogeneous steel used, to the care in its selection, to the oil tempering which it receives, to the use of the hydraulic press instead of the hammer, and to the mode of constructing and connecting the cylinders and other parts of the gun.

In relation to the quality of duration, the committee mention that while the Krupp cannon has an average life of 600 to 800 shots, the Whitworth cannon employed by the Brazilian forces during the Paraguayan war have averaged 3,500 to 4,000 shots each, without a single case of bursting or serious damage having occurred among them.

It is understood that some 35-ton guns are now ready for export to the Brazils. If possible, it would seem desirable that these should be tried in competition with similar guns used in the British service before they are sent away.

AMERICAN PROCESS OF GALVANISING IRON.

Although galvanised iron has become a very necessary article of commerce, and its advantages are both well known and well appreciated, yet for some reason its preparation has not proved very profitable to Americans, as several who have undertaken it have given up the business. The present description is that of the operation as carried on at the works of Messrs. Alex. McClees and Co., of New York, and Phillipsburg, New Jersey.

The sheets, which are prepared at the rolling mill of this firm at Phillipsburg, are brought to the works in bundles and immersed in a vat of dilute sulphuric acid. The vat, which is lined with lead, is filled with water to about four inches below the top of the sheets, which are placed in the vat on their edges. Sulphuric acid is then poured in until the liquid just covers the metal. Ten bundles of sheet iron, each weighing 150 pounds, are placed in the vat at a time, and half a carboy of acid used. These bundles remain "in pickle" for a hour and a half, after which they are removed, ten more bundles placed in the vat, and half a carboy of acid added. When these last bundles have been pickled and removed, the whole contents of the vat must be allowed to run off. This refuse is used to galvanise miscellaneous matters, such as ships' bolts, nails, spikes, anchors, chains, &c. The vat is filled again with fresh water and acid, and twenty bundles more prepared in a similar manner.

Upon being taken from the sulphuric acid vat, the sheets are immediately immersed in an alkaline solution, potash being preferable, and the acid adhering to them neutralised. The sheets are next immersed in vats of pure water, from which they are afterwards taken, placed upon the bench and vigorously scoured and scraped. These minute precautions are taken because it is absolutely necessary to have the sheets clean, since dirt cannot be galvanised. The sheets are next thrown back into vats of water, and afterwards immersed in vats of strong muriatic acid, which develops on the surface of the iron an affinity for the zinc. The sheets remain in the muriatic acid but a short time, and are soon removed and placed in a large drying oven, on cars, and as soon as a car load is dried it is run out to the galvanising tank.

The latter is made of charcoal bloom iron about one inch in thickness, and is four feet deep by twenty-three

inches wide and eleven feet long. Its capacity is therefore nearly 580 gallons. It is built in brick, being surrounded by eight inches of firebrick and sixteen inches of ordinary brick. These precautions must be taken because the tank always contains from 50,000 to 60,000 pounds of melted zinc. The tank burns out in six months, at the end of which time a new tank is built up in another place, and the melted zinc poured from the old one into the new one, for the molten metal is never allowed to solidify. About twenty-five plates, or about half a ton of spelter, is added to the mass every day. A partition dipping only a few inches below the top of the molten metal extends across the top of the tank. Upon one side of this partition or strip sal-ammoniac is thrown upon the zinc, and on the other side is thrown sand, both materials floating on the surface, the partition preventing them from mingling.

The operation proceeds very regularly. One person on the sal-ammoniac side of the tank takes the sheets of iron from the car on which they have been drawn from the oven, and immerses one at a time in the liquid metal. When the sheet is entirely under, he pushes its top edge over by means of a lever pivoted upon the edge of the tank. Previous to inserting the sheet, the workman has a rod, terminating in a hook in the metal, and as the sheet goes down below the surface its lower edge falls in the hook. The lever pushes over the top edge under the partition to the other side of the tank, and when this has been done the workman raises the sheet up a short distance with his hook. All this has for its object simply to keep hold of the iron while immersed in the zinc, as otherwise it might be difficult to find it when it had been passed to the other side of the tank. From the moment the sheet appears above the surface of the zinc the operation of raising it must be continued without stopping till it is entirely out of the bath, for if it stops for an instant a broad streak is left across its surface. Consequently, when the edge appears above the melted metal it is seized by two pairs of nippers, one of which is suspended to a pulley, and hoisted out of the bath. In passing out the sheet is cleaned by the sand floating on the surface of the metal. Four men can pass fifty bundles of sheet iron through the bath in eight hours. The sheet is next passed between three rolls to take out "the buckle," and afterwards through the rolls again to straighten it.

The *Nord* gives the following as the quantity of food and liquor consumed by Paris in 1873. It drank 4,253,017 hectolitres (22 gallons each) of wine, alcohol, liqueurs, vinegar, beer, &c.; and devoured 392,037,564 kilogrammes of meat; poultry and game worth 27,785,769f.; of butter, 31,836,265f.; eggs, 17,006,000f.; salted provisions, 15,268,926f.; oysters, 1,869,166f.; fresh waterfish, 2,139,956f. truffles, 150,022f.

A commission of the Co-operative Society of Russian Manufacture and Trade has reported in favour of the construction of a railroad between Russia and China, through Siberia. The road, would traverse for the most part a thickly populated country, and open up cattle and wool-growing districts now isolated from the world. It would commence with a fortified town in Western Russia, and ultimately reach Pekin.

The United States Department of Agriculture estimate the consumption of timber during the present decade at one hundred millions of acres, or an average of ten millions of acres per year. It is said that 30 years will strip the United States of every description of timber—firewood, pit props, railway sleepers, scaffold poles, hop poles, bean poles, in fact leave them without a faggot from the Pacific to the Atlantic seaboard.

During the last twelve months the errors of the great clock at the Houses of Parliament, Westminster, were below one second on 67 per cent. of days, below two seconds on 25 per cent., and below three seconds on 5 per cent. When the error amounts to four seconds it can be corrected by the attendant, by lifting a pallet.

INTERNATIONAL METRIC COMMISSION AT PARIS.

Melting of the Metal for the new Metric Standards.

At the meeting of the Executive Committee of the International Metric Commission in October last, the fusion of the large single ingot of platinum-iridium, weighing 250 kilogrammes, out of which all the new metric standards were to be constructed, was fixed for the end of the following April, but the completion of the operation was delayed by accidental circumstances until the middle of the following month. As this was the first occasion on which any attempt had ever been made to melt together more than a few kilogrammes of platinum or of platinum alloyed with iridium, it was necessary to make a great number of experimental meltings during the intermediate time in order to secure success in the great operation.

All the actual meltings of the platinum and iridium have been made at the Conservatoire des Arts et Métiers, in a building erected for the purpose. The work has been carried out under the superintendence of M. Tresca, the Sous-Directeur of the Conservatoire, who is also honorary secretary of the Commission, and more immediately intrusted with the technical operations of constructing the new standards. He has had the advantage of the cordial assistance of Mr. George Matthey, of the firm of Johnson and Matthey, Hatton-garden, from whom the large mass of platinum and iridium was obtained. Mr. G. Matthey has had large personal experience in melting platinum, and he remained at Paris from the begining of April assisting in the work.

It was necessary that the whole of the platinum and iridium should be separately assayed and purified previously to their being melted together. This process was intrusted to M. Henri Sainte-Claire Deville, and carried out at the Ecole Normale, of which he is director. The greatest difficulty in the purification consisted in getting rid of the osmium, which is found in the natural ore in combination with platinum and with iridium. But the chemical difficulty was satisfactorily overcome by M. Deville after many experiments made by him.

The whole of the platinum and iridium had thus been ascertained to be perfectly pure when delivered to M. Tresca for melting. The first process was to melt portions of the pure platinum, its melting point being about 1,900° C., and considerably lower than that of iridium, which is about 2,400° C. Portions of the platinum were then remelted together with iridium, in the proportions fixed upon of 90 per cent. of platinum and 10 per cent. of iridium. Quantities of from 10 to 15 kilogrammes of platinum-iridium were, in the first instance, melted together. Several of these smaller ingots were then remelted into larger ingots of rather more than 80 kilogrammes each, and the final operation was to remelt three of these larger ingots into a single ingot of 250 kilogrammes.

Each of the meltings was made as nearly as possible of uniform form, in a furnace heated with oxy-hydrogen gas. The furnace was made of a block of the ordinary sandy limestone used for buildings in Paris. For the smaller ingots a square block of stone was employed with a hemispherical cavity about six inches (15 centimetres) in diameter, for containing the metal. This small block had a cover of similar form, and through its middle was a vertical hole, about three-quarters of an inch in diameter, in which the tube for conveying the gas was fixed with mortar. When the metal was placed in the furnace, and the jet of lighted gas directed upon it, sufficient mortar was placed on the joining of the upper and lower blocks of stone to make it air-tight. For the three larger ingots a long oblong furnace was used, with a cavity of the same breadth, but a little deeper and much longer, and three gas-tubes were used.

The largest furnace required for the whole quantity of metal had six gas-tubes, each about 1 in. in diameter, inserted in the upper block. The ordinary illuminating gas was used, mixed with the requisite proportion of oxygen gas, made on the premises and stored in a large gasometer placed near the furnace room. For obtaining a sufficient blast the powder of a 15-horse steam-engine was employed.

In order to facilitate the melting, it was necessary first to divide the larger ingots into small pieces. About half the quantity for a single melting, thus divided into small lumps, was placed in the mould, and when this was completely melted, the remainder, which had been drawn out into long thin bars, was introduced gradually through two small holes opposite each other in the furnace. These holes also enabled the interior of the furnace to be seen, together with the progress of the melting, and they could be closed by stone plugs when requisite. The division of the ingots was a difficult operation, as this alloy of platinum and iridium is harder than ordinary steel. A V cut, about $\frac{1}{8}$ in. deep, was made around the ingot with a cold chisel, though not without splintering the edges of a considerable number of the best tempered chisels. The ingot was then placed under a hydraulic press, supported upon the rounded tops of two strong iron bars, a sufficient distance apart. The rounded part of a third bar was placed upon the ingot, in the line of the cut, and the power of the press being applied, the ingot was broken in half, presenting in every instance a regular crystallised grain.

The melted metal was not cast into a separate mould, but was allowed to cool in the furnace. During the melting a portion of the interior of the stone, to the depth of about half an inch, became coloured by the excessive heat and formed into lime in a powdery state, which floated on the surface of the melted metal. When the metal was sufficiently cool, the stone mould was broken and the ingot removed to a bath of hydrochloric acid, which dissolved every portion of lime or other foreign matter upon the surface of the ingot, but does not act upon platinum-iridium. The ingot was then left quite clean and pure.

The first of the larger ingots of 80 kilogrammes was successfully melted on April 25th. The second was melted on May 1st, when Marshal MacMahon, the President of the Republic, accompanied by M. Deseilligny, the Minister of Commerce, were present unofficially, and remained during the whole process, appearing to take great interest in the operations. The third of the larger ingots was melted on May 7th.

The melting of the great ingot of 250 kilogrammes took place on May 13th, in presence of nearly every member of the French section of the Commission, of M. Struve from St. Petersburg, MM. Stas and Heusschen from Brussels, M. Bosscha from Holland, Professor Miller and Mr. Chisholm, delegates from Great Britain, and other foreign commissioners. It was successfully accomplished with the greatest facility and regularity, and without the slightest hitch or accident.

The dimensions of the cavity in the furnace, and consequently of the large ingots produced, were as follows:—

	Mètre.		Inch.
Length	1·24,	or about	44·9
Breadth	0·15,	„	5·9
Depth	0·07,	„	2·8
Thickness of stone above the cavity	0·15,	„	5·9

The time occupied in the process was as follows:—

2.10 P.M.—Furnace heated and lighted by degrees.
2.24 „ —Furnace thoroughly heated.
3.4 „ —Contents of metal (130 kilogrammes) melted and bars begun to be introduced.
3.27 „ —All the metal melted.
4.15 „ —Metal entirely solid, but still at white heat; lid lifted.

In about half an hour the mould was broken and the ingot removed to the hydrochloric bath. When taken out it was examined, and found, to all appearance, perfect.

The stone used is so remarkably slow a conductor of heat, that when the whole mass of metal was in a melted state the upper surface of the stone was hardly warm, as was tested by the hands of several of the persons present being placed upon it.

Portions of the three large ingots had been previously tested and found to be very nearly indeed of pure platinum and pure iridium in the proportion of 9 to 1. The large ingot will also be assayed, and, if deemed necessary, again melted, in order that the requisite homogeneity may be attained.

The work of constructing all the new line-standard metres from this single ingot will at once be proceeded with, and there will be sufficient surplus metal for making first of all the new standard kilogrammes, and then such number of standard metres as may be required.—H. W. Chisholm, in *Nature.*

THE COPAL TRADE OF ZANZIBAR.

Captain Elton, the First Assistant to the Political Agent at Zanzibar, has drawn up a valuable report on the condition of gum copal in Zanzibar, based upon inquiries lately made by him at Dar-es-Salam. It was difficult, we learn, to arouse any interest in inquiries made at Dar-es-Salam with regard to the whereabouts of the modern copal tree. The Arabs asserted that it was not worth taking the trouble to look at, and when the Banyans, who in the neighbourhood of Zanzibar trade largely in "Anime," were referred to, they adopted a similar view of the inutility of taking any trouble in the matter, adding, with characteristic hankering after profit, "If the true Sandarusi could be dug nearer the coast that would be a gain to us; but do not all know the tree copal is cheap stuff?" Some maintained with persistency that there were no such trees now standing near Zanzibar: "those seen by people before had long since been cut down," "there were but few far inland," and others seriously attempted to convince the inquirers that the existence of the "Inti Sandarusi" was questionable. In fact, Captain Elton failed altogether to elicit any information or excite any sympathy on this interesting subject amongst the more civilised portion of the community, so he turned to the slave population and instituted an inquiry on the Seyyid's plantation outside the town. Here he soon discovered not only that several isolated trees and small groups existed within reach, but also that the slaves employed in clearing land had arrived at an extensive belt of them, where the india-rubber Uiana was also abundantly found, which spread for a considerable distance inland. He left Dar-es-Salam in company with Lieut. T. F. Pullen, and proceeded with a guide in a westerly direction for some two miles, until a "clearing" of the customary east coast description was reached. Charred stumps of trees and felled and blackened trunks, entangled with the tough half-burned ropes of the India-rubber climber, strewed the ground, and obstructed rapid progress over ancle-deep layers of wood ashes and treacherous "stubbing" holes, on the one side as far as the long "straw" grass and thick brushwood bordering the cultivated lands, and in the other direction up to the outskirts of a dense African forest stretching far away towards the Marni Hills and the Uzaramo. Past this clearing slaves were found busily at work hacking down trees recklessly, and from amongst these people the guide chose two slaves, one a Miao and the other an Inninde, who led the way over the wrecks of some hundreds of fallen trunks, until at last the explorers found themselves amongst the "Inti Sandarusi." They were astonished at the immense number and size of these trees.

The following carefully measured dimensions are given

as representing an average tree, but by no means one of the largest of the group:—

	Ft.	In.
Height (top branches lopped off) ...	60	0
Girth at ground...	4	3
Girth at 5 feet above ground	3	2
Height to 1st branch	21	6
Girth at 1st branch	2	10

The trunk, which is covered with a moderately thick bark, 3-16ths of an inch, resembling that of the birch, grows perpendicularly in the larger proportion of trees to a height of about 20 to 25 feet. At this point the main limbs fork out, and from the extremities of the branches the foliage spreads into that flat-crowned appearance so common to many African trees. The fruit is of a brown colour and an irregular almond shape, studded with small excrescences, the leaves glossy and of a vivid green.

On stripping off the bark the gum is found deposited in many places between it and the wood, in a liquid form. This was also observable to a greater extent when sawing off sections of branches. Where the tree was injured a resinous gum had collected in considerable quantities, and was also seen on several trees on the lower sides of the branches: on the upper sides none was seen.

The Inninde climbed up and stripped off several specimens with a knife, but none of these run to a large size. The larger pieces, Captain Elton was told, are found at the foot of the tree, where, falling, they become buried in the sand.

Marks of digging were observed in all the surrounding soil; however, Captain Elton is inclined to think the gum falls in a liquid state, for no extensive deposit was noticed except where a state of decay existed.

It is probable that where trees have been left to fall to pieces from sheer old age large quantities may with reason be expected to be found buried, and to have survived all traces of the tree itself on the ancient site.

Insects innumerable live on the "Inti Sandarusi." One branch was cut down in which a family of ants had formed a large nest behind a wall of the gum, and were rapidly undermining the heart of the wood. Between the bark and the wood, and stripping the former covering, legions of ants and wood lice were seen, and a small green lizard with a yellow head, striped longitudinally with black lines, was pointed out as peculiar to the tree.

"The conclusion," says Captain Elton, "which both Lieut. Pullen and myself arrived at is that the attacks of the swarms of ants and other insects lead invariably to the slow but sure destruction of these trees, piece after piece, branch after branch; as the heart of the wood becomes undermined the tree throws out the resinous gum in considerable quantities, almost, it would seem, in an effort to arrest the process of decay which occasions finally its fall, after which but a few years would be necessary to bury the wreck in the shifting sand which covers the surface of the sienna-coloured sub-soil, rich in vegetable remains, in which the copal tree is found. Almost all these trees were festooned with the long intertwined ropes of the India-rubber Uiana, the thickly matted cords of which, pendant from the main limbs and knotted into a sort of rigging, become an easy means of ascent to the natives looking for the resinous deposits on the branches. This india-rubber was worked rather extensively here at one time, but was soon given up as unprofitable in consequence of the number of slave lads carried off by leopards. Now, however, it does not appear to strike the Sultan's overseers that it would be more lucrative to collect it as they move on with the clearing than to cut down and burn the Uiana by hundreds. Our guides easily worked up two large balls of india-rubber for us. After making deep longitudinal incisions in the main ropes of the Uiana, the milky substances which exuded profusely they smeared on the fore part of the left arm. When enough had been procured, this was stripped off in flakes and rolled up in the hands until it assumed the shape of a small dumpling. At Dar-es-Salam this article of commerce commands a price of from 9 to 10 dollars per frasilah of 35 lbs. weight. The slaves told us that you could travel for two days into the interior before losing the 'Inti Sandarusi,' and that during the whole of that distance the india-rubber was commonly parasitic to the trees. At the rate the clearing progresses, however, it will not be long before this copal tree will become a thing of the past. At a second visit, when we worked along and into the wood, all we saw only confirmed the conclusion we had already come to. However, I trust after inspecting the principal diggings, to be able to give a more detailed account of the situations in which the tree is found, and its relation to the fossil Animé."

Captain Prideaux, the Acting Political Agent, brought the matter of the wanton destruction of the gum copal and india-rubber trees to the notice of the Sultan of Zanzibar, who, we are told, at once promised that orders should be given for the practice to be discontinued.—*Chemist and Druggist.*

NEW METHOD OF COLOURING METALS.

Metals may be coloured quickly and cheaply by forming on their surface a coating of a thin film of a sulphide. In five minutes brass articles may be coated with any colour, varying from gold to copper red, then to carmine, dark red, and from light aniline blue to a blue-white, like sulphide of lead, and at last a reddish white, according to the thickness of the coat, which depends on the length of time the metal remains in the solution used. The colours possess a very good lustre, and if the articles to be coloured have been thoroughly cleaned by means of acids and alkalies, they adhere so firmly that they may be operated upon by the polishing steel.

To prepare the solution dissolve 1½ ounces of hyposulphite of soda in 1 pound of water, and add 1½ ounces of acetate of lead dissolved in ½ a pound of water. When this clear solution is heated to from 190 to 210 degrees Fah., it decomposes slowly, and precipitates sulphide of lead in brown flakes. If metal is now present, a part of the sulphide of lead is deposited thereon, and, according to the thickness of the deposited sulphide of lead the above colours are produced. To produce an even colouring the articles must be evenly heated. Iron treated with this solution takes a steel-blue colour; zinc, a brown colour; in the case of copper objects, the first gold colour does not appear; lead and zinc are entirely indifferent.

If, instead of the acetate of lead, an equal weight of sulphuric acid is added to the hyposulphite of soda, and the process carried on as before, the brass is covered with a very beautiful red, which is followed by a green (which is not in the first-mentioned scale of colours), and changes finally to a splendid brown, with green and red iris-glitter. This last is a very durable coating, and may find special attention in manufactures, especially as some of the others are not very permanent.

Very beautiful marble designs can be produced by using a lead solution thickened with gum tragacanth, on brass which has been heated to 210 degrees Fah., and is afterwards treated by the usual solution of sulphide of lead. The solution may be used several times. —*Iron.*

The value of the ore raised and the iron produced in the Lake Superior district between 1848 and 1873 inclusive, was estimated at 55,000,000 dols.

An American engineering commission has left the United States for Central America for the purpose of examining the routes for an interoceanic canal. There are two of these routes, one by the Atrato river and the other by Lake Nicaragua; and the duty of the commission is to examine and report which is the better.

NEW ZEALAND INDUSTRIES.

The following report was recently brought up to the House of Representatives, and ordered to be printed:—

Coal.—Your committee are gratified to find that the importance of this great source of national wealth is now being recognised, and that in Otago and Canterbury, by the construction of railways, the vast deposits of coal suitable for domestic and mechanical purposes will be rendered cheaply available; whilst in the province of Auckland it is hoped that by the early completion of the Kawa Kawa or other railway it will also be cheaply supplied, for on this much of the prosperity of the Thames Goldfields depends.

Conservation of Forests.—Your committee recommend that the Government should invite the various provincial Governments to consider how best to prevent the wasteful destruction of the forests of the colony, and to supply statistics and recommendations for the consideration of Parliament.

Planting Trees.—Your committee recommend that the Government should continue to procure considerable quantities of the most approved tree seeds, and should sell them at cost price to associations, nurserymen, and individuals; and should also, by way of experiment, procure seeds of the olive, hickory, and cork trees, for a growth of which a large part of the colony seems well fitted.

Kerosine.—Your committee recommend that a bonus on kerosine produced within the colony be offered to the extent of sixpence per gallon up to 50,000 gallons, payable on quantities of ten thousand gallons at a time, to be sold at a fair average price, the quality being approved by the Government.

Iron.—It is gratifying to your committee to be able to report that, besides the deposits of ironsand at Taranaki, vast quantities of the best iron ore exist in many parts of the colony, and in places convenient to excellent coalfields and places of shipment; and your committee, taking into consideration the value and importance of iron manufactures, recommend that, subject to existing engagements entered into by the Government on the recommendation of the committee of last year, a bonus be offered for the erection of a suitable blast furnace for the manufacture of pig iron in an approved locality; such bonus not to exceed 25 per cent. on the cost of erection, and not to be paid till the works are in full operation; bonus not to exceed five thousand pounds sterling. And your committee also recommend a bonus be offered for the erection of suitable machinery for the manufacture of bar and rod iron, and rails, in an approved locality; such bonus not to exceed 25 per cent. on the cost of erection, and not to be paid until the works are in full operation; total amount of bonus not to exceed five thousand pounds sterling, and to be available for three years. Your committee further recommend that these bonuses should be in addition to any bonus or land grant given by any provincial Government, and that the agents of the colony in Europe should be instructed to encourage co-operative associations to come to New Zealand to establish these and other industries by grants of free passages. Your committee would call attention to Mr. Mills' report as to the quality of New Zealand coal and iron.

Portland Cement.—Your committee suggest for the consideration of the Government the advisability of the Public Works Department endeavouring to utilise the materials for the manufacture of Portland cement which exists in the colony.

There appears a prospect of good coal being shortly made available for consumption in Japan. The largest of the coalfields of Japan, that of Takosima, has come into possession of the Japanese Government, and it is hoped that an increased outlay of capital will produce satisfactory results.

THE FRENCH IN TONKIN.

The *Revue des Deux Mondes*, says a writer in the *Academy*, contains an interesting paper, entitled "Le Tonkin et les Relations Commerciales," which, it appears, is intended to be, in some sort, an apology for the line of action recently pursued by the French in that remote part of the Indo-Chinese peninsula, about which, unfortunately, we possess so little trustworthy information, and some of the assertions put forward must probably be received with a certain amount of caution. After some introductory observations respecting the expedition which, at the request of the Annamite Government, was sent to Tonkin last October, under the command of the ill-fated Lieut. Francis Garnier, the writer divides his paper into two distinct parts, in the former of which he relates how one M. Dupuis made his way through Tonkin by the Red River and its affluents to the Chinese provinces of Yünnan, and how a few months ago the commander of the *Bourayne* war-steamer explored the sea coast of this country, and delivered it from the pirates who had so long infested it, and who had for four months actually kept the ports in a state of blockade. M. Dupuis, it should be mentioned, originally started from Hong-Kong at the end of October, 1872, with the ostensible purpose of conveying through Tonkinese territory a cargo of munitions of war, including chassepots and revolvers, to the Chinese General Ma, who was then engaged in operations against the Mohameddan rebels in Yünnan. After encountering considerable difficulties and delays, M. Dupuis reached his destination in the spring of last year, and was well received by Ma, who congratulated him on having been the first to accomplish so hazardous a journey. On his return the Chinese General gave him an escort of 150 *braves* (*i.e.*, soldiers), with whom, after having sent his companion back to Hong-Kong, M. Dupuis took up his quarters at the chief town of Tonkin, "afin d'y ouvrir un comptoir et de poser les premières bases du traité de navigation," which was also one of the objects of poor M. Garnier' mission. The complications arising from this course of action on the part of this somewhat curious diplomatic agent (who, says the writer in the *Academy*, has usually carried on a very humble mercantile business at Hankow, in China), gave rise to the active interference of the French naval authorities in Tonkinese affairs, the immediate result of which has been the signature of a treaty of commerce, but with regard to what is to follow eventually, it would be premature to hazard a guess. The writer in the *Revue des Deux Mondes*, in speaking of M. Dupuis' journey through Tonkin, takes occasion to allude to our repeated and hitherto ineffectual efforts to open a commercial route between the north-east provinces of India and south-western China, and he maintains that if the Song-koi or Red River be opened to European commerce, no other route will be able to compete with that through Tonkin, which M. Dupuis has so successfully explored. In the second portion of his paper the writer gives, at some length, interesting details respecting Tonkin and its resources, from which it appears that it abounds in the precious metals, as well as copper, iron, zinc, &c., that it is well off in the matter of vegetable products, and that the inhabitants are remarkable for the pureness of their Mongol type, though they differ somewhat in appearance from their neighbours the Chinese. Hurricanes and typhoons, tigers and other wild beasts, fevers and dysentery, are the chief, and, it must be owned, rather serious, drawbacks to a residence in this country, which may not improbably become of great importance to the commercial world at no very distant date, if Captain Sprye's proposed caravan route to Yünnan should prove a failure.

The city of Tunis was illuminated on Saturday, the 23rd May, with gas for the first time, amid great rejoicings, in the presence of the Court and the representatives of all the foreign Powers.

NORTHERN BORNEO.

At Brunei, in the northern portion of Borneo proper, not far distant, and therefore in close communication with the British settlement of Labuan, and contiguous with the Rajahate of Sarawak, the Consul-General for Great Britain has his residence. The account which he gives of the industrial condition of the people and the productions of the surrounding country possesses a certain degree of interest. The port of Brunei, as we are informed, lies about fifteen miles up the river of that name, the navigation of which is easy, but an artificial bar, which was constructed about three hundred years ago for the purpose of defence, obstructs the free passage near the island of Cherimon. At this spot, however, the river itself keeps a narrow channel clear, sufficiently deep at all times for small craft, but large ships can only pass the bar during the high water. The town has been called by travellers who have visited it "a water city," the houses being built on piles driven into the mud on either side the main stream or channel of the river. All communication is by water, but when the tide is out the mud is left bare under a great part of the town. The river acts as a most efficient sewer for the whole of the town, and though at low tide an unpleasant effluvia rises from the exposed mud, no unwholesome effects are experienced; on the contrary, the town is a remarkably healthy one. Fever is almost unknown, but when an epidemic of small-pox or cholera occurs, then the densely crowded houses, the absence of all medical treatment, the neglect of all sanitary precautions, the ignorance and the apathy of the people, offer an unresisting mass of human beings to its attack.

The population is a branch of the Malay race, and is estimated to number between 30,000 and 40,000 persons. The population of the interior and of the coast is an aboriginal, as distinguished from what is commonly called the Malay race. There are various tribes, the most prominent being, on the coast, the Badjow and the Ilanim; in the interior, the Kayan, the Bisayan, the Murut, the Idaan, and the Kadyan. All these tribes speak different dialects of an aboriginal language. It is impossible to estimate their numbers, but the country is very sparsely inhabited, the prevailing feature of the districts which are accessible being primitive jungle, with here and there a clearing and a settlement. In the interior the population is generally employed in agriculture, and in the collection of jungle produce. The people on the coast occupy themselves in fishing, and in the collection of sea produce, and they also carry the trade of the coast, and that brought down from the neighbouring districts, to the ports of Brunei and Labuan. The occupations of the people of Brunei, though they cannot claim any superiority in point of industrial exertion over the people of the coast or the interior, are more varied. A chief article of consumption is fish; and a large number of professional fishermen thus secure employment and a livelihood. These fishermen constitute a distinct class, and inherit a separate quarter of the town. Different classes also, though none so large as that of the fishermen, are created by other industrial pursuits. The manufacturers and traders in oil, for instance, form a distinct class, and occupy a separate "Kampong," or quarter. So also the matmakers, the blacksmiths, the workers in brass, the workers in gold and silver. Besides these, there are manufacturers of gold lace, embroiderers of gold and silk brocade, weavers of cloth, boat-builders, and manufacturers of native arms and implements. There is, moreover, a gun foundry, where, rude as is the process adopted, bronze guns, sometimes most tastefully ornamented, are cast with remarkable skill and success. The industrial classes form, however, by no means the majority of the population of Brunei, a large proportion of which is composed of families living in dependence on those pangerans, or nobles, who are the proprietors and chiefs of districts, but who reside for the most part in the town, deriving an annual income from contributions levied on the people of their districts.

The export trade of Brunei, as indeed of the whole coast of Borneo, appears to consist almost entirely of the raw produce of the country. The produce which is brought to Brunei from the coast or from the interior includes sago, gutta-percha, edible birds'-nests, bezoar stones, bees'-wax, camphor, tortoiseshell, trepang, and hides. This trade is mostly in the hands of the Chinese, who, few in number as they are, form the centre of what commercial enterprise exists. Some of the native chiefs also engage in trade, and the Sultan derives a part of his small revenue from profits obtained by purchasing in a cheap and selling in a dear market. The character of the trade will be further understood when it is borne in mind that nearly all these articles of export are what is known as jungle produce. Sago, with some qualification, india-rubber, bees'-wax, edible birds'-nests, bezoar stones, camphor, all come under this denomination. These exports are therefore the indications of the natural, as distinguished from the cultivated produce of the country, the test of its spontaneous resources rather than of the industry of the people, though of course there is the industry which is engaged in the collection of the produce. In placing sago under the head of jungle produce, some qualification is undoubtedly necessary, because it is not the raw, but a manufactured sago that is imported. The raw sago is brought down by the natives from the interior to Brunei, and is there washed, and undergoes a refining process before being shipped. The labour employed in the washing and manufacturing process is exclusively Chinese, and the three sago manufactories which are to be found in Brunei were established by and belong to Chinese traders. The qualification even goes further, for the increasing demand for sago of late years has had the effect of encouraging the extension by cultivation of the sago palm. Whether this palm is an indigenous plant, or whether it was originally introduced and cultivated is perhaps a question, but so abundant is its natural growth, that so long as it was only required for native consumption there never was any occasion for its cultivation. The palm grew wild and in luxuriance, and trees were cut down whenever required. With the increasing demand by foreign markets for sago flour, the inhabitants of the more accessible or more populous districts have been induced to extend the existing area of the natural growth of the palm, by planting new ground with young shoots. No further cultivation is required. Once planted, the young shoot in about seven years becomes a tree of sufficient maturity for the extraction of the medullary pith, out of which the sago flour is made, and already propagating itself by sending out fresh shoots in all directions. The cultivation, then, is of the simplest character, but such as it is it is noticeable, as everything is that marks an industrial tendency amongst a rude people.

The neighbourhood of Brunei presents a soil capable of producing an unlimited growth of *padi* and the cocoanut tree. Both are cultivated to some extent, the former sufficiently perhaps for the wants of the rural population which cultivates it, with a surplus for the consumption of the town of Brunei. But the fact that it is necessary every year to import considerable quantities of rice and cocoa-nut oil, suggests a failure in native industry which ought not to exist. It would not be just to attribute this failure solely to the character of the people. A weak government and oppressive conduct on the part of the local chiefs are certainly as much responsible, undoubtedly tending, as they have done, to check industry in the people beyond the point which is sufficient for bare maintenance. It is this cause which explains also, in some measure, the peculiar and restricted character of the export trade. Indeed, what trade there is is due entirely to a few Chinese traders, through whose hands the whole of the import and export trade, with little exception, passes.

THE SYRIAN SPONGE FISHERIES.

Some interesting information respecting the Syrian sponge fisheries is given by Vice-Consul Jago (Beyrout) in his commercial report for 1873, just issued. The total value of the sponges fished on the coast of Syria is from £20,000 to £25,000. The production is, however, falling off through excessive fishing, and the consequent exhaustion of the fishery grounds. About 250 to 300 boats are at present employed in this industry on the coast of Syria, manned by about 1,500 men. The centres of production are Tripoli, Ruad, Lattakia, and Batroun on the coast of Mount Lebanon. The best qualities are found in the neighbourhood of Tripoli and Batroun; but the boats visit all parts of the coast, from Mount Carmel in the south to Alexandretta in the north. The majority of the boats used are ordinary fishing boats, three parts decked over, and carrying one mast with an ordinary lug-sail. They are from 18 ft. to 30 ft. in length, and are manned by a crew of four or five men, one of whom is especially engaged for the purpose of hauling, while the rest are divers. In some cases the men own their own boats, but generally they are hired for the season, which extends from June to the middle of October. No wages are paid; the remuneration consists in an equal share of the produce of the fishing. The profits of a good diver reach as high as £40 a season. Diving is practised from a very early age up to forty years, beyond which few are able to continue the pursuit. It does not appear, however, that the practice has any tendency to shorten life, although as the diver approaches forty he is less able to compete with his younger and more vigorous brother. The time during which a Syrian diver can remain under water depends, of course, on his age and training. Sixty seconds is reckoned good work, but there are rare instances of men who are able to stay below eighty seconds. The men on the coast, however, make extraordinary statements as to the length of time their best hands are able to remain under water, and gravely assert that eight and ten minutes are not impossibilities. The manner of diving is as follows:—The diver (naked of course) with an open net around his waist for the receptacle of his prizes, seizes with both hands an oblong white stone, to which is attached a rope, and plunges overboard. On arriving at the bottom the stone is deposited at his feet, and, keeping hold of the rope with one hand, the diver grasps and tears off the sponges within reach, which he deposits in his net. He then, by a series of jerks to the rope, gives the signal to those above, and is drawn up. No knife, spear, or instrument of any kind is used. The Syrian diver, unlike his Greek competitor, never uses the diving-dress, having an antipathy to it on the score of its alleged tendency to produce paralysis of the limbs. Two or three fatal accidents annually occur, mainly among the skilful and daring. The diver will quit his hold of the rope, and wander some distance to secure a prize, and on returning to regain the rope will miss the spot, and be unable to find it. He then attempts to rise unassisted, and, being ignorant of the exact direction, often strikes out diagonally, and is drowned before he can reach the surface. Other accidents again happen from jagged or pointed rocks, which besides sometimes wounding the diver often entangle his rope, and thus in great depths expose him to the risk of drowning. The depths to which the diver descends varies from five to thirty "brasses," each equal to an ordinary man's height. Below the extreme limit mentioned no good sponges are found. In former years the Syrian coast was much frequented by Greek divers from the islands of the Archipelago. Their number is now restricted to five or six boats annually, the skill of the Syrian combined with his superior knowledge of the fishing grounds enabling him to compete successfully with his foreign opponent. Although they vary much in quality and size, sponges may be generally classified as —1. The fine white bell-shaped sponge, known as the "toilet sponge;" 2. The large reddish variety known as "spongo de Venise," or "bath sponges;" 3. The coarse red sponge used for household purposes and cleaning. Two-thirds of the produce of the Syrian coast are purchased by the native merchants, who send it to Europe for sale, while the remainder is purchased on the spot by French agents, who annually visit Syria for the purpose. France takes the bulk of the finest qualities, while the reddish and common sponges are sent to Germany and England. The revenue derived by Government from this industry is a tenth of the value of the produce calculated upon the prices paid to the finders by the traders, and this is paid in cash by the former to the tax-farmer on the conclusion of his sale.—*Pall Mall Gazette.*

GENERAL NOTES.

Sulphur in Sicily.—According to a report addressed by Signor Parodi to the Italian Government, it is estimated that the sulphur in Sicily will be exhausted in from fifty to sixty years. There are about 250 sulphur-mines in the island, producing about 1,800,000 quintals yearly, beside the enormous quantity which is lost through defective methods of working. In 1871, 1,725,000 quintals were exported, of which England took from 500,000 to 600,000, and France about 400,000 quintals. The ore contains from 15 to 40 per cent. of pure sulphur, but the average amount extracted is only 14 per cent. The sulphur fetches at the pit's month about 6 fr. 60 c.

Water Supply of Towns.—On the 24th of last month, Lord Henry Lennox laid the foundation stone of the new works for the supply of water to Chichester. In the course of his speech be said the supply of water to the metropolis was constantly under the attention of the Government. During the present session a Bill dealing with that matter had been introduced under the auspices of the Society of Arts. That Bill, through an informality, did not pass the standing orders, but it would be introduced again next year, and if passed would, he believed, give greater security against fires in the metropolis, while the principles of the Bill were such as could be easily accommodated to all the waterworks throughout the country.

Growth of International Communication.—A recent report of the Austrian Government on the Vienna Exhibition gives some curious particulars respecting the increase of means of communication in various parts of the globe, during the last six years. Lines of telegraph wire have increased from 57,166 to 77,000 geographical miles, and a complete line now runs from San Francisco accross the continent of America and the Atlantic, through Europe and Siberia, to the mouth of the Amur on the eastern confines of Asia; while branch lines connect India, Japan, and Australia. The mileage of railways has increased during the same period from 24,500 to 37,300 miles; and a calculation has been arrived at that no less than four millions of people are daily conveyed by this species of locomotion. By means of the postal service it is calculated that 3,300 millions of letters circulate annually, or about nine and a quarter millions a day, or 100 a second. In 1860 the value of the exports and imports over the face of the globe, amounted, according to an Austrian statistician, Herr Kolb, to about 15,000 millions of florins, or 1,500 millions sterling; while ten years later, according to a French calculation, it had increaced to 23,170 millions of florins, or no less than fifty-four per cent.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

MON. ...Entomological, 12, Bedford-row, W.C., 7 p.m.
TUES. ...Biblical Archæology, 9, Conduit-street, W., 8½ p.m. Mr. George Smith, "Account of Recent Excavations and Discoveries made on the site of Nineveh."
Sculptors of England, 7, Gower-street, W.C., 7 p.m.
WED... Royal Literary Fund, 10, John-street, Adelphi, W.C., 3 p.m.
FRI.......Quekett Club, University College, W.C., 8 p.m.
SAT......Royal Botanic, Inner-circle, Regent's-park, N.W., 3¾ p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,129. Vol. XXII.

FRIDAY, JULY 10, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ELECTION OF CHAIRMAN OF COUNCIL.

The Council at their meeting on Monday last, the first after the Annual Election, chose Major-General F. Eardley-Wilmot, R.A., F.R.S., as Chairman for the ensuing year.

ECONOMICAL USE OF FUEL.

A meeting of this Committee was held on Saturday, the 4th instant. Present — Major General F. Eardley-Wilmot, R.A., F.R.S. (in the chair), Mr. F. A. Abel, F.R.S., Capt. Douglas Galton, C.B., Dr. Mann, the Rev. Arthur Rigg, and Capt. Scott, R.N.

REVOLUTION INDICATOR.

A meeting of this Committee was held on Saturday, the 4th inst. Present—Major-General F. Eardley-Wilmot, R.A., F.R.S. (in the chair), Mr. T. Brown, Mr. W. Froude, F.R.S., Vice-Admiral Erasmus Ommanney, C.B., F.R.S., Mr. J. R. Ravenhill, Vice-Admiral A. P. Ryder, Lieut.-Col. A. Strange, F.R.S., Mr. Seymour Teulon, and Mr. T. R. Tufnell.

IMPROVED RAILWAY LAMP.

The Society's Gold Medal, or Twenty Guineas, is offered for an improved lamp or means of illumination, suitable for railway passenger-carriages, that shall produce a good, clear, steady, durable, and safe light.

It must be simple in construction, and capable of being readily cleaned and repaired.

In judging the merits, cost will be taken into consideration.

Specimens, in a condition suitable for trial, to be sent in to the Society's House not later than the 1st of November, 1874.

The Council reserve to themselves the right of withholding the medal or premium offered, if, in the opinion of the judges, none of the articles sent in competition are deserving of reward.

INTERNATIONAL EXHIBITION OF 1874.

The Council have resolved to offer the Society's Gold and Silver Medals in connection with the International Exhibition of 1874.

A gold and a silver medal is offered in each class, and these medals will be given for any object exhibited which, in the opinion of the Council, shows paramount or very great excellence, whether in respect of the final result, the machinery, method of production, or novelty.

TECHNOLOGICAL EXAMINATIONS.

The programme for these Examinations is in preparation, and will shortly be issued. It will include the nine subjects of last year, viz., Cotton Manufacture, Silk Manufacture, Paper Manufacture, Steel Manufacture, Carriage Building, Cloth Manufacture, Glass-making, Pottery and Porcelain, and the Manufacture of Gas, with the addition of four new subjects, viz.. Agriculture, Silk and Woollen Dyeing, Calico Bleaching, Dyeing, and Printing, and Alkali Manufacture.

ENDOWMENT FUND.

The following subscriptions have been received towards the establishment of an Endowment Fund for the Society :—

	£	s.	d.
G. T. Saul	5	0	0
W. R. Spieer	5	0	0
Colonel A. Angus Croll	20	0	0
G. W. Hart	2	2	0
Charles H. L. Woodd, F.G.S.	5	0	0
John E. Evans	2	2	0
Sir Walter E. Trevelyan	50	0	0
E. T. Blakely	1	1	0
W. R. Sandbach	50	0	0
Thomas Dixon	1	1	0
W. Atkinson	50	0	0
John Noble	20	0	0
James Bentley	20	0	0
J. Jonas	1	1	0
Samuel Jackson	5	5	0
Charles Goding	20	0	0
F. Mocatta	10	10	0
Jonah J. Wells	10	10	0
Charles Downes	2	2	0
G. T. Saul	2	2	0
Mrs. Charlotte Holmes	10	0	0
John Knowles	25	0	0
Sir John Le Couteur	1	0	0
John Peekover	5	5	0
Frederick Braby	2	2	0
Decimus Burton, F.R.S.	5	5	0
Percy Rowlands	2	2	0
The Right Hon. Lord Hatherley	20	0	0
Colonel John Thomas Smith, R.E.	2	2	0
Ardaseer Cursetjee, F.R.S.	5	0	0
H. V.	25	0	0

The Council will be glad to see further contributions to this fund. Members can receive full information as to its nature and objects on application to the Secretary.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

MACHINERY, ENGINEERING, AND CONSTRUCTION.

Pursuing steadily—so long at least as the present annual series of exhibitions endures—the programme prescribed at the outset by the Commissioners, the present Exhibition, the fourth and as it now appears the last of the current series, embraces, in the industrial department, Class IX., under various sections, machinery and appliances of—A, Civil and Mechanical Engineering; B, Architecture, Building Apparatus, and Construction; and C, of Sanitary Apparatus and Construction—a large and important class, well represented and illustrated, in relation to which it is proposed to describe the chief exhibits, more particularly those which are included in the Machinery in Motion, and in the Galleries of the Western Annexe.

Of the more important materials which constitute the elements of building and construction in works of civil engineering and architecture, the chief are, iron, stone, timber, and brick. Of the first named of these, however, iron, which formed a special and important class in the exhibition last year, there are now only a few examples of the application as a constructive element, and of the machines whereby its manipulation and preparation are facilitated and effected; but no exhibit illustrative of the actual processes and mode of treatment is in actual practical operation. Neither is the second, stone, much more extensively represented, as, in addition to various samples of stones used in building, worked by hand, and in the finished state, there is only a solitary exhibit, of a machine for dressing stone-blocks, among the machinery in motion. In connection with the third, timber, there is however an extensive series of exhibits of machinery in motion, illustrative of most of the mechanical processes connected with the manipulation and preparation of wood by power-machines; and this is, indeed, the most complete, fully exemplified, and interesting of the whole series. Finally, in connection with bricks and kindred materials, besides a numerous collection of brick-components of structures, there are exhibited in the machinery in motion some excellent examples of the power-machinery and processes whereby these building constituents are produced.

Many important and instructive exhibits of materials and processes will also be found, in connection with and illustrative of composite structures, such as concrete and other fire-proof constructions, supplementary to the chief building elements hereinbefore specified.

In submitting, for the information of the readers of the *Journal*, descriptive and technical details of the principal and most noteworthy exhibits, it will be convenient to treat of the machines and mechanical processes first, and to deal with them consecutively, according to the arbitrary order and arrangement above adopted, viz., those connected with the mechanical treatment of 1, iron; 2, stone; 3, timber; and 4, brick. And in so doing it should be premised that if there be any solution of continuity, if the sequence of machines and processes is not complete, it is not because the missing links, if any, do not exist at all, but only for that they do not appear among the exhibits of 1874.

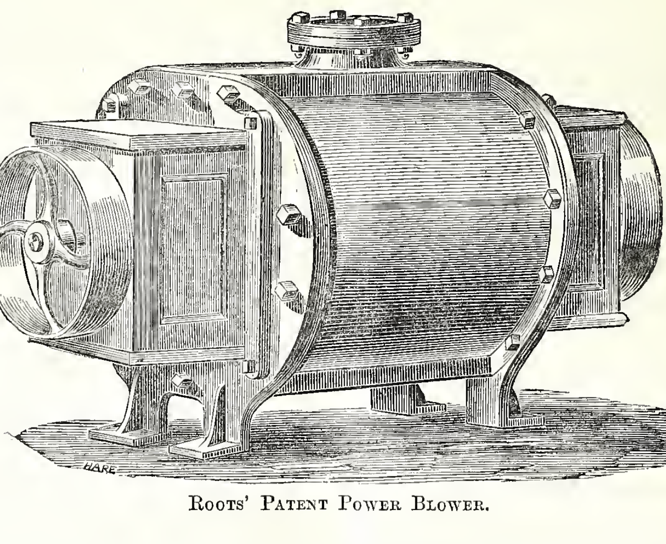
I.—Iron Machinery.

In this department there are to be found actual machines, and those merely of a special and limited class, exhibited by two well-known firms only.

No. 6,042—Messrs. Thwaites and Carbutt exhibit in the West Galleries, Room II., specimens of their Blowers, whereof one is fitted and combined with a vertical engine, and with smiths' hearths, &c.

The chief speciality exhibited is the Root's Patent

Fig. 1.



Roots' Patent Power Blower.

Blower, which has been devised for the generation of "blast" upon a large or a small scale, for smelting or for forging purposes, in lieu of the aboriginal device of the bellows, or the more modern but mechanical means of the fan. The term blower is employed to distinguish a machine that creates a positive or forced blast, in contradistinction to the fan, that does not; and the machine is analogous to a blowing cylinder, inasmuch as the air acted upon must find an outlet, or the machine must stop. The operation of the blower is by a constant and regular displacement of air, whereof a definite quantity is displaced and driven forward at every revolution. The

machine is constructed generally with a pulley at each end, one on each of two shafts, driven with one open and one cross-belt, so that they may revolve in opposite directions. The shafts themselves are of steel, and geared together at their extremities by ordinary spur wheels; they carry wooden rollers, or revolving pistons as they may be called, shaped somewhat like a figure of 8, the round heads or ends of the one engaging and working into the hollow sides of the other, and *vice versâ*. These revolve in a casing of wood, enclosed in an outer framing or case of iron, constructed in halves bolted together; in section the sides of the case are semicylindrical, the top and bottom flat, the ends being perfectly flat, and planed smooth, pierced for the steel shafts, which run in long gun-metal bearings. Considerable care is requisite in turning and finishing the surfaces of the rollers, which are shaped in a special machine or lathe, the cutters whereof, revolving at high speed, leave the roller of the exact form and dimensions required. The object is that the revolution of the rollers may be effected without their surfaces coming into absolute contact with each other or with the interior surface of the case, while the clearance is so minute as to create no perceptible loss of useful effect. The moving parts pass as closely together as is possible without actual contact, and there is therefore little or no friction, and the machine is virtually air-tight, whereby the air is displaced and forced forward, generating a positive blast. The friction is minimised, and absorbs very little of the motive power, which, therefore, with this slight deduction, is entirely utilised in blast. The machine is run at a moderate speed only, from 100 to 300 revolutions per minute.

In connection with the manufacture of iron, the Root's blower has been extensively adopted in lieu of the ordinary blowing engines, as for example at Barrow-in-Furness, to supply blast for cupolas employed to melt the cast-iron for the production of Bessemer steel, also at the Ebbw-vale Ironworks, and the foundries at Crewe, and those of Messrs. Eddington and Sons, and Mr. Ireland, *cum multis aliis*. Mr. Ireland, it is stated, has used two of these blowers for a pair of large cupolas running 30 tons of metal per hour for the casting of a large anvil-block, weighing 250 tons. They are also in use for puddling furnaces, Dank's rotary furnaces, Bessemer converters, refineries, the smelting of copper, tin, and silver, chemical works, distilleries, Tilghmann's sand-blast process, gas-exhausting, ventilating, wool-drying, &c., and are stated to do the same work as a fan with half the power.

Table of Experiments made in Cincinnati with a No. 3 Root's Blower.

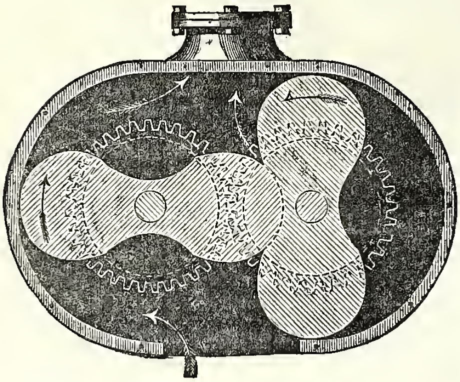
	Number of Experiments.											
	1st.	2nd.	3rd.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.
Conditions of Apparatus.												
Diameter in inches of pulley on dynamometer shaft	35·8	35·8	35·8	35·8	35·8	35·8	35·8	35·8	35·8	35·8	35·8	35·8
Diameter in inches of pulley on counter shaft worked from pulley on dynamometer shaft	29·6	29·6	29·6	29·6	29·6	29·6	29·6	29·6	29·6	29·6	29·6	29·6
Diameter in inches of pulley on counter shaft working into pulley on Blower	17·66	17·66	77·66	17·66	17·66	17·66	17·66	17·66	17·66	17·66	17·66	17·66
Diameter in inches of pulley on Blower	17·35	17·35	17·35	17·35	23·55	23·55	23.55	23.55	35·8	35·8	35·8	35·8
Diameter in inches of discharge opening	6	6	4½	4½	4½	4½	3½	3½	3½	3½	2½	2½
Original Notes.												
Number of revolutions per minute of dynamometer shaft	165	156	123	123	168	167	137	138	189	192	144	141
Readings of dynamometer dial	1·2	1·0	2·0	1·75	1·25	1·25	2·1	2·2	1·25	1·25	1·75	2·00
Pressure of air in ounces as indicated by manometer attached to the discharge pipe	4	4	8	8	8	8	12	12	12	12	16	16
Calculated Deductions.												
Volume of air in cubic feet discharged per minute after reduction to the same temperature and barometric pressure as the atmosphere when the experiments were made	1,196	1,196	951	951	951	951	705	705	705	705	415	415
Number of revolutions of Blower per minute	203	192	151	151	152	151	125	125	113	116	86	84
Cubic feet of air discharged per revolution of Blower	5·89	5·71	6·3	6·3	6·26	6·3	5·64	5·64	6·24	6·08	4·82	4·94
Number of horse powers expended per minute	1·98	1·56	2·46	2·15	2·10	2·09	2·88	3·04	2·36	2·47	2·47	2·82
Useful effect obtained in horse power per minute	1·30	1·30	2·07	2·07	2·07	2·07	2·35	2·35	2·35	2·35	1·81	1·81
Fractional portion of expended horse powers that is rendered useful	0·656	0·833	0·841	0·963	0·986	0·990	0·816	0·774	0·992	0·951	0·735	0·733

Three of these blowers are here exhibited—a No. 3, such as the foregoing experiments were made with; a No. 5, adapted to blow for 70 smiths' fires, or to supply blast for a cupola running 10 tons of iron per hour; and a No. 7, with a 15 horse-power vertical engine combined. This is, so to say, self-contained, and is capable of melting 20 tons of iron per hour, or of blowing for 120 smiths' fires. In the annexed engravings, Fig. 1 represents a general view of the Root's Patent Blower, Fig. 2 being a transverse section of the same; Fig. 3 shows an application of this blower on a smaller scale, namely, to portable forges, of which Messrs. Thwaites and Carbutt exhibit a large and a small one for heating iron bars, up to the size of 3-inch round or square, and for heating rivets for boilermakers, respectively.

These portable forges are very compact. The blast is produced by hand with a small Root's blower of simple construction, conveniently fixed directly underneath the hearth, and protected so that there is little liability to get out of order. The smallest size fitted up complete gives a blast equal to 24-inch bellows, and weighs only 85 lbs., the manual power being easily applied. For small factories in the colonies, or where there is no steam power, for open-air smiths' work, bridge building,

ship-building, &c., these are in use. The blast is conducted from the blower through a pipe, and delivered into the fire on the hearth by a special pipe-nozzle, or patent tuyere, of which Fig 4 is a sectional view. This

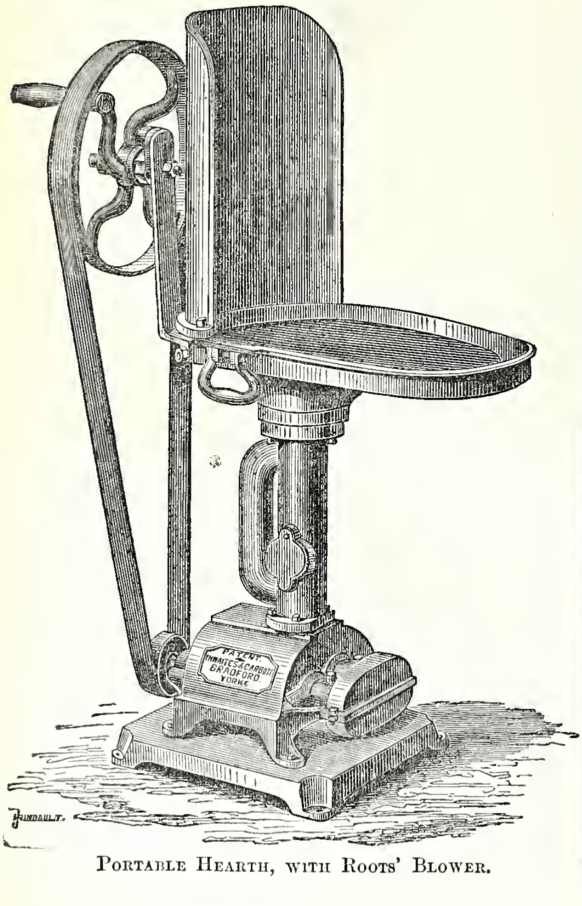
Fig. 2.



Section of Roots' Blower.

tuyere is devised to supersede the ordinary water-trough, and is simply arranged that the blast within and the free circulation of air without shall keep it cool and prevent its being burnt by the action of the fire.

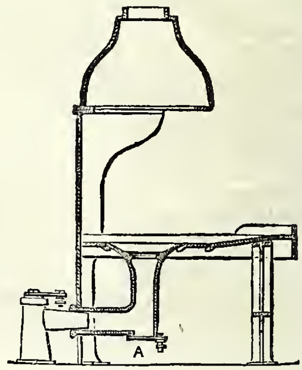
Fig. 3.



Portable Hearth, with Roots' Blower.

It is provided with a valve at the bottom of the elbow, the opening whereof, when the blast is shut off, subserves three purposes—as an outlet for the removal of any ashes that may work through the air openings, for

Fig. 4.



Roots' Patent Tuyere.

preventing the accumulation of gas, and for keeping the fire alive when not in use. The grid-pieces are made loose, with apertures for distributing the air, and are moveable, for easy renewal when burnt out. By this arrangement the blast is delivered at the bottom and centre of the hearth for the more thorough combustion of the fuel and concentration of the heat around the object exposed to its action.

No. 6,036—Messrs. Andrew Handyside and Co. exhibit in the West Galleries, Room II., several examples of their Smiths' Hearths, Stand Pipes, and Portable Forges.

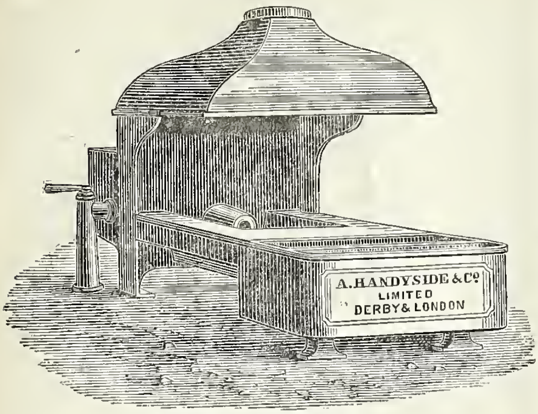
There can be no doubt that in the fitting up of engineering workshops, the smithy and hearths receive but scant attention; the generation and conveyance of the blast, the form and location of the nozzle or tuyere, are all points on which effective and economical results materially depend; defects entailing waste of blast, fuel, and heat, ineffective work, and costly maintenance. Messrs. Handyside and Co. have arranged their smithy appliances on a sound and practical system, and on an extensive scale, at the Woolwich Royal Arsenal, the Enfield Small Arms Factory, and many other industrial works.

For the generation of the blast the firm now adopt and recommend the Root's patent blower of Messrs. Thwaites and Carbutt, of which a description has just been given. From such a blower, either fitted and combined with its own vertical engine, or driven by independent power, steam or other—examples of both being exhibited in the same room by Thwaites and Carbutt, as hereinbefore specified and described—the blast-pipe is taken under ground, alongside of the wall, round the smithy walls, with diameter diminishing, for example, from 16 inches to 12 and 10 inches; having branches to any hearths or groups of hearths situated in the central space, and applying the blast to all the hearths by means of suitable connections and stand pipes, which transmit the blast from the main pipe under the floor to the hearths.

The smiths' hearths are made principally of cast-iron, in pieces quickly put together, each complete in itself, readily fixed and removed; most of them are adapted for a lining of fire-brick, for the purpose of keeping the outside cool, and preventing radiation and waste of heat. They are of various kinds, as shown in the accompanying engravings; such in fact as are here exhibited. Fig. 5 shows a hearth suitable for the larger forgings in an engineer's factory, weighing about 21 cwt., the plate being 4 ft. by 3 ft. 9in. in dimensions, and provided with

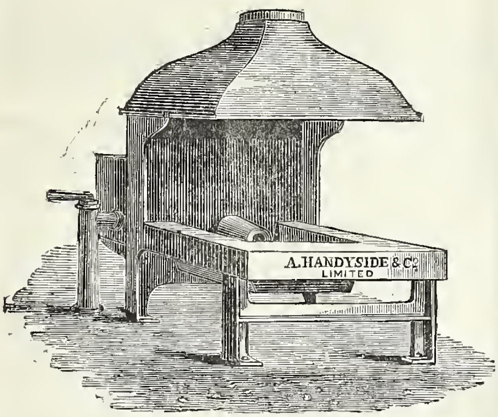
a double cistern in front, having a compartment 10 inches wide for a slack trough, and another 13 inches wide for

Fig. 5.



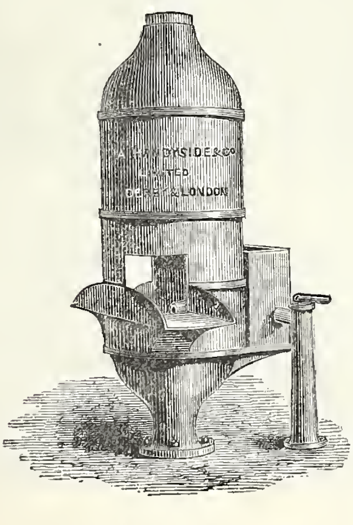
fuel. It is fitted, as shown, with a water-tuyere and blast stand-pipe, and sometimes also, if required, may

Fig. 6



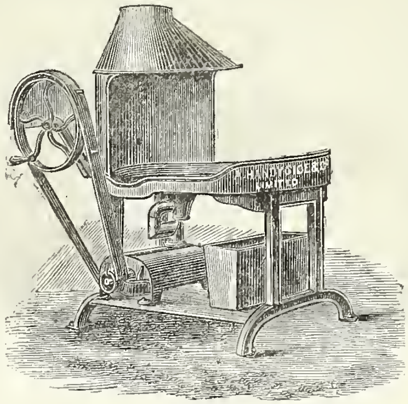
have additional appliances for convenience, viz., a screen to the hood or bonnet, and a bracket to the side of the

Fig. 7.



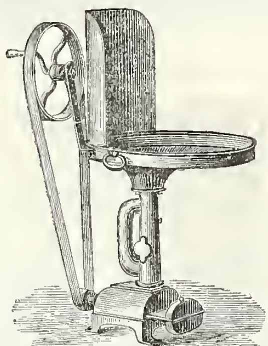
hearth-plate for carrying the outer end of a long forging. Fig 6 is a somewhat similar hearth, weighing about 19

Fig. 8.



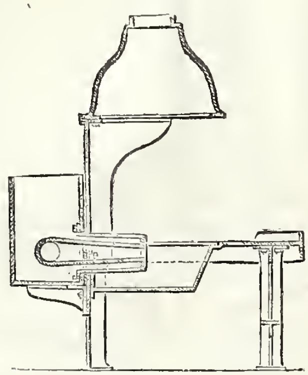
cwt., plate 4 ft. by 3 ft. 6 in., but having the hood raised and fitted with a square case lined with fire-brick, to

Fig. 9.



reduce radiation and improve draught. This example is without the cistern shown in the former case, and as exhibited is fitted with Root's patent tuyere, previously described. Fig. 7 is a circular hearth, 2 ft. 6 in. in diameter outside the iron case, weighing about 14 cwt., convenient and suitable for small and light forgings. It has an opening at each side, and the hearth-plate pro-

Fig. 10.

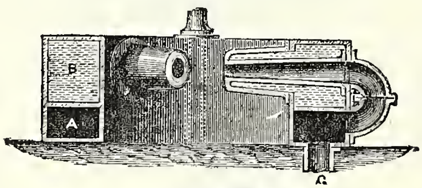


Hearth with Water Tuyere.

jects so as to form a table 4 ft. 4 in. long, recessed in the centre for the fire, whereon a shaft or long article can be laid while the centre part is being heated. This hearth is fitted with water-tuyere and stand-pipe as before described. A similar hearth of a smaller size, 20 inches in diameter, is also exhibited.

In the portable forges (Figs 8 and 9), Messrs. Handyside adopt the Root's patent blower, operated manually, and the Root's patent tuyere, as previously described and illustrated. Figs. 10 and 11 show the ordinary water tuyere in view and section, with details; by surrounding the nozzle or point with water, it is kept cool, and protected very materially from being burnt, and thus protected it lasts a long time in constant use. As shown in Fig. 11, adapted to a large annular hearth, **A** is a blast-chamber, **B** the water-cistern, and **C** the branch from the main blast-pipe under ground to the blast-chamber, whence it passes into the fire by the nozzle, as shown in the section; at the bend, a shutter-valve is provided for regulating or shutting off the blast at will.

Fig. 11.



Cross Section.

The annular hearth, here shown in section, weighs about 30 cwt. when complete; it is cast in one piece, with an external diameter of five feet, and divided into two compartments, an upper and a lower chamber, as shown. It is specially adapted for the bossing of large wheels, but equally suitable for the working of large workings. The centre of the hearth is built up with fire bricks, and a gap is made in the circle of the hearth in front, which can be closed by a properly-fitting plate, or left open by its removal. Opposite to the gap, on the other side, or at the rear of the hearth, a groove eight inches wide and four inches deep is made in the upper or water-chamber **B**, so as to allow the passage of such articles as long rods, crank shafts, and other like forgings, where the part to be heated is in the middle of the length.

In concluding the description of these smithy appliances, it may be remarked that the generation of blast by a fan has certain disadvantages. The pressure, or effective result is but small, even when large volumes of air are propelled. Thus, even with considerable power, a pressure of ½ lb. per square inch can with difficulty be attained. The fan must be driven at a great velocity, from 1,000 to 2,000 revolutions per minute, requiring great power, and involving trouble and expense, in first cost and maintenance, for the necessary multiplying gear and shafting, absorbing much power. Hence the advantages of the blower over the fan are obvious, as evidenced by its success both in America and in England.

No. 6,928*a*—Mr. James Mackintire exhibits the appliances and results of the process of making metallic castings under pressure; also highly finished working models of his patent rotary puddling furnace, and of his process for the manipulation and transport of molten metal. These, though classified with Recent Scientific Inventions and New Discoveries (XIV. Room 23), are to be found in the West Galleries, or Machinery Annexe (Room V.).

The process of the manufacture of metallic castings is illustrative of the American invention of Mr. J. J. C. Smith, first introduced to notice in this country by the inventor some three years ago, and comprising two operations, viz., the manufacture of the special moulds for the same, and that of the castings therein. The principles are the same—but with less pressures—as those of Sir Joseph Whitworth's compressed fluid steel, adopted for the manufacture of the Whitworth field gun, as exhibited last year at South Kensington in the Eastern Annexe; the objects being to attain a greater density and homogeneity, and a finer grain, so to say; the results are very remarkable, being produced by the simple application of continuous and considerable pressure to the molten metal—iron, brass, and alloys, &c.—during the operation of casting. The peculiar preparation and formation of the moulds is the preliminary and essential stage of the process. These are formed of a fine moulding sand, specially prepared. The pattern, or article which is to be reproduced, is superficially and thoroughly coated over with a fine "slip," or semi-fluid mixture of clay and sand, such as porcelain manufacturers employ for their products, prepared and brought by washing into a state of fine comminution. The object, or matrix, is then placed within a mould-box of metal, and sand is sprinkled over it; the mould-box is filled with sand, which is first compressed by hand, and finally subjected to powerful pressure, by means of a screw or hydraulic press, operated manually or by power, whereby a solid mould is produced with very fine interior surfaces, which is then further hardened by heat. Each mould is provided with suitable "gates" for the passage of the fluid metal, so placed that when several moulds are placed in the casting machine, the "gates" are connected from end to end throughout, forming a continuous conduit; and the moulds may be for single articles or for several, and in one or two pieces, according to the nature and size of the objects.

For casting, a strong metal box or frame is provided, to contain a number of such prepared moulds, which are brought into close contact therein by means of a powerful screw at one end. At the other end is the inlet, corresponding with the gate conduit, and communicating with a cylinder into which the molten metal is run when ready, the communication being closed by a plug, which fits with sufficient closeness to withstand the more ordinary pressure of the fluid metal, but to yield to the extraordinary pressure. The casting cylinder is formed of a stout metallic ring, with a fettled lining of refractory material, and is provided with a feed-hopper, and a piston fitting tightly in it, in rear of the chamber containing the molten metal. Pressure being then exerted on the piston by suitable mechanical means, the molten metal forces in the plug at the inlet to the box containing the moulds, and is drawn by the pressure into the interior of the moulds through the "gates," filling thus the minutest detail of the pattern, and making a fine, solid, dense, and minutely delicate casting, which is a perfect work of art, whereof many articles are exhibited.

Of Mr. Mackintire's process for the manufacture of steel direct from the commonest ores, for puddling, and for handling, transporting, weighing, and delivering masses of molten metal—as it is only illustrated by models—it suffices, at present, merely to notice the fact of their exhibition, and seeming practical adaption and utility.

(*To be continued.*)

THE OWEN JONES MEMORIAL.

An exhibition in aid of the funds of the Owen Jones Memorial is to be formed under the roof of the International Exhibition at Kensington. A handsome apartment has been provided for the reception of the works of the late artist. It will be remembered that at the decease of Mr. Owen Jones, a committee met at the house of Mr. Alfred Morrison, in Carlton-house-terrace, a mansion which reveals in every apartment the touch of the master hand now still. It was then decided to open a subscription for the foundation of a "Scholarship," or

for such other memorial as might be deemed most appropriate.

To the late Mr. Owen Jones is due the infusion of much "sweetness and light" into modern English decoration. Since the publication of his famous work on the "Alhambra," tho employment of colour in household decoration has been generally adopted. At the inception of his brilliant career our national style of decoration was of the most barbarous and lugubrious character. Frightful carpets threw into prominent relief walls which revealed either utter barrenness of invention or unutterable hideousness of design, and curtains of "crying" colours failed to "set-off" furniture—glowing in material and horrible in outline. From his studies in the courts of tho Abencerages, Mr. Owen Jones learned those marvellous combinations of brilliant and sombre colours which gave a distinct "cachet" to all his work. Albeit, fulfilling the famous definition of a Turkey carpet, like nothing in heaven above nor in the earth beneath, nor in the water under the earth, these designs, depending less upon form than upon exquisite arrangement of colour, have not failed to produce a revolution in insular ideas of decoration.

Nothing was too big or too little for Mr. Owen Jones. The Crystal Palace with its numerous courts did not prove too large, nor playing-cards and trade marks too small. His genius directed itself with equal force towards the reproduction of the Alhambra, or to the designs for a cornice or a carpet, a boudoir or a bedstead.

Chief among the objects exhibited is a superb set of furniture, the property of Mr. Alfred Morrison. One great charm of this suite is that it is impossible to assign it to any other period than its own. It is of white wood, richly inlaid, but is far from being a slavish imitation of the traditional *marqueterie*. On the contrary, it marks a bold departure from conventional forms. In the rich assemblage of colours is perceptible the influence of the Moorish studies, which may be said to have so thoroughly infiltrated through the mind of the great decorator as to influence all his subsequent work. It is here amply demonstrated that a bedstead need not necessarily be a hideous object; and the quaint form of the chairs and their superb inlaying work amply prove that this age might—if it really were as strong as it pretends to be—initiate, as other ages have done, a clear and distinctive style of decoration entirely and completely its own.

Suspended around the walls are many illustrations of the mastery of decorative art displayed by Mr. Owen Jones in the treatment of large buildings, such as the Exhibition of 1851, wherein the adoption of his principles of colour was attended with great success, followed by a greater triumph in the case of the Crystal Palace; but the eye of the public, satiated with the frequent contemplation of these masterpieces, rests with more complacency on the wonderfully original designs for the fire-places, cornices, and wall decorations adopted by Mr. Alfred Morrison, and the charming carpets made popular by the enterprise of Messrs. Jackson and Graham. For originality of design, and bold and novel arrangement of colour, these efforts have never been surpassed. In the place of carpets which "leapt at your eyes," these admirable combinations show how a deft assimilation of dull greens and dingy reds may be made to achieve the happiest results. A fine instance of this is found in the Axminster (Indian) carpet, contributed by Messrs. Lewis, a superb design in green, most admirably worked out in admirable material.

The chief contributors to the collection are Mr. Alfred Morrison, Mr. Peter Graham, Mr. Warren De la Rue, and the Messrs. Jeffrey. Among the general committee are found the names of many distinguished artists and patrons of art, notably, Sir M. Digby Wyatt, Messrs. Charles Barry, W. Burges, Henry Cole, C.B., Alan Summerly Cole, Warren De la Rue, Joseph Durham, W. L. Winans, James Gurney, George Godwin, Alfred Morrison, and Peter Graham; Mr. Coleridge Kennard acts as hon. treasurer, Mr. Edward F. Pigott as hon. secretary, and the collection at South Kensington is watched over carefully by Mr. F. Fladgate.

The following is the return of admissions for the week ending July 4th—Season tickets, 1,280; payment, 10,231; total, 11,511.

EXHIBITIONS.

Antwerp Gymnastic Exhibition.—The Committee of the eighth fête of the Belgian Gymnastic Federation has issued a circular inviting constructors, schoolmasters, doctors, professors, and amateurs, to take part in an exhibition of objects of corporeal education, which is fixed for the 15th to 25th of August, at Antwerp. The exhibition comprises four sections:—1. Fixed and portable gymnastic apparatus, and representations or models of the same, whether for hygienic or curative purposes, of all systems; 2. Drawings or models of gymnastic establishments; 3. Books, manuscripts, drawings, tablets of exercises, treatises on hygiene, anatomy, and physiology, lecture and class tablets; 4. Costumes for gymnastic exercises, excursions, pedestrian journeys, &c. Also all objects aiding physical development, and employed in games or recreation, such as skating, swimming, fencing, excursions, &c.

THE PUBLICATIONS OF THE PATENT OFFICE.

As the authorities of the Patent-office are just now contemplating a slight change in their mode of publishing some of their current indexes, it may perhaps be not without interest to give a sketch of the various works which have from time to time been issued from that office, and of those which are now in actual course of issue.

It will be remembered that shortly after the passing of the Patent Law Amendment Act, 1852, Mr. B. Woodcroft, F.R.S., the present Clerk to the Commissioners, commenced the publication of the provisional, final, and complete specifications deposited and filed under that Act; he also sought and obtained permission to print and publish copies of all the specifications, disclaimers, &c., relating to patents for inventions which were then lying hidden, it might be said, in the various offices in which at that time such documents were deposited. The printing of all the specifications under the old law was completed in 1858. Under the old law previous to 1852, 14,359 patents had been granted; of these 798 had no specification. The specifications of patents for inventions, disclaimers, &c., enrolled under tho old law, from A.D. 1617 to October, 1852, are comprised in 13,561 Blue Books, imp. 8vo. The total cost price of these is stated to have been about £600. Next come the specifications of inventions, disclaimers, &c., deposited and filed under the Patent Law Amendment Act, from October 1, 1852, to December 31, 1873. These are comprised in 70,438 Blue Books. The total cost price of these was about £2,250. The total number, therefore, of printed specifications down to the end of last year is 83,999.

Then perhaps in importance come tho indexes, the first of which were published in 1854. There are four indexes to patents under the old law:—1. Chronological; 2 vols. (1,554 pages.) 2. Alphabetical; 1 vol. (647 pages.) 3. Subject-matter; 2 vols. (970 pages.) 4. Reference index, pointing out the office in which each enrolled specification may be consulted,

and the books in which specifications, law proceedings connected with inventions, &c., have been noticed. There is also an appendix to the reference index, containing abstracts from such of the early patents and signet bills as describe the nature of the invention. 1 vol. (91 pages.) The indexes of applications for patents and patents granted under the Patent Law Amendment Act, 1852, are rather more varied in their character, owing to several changes in the method of publication. The chronological indexes for 1852 and 1853 were published in one volume, and from 1854 to 1868 a volume was published each year, making in all 16 volumes, which increased in size steadily from 167 pages in 1854 to 274 pages in 1868. In the next year the chronological index proper ceased to appear, and its place was taken by a publication entitled the "Chronological and Descriptive Index." From 1852 to 1870 a subject-matter and an alphabetical index were published for each year, that for 1852 and 1853 forming one volume in the former case, so that there are 18 volumes of one, and 19 of the other.

Since 1867 each applicant for letters patent has been required to send in with his specification an abridgment of the same. These abridgments were published in chronological order, and for four years, till the end of 1870, in quarterly parts, forming four yearly volumes, to the last two of which an alphabetical index was added. In 1871 a change in the method of publishing this work took place. Instead of being brought out in quarterly parts it was published weekly, and a subject matter, as well as an alphabetical index added. This one publication, therefore, gradually took the place of the three indexes as originally published. At present a still further development is proposed and will shortly be effected. The alphabetical index for the year will be published at once upon the conclusion of the year, and without waiting for the six months of provisional protection to expire, and it and the subject matter will be considerably developed and enlarged.

With regard to these indexes, it will be noticed that for the years since 1862 a separate index has to be consulted for each year.

The above "Chronological and Descriptive Index" is considered sufficient to facilitate reference to specifications since 1866. For the same purpose, with regard to those of an earlier date, a series of classified abridgments has been published. For this purpose all the specifications relating to a special subject have been selected, abridgments of these prepared, and these abridgments published in duodecimo volumes. To the present date 65 subjects have thus been treated, and, with a few exceptions, all the important classes of manufactures, &c., are now complete. As soon as this work is quite finished it is understood that the more recent specifications will be similarly treated, and as it is now going on for ten years since the latest period reached by this series, it would seem probable that such a second series would soon have to be put in hand.

Besides the above, the office has, since January, 1854, published a bi-weekly journal, in which lists are given of applications, grants, void, cancelled, and extended patents, with other kindred information referring to English, Colonial, and Foreign Patent-laws.

Such are the most important publications issued from the office. There are also a number of works which have been published at various times, such as the "Appendix to the Specifications of English Patents for Reaping Machines," prepared some time since by Mr. Woodcroft; and the "Supplement to the Series of Letters Patent and Specifications, from A.D. 1617 to October, 1852," consisting for the most part of reprints of scarce pamphlets, descriptive of the early patented inventions comprised in that series. These supplementary and occasional volumes are brought out as opportunity offers, and whenever any old tract or pamphlet worth reprinting is discovered.

With the exception of circulars, Acts of Parliament, &c., issued for the information of intending patentees, all the existing publications of the office have now been enumerated. Two that have lapsed are the "Index to Foreign Periodicals," continued from 1866 to 1872, and the "Catalogue to the Patent-office Museum at South Kensington." The former of these was an index in which was given a list of the contents of the principal foreign scientific periodicals; and though no exception was ever taken to its value, it was proved that the demand for it was not equivalent to the cost and trouble of its preparation. With regard to the second, the last edition of the descriptive catalogue was published in 1859; this has long been out of print. In 1863 a simple catalogue, or list of the articles exhibited, was published; but this is also out of print. It has never been brought down to date, and except such manuscript and private lists as may exist in the care of the officials, the museum is now practically without any catalogue at at all.

In the distribution of these works the Commissioners of Patents are very liberal. Any important public library or institution that can make out a reasonable case, can always obtain a free grant, on the sole condition that the works shall be rendered daily accessible to the public, for reference or for copying, free of all charge.

In London, complete sets of the publications (each set including more than 3,000 volumes and costing for printing and paper upwards of £2,900) have been presented to the British Museum, the Society of Arts, the School of Mines, the Board of Trade, the War-office, the India-office, and the Incorporated Law Society. They can also be consulted in the Patent-office Library and at the Patent-office Museum, South Kensington. They have also been given to 84 public libraries or scientific societies in the kingdom, to 27 British colonies, and to 31 foreign municipalities or seats of learning. Besides this, presentations of portions of the works have been made to 40 libraries in the United Kingdom, and to 17 in British colonies and foreign states; and, finally, grants of complete series of abridgments of specifications have been made to 370 mechanics' literary and scientific institutions at various places throughout the kingdom.

From 1850 to 1870, the declared value of British produce and manufactures, mineral and metallic, rose from about fourteen millions sterling to forty-three and a-half, the iron and steel in the last-named year being valued at £21,675,218, or four times what it was twenty years previously; machinery and millwork to nearly six millions; and hardware and cutlery to nearly four. The value of coals, coke, and patent fuel exported in the same period increased from £1,284,224 to £5,638,371.

Under the name of *Ludwigite*, Prof. Tschermak describes in his *Mineralogische Mittheilungen* a new mineral from the Bannat. This consists of borate of magnesia combined with protoperoxide of iron. Microscopic sections show that the iron compound does not exist as magnetic ore, mechanically disseminated through the mineral, and it seems probable, therefore, that Ludwigite is a true molecular combination of a borate and an oxide.

Utah now claims to have the richest mine in the world—a two-foot vein of horn silver has been struck in the Mona mine. The ore previously taken out has been exceedingly rich, and the mine has paid since the day the first pick was struck into it.

In ten years the annual expenditure for cleaning the streets of New York has increased from 13,500 dols. to 1,000,000 dols. At the same rate of increase, the expenditure in 1884 would amount to upwards of 70,000,000 dols. But probably reforming tendencies will prevail.

It is announced from Bombay that duplex telegraphy is being satisfactorily accomplished on the cable between Bombay and Calcutta. The system experimented with is Schwendler's.

ON A NEW SOURCE OF INDIA RUBBER FROM PARA.

By Thomas T. P. Bruce Warren.

Among the collection of natural curiosities which I made during a short stay at Pará, was a bottle of the juice of the massaranduba tree, which was given to me by my frind Capt. Bloem, as yielding gutta percha.

The principal use to which this juice is applied by the Brazilians is in mending broken glass and China. I saw several articles which were cemented with this juice, and am able to bear evidence as to the reported tenacity with which pieces of glass, &c., hold together after the juice has dried. This fact has been noted by Mr. Bates in his highly interesting book "The Naturalist on the River Amazons."

Bates, writing on the massaranduba, or cow-tree, says, "We had already heard a good deal about this tree, and about producing from its bark a copious supply of milk, as pleasant to drink as that of the cow. We had also eaten its fruit in Pará, where it is sold in the streets by negro market-women, and had heard a good deal of the durableness in water of its timber. We were glad, therefore, to see this wonderful tree growing in its native wilds. It is one of the largest of the forest monarchs, and is peculiar in appearance on account of its deeply scored, reddish, and ragged bark. A decoction of the bark, I was told, is used as a red dye for cloth. A few days afterward we tasted its milk, which was drawn from dry logs that had been standing many days in the hot sun, at the saw-mills. It was pleasant with coffee, but had a slight rankness when drunk pure; it soon thickens to a glue, which is excessively tenacious, and is often used to cement broken crockery. I was told that it was not safe to drink much of it, for a slave had recently nearly lost his life through taking it too freely."

Kingston, in his "Narrative of the Banks of the Amazons," says, "We went on a few yards further, when we stopped under an enormous tree, one of the giants of the forest. Its trunk was covered vith deeply-scored reddish and rugged bark. Duppo patted it, saying 'This my cow.' Another tree of the same species, but much smaller, grew near. He ran to it, saying, 'Small cow give better milk,' and began to attack it with his axe. After making a few strokes, out flowed a perfectly white liquid, which John, kneeling down, caught in the monkey-cup. As soon as it was filled I handed him another, the milk continuing to flow in great abundance, so that we soon had four cups filled full of the tempting liquid. On tasting it we found it sweet, and of a not unpleasant flavour, and wonderfully like ordinary cow's milk.

"We returned to the hut with the prize. Domingos had meantime been boiling some coffee; as we had now no sugar, the fresh milk proved a most valuable acquisition. The Indians, however, recommended us not to take too much of it. We kept it, intending to use it again in the evening, but on taking off the lid of one of the monkey-cups we found that our milk had thickened into a stiff and excessively tenacious glue. 'My cow good?' asked Sappo, as he saw us tasting the liquid. When we showed him the gluey substance in the evening; he inquired sagaciously 'whether the milk of our cow would keep so long,' and we confessed that in that climate it would be very likely to turn sour. After this, on several occasions, we obtained fresh milk from the cow-tree for our breakfasts and suppers."

I must confess that my experience of its taste and flavour confirms what Mr. Kingston has written, especially as regards the recently collected juice, and I have no doubt that if the juice were carefully bottled up it would retain its freshness for a very long time, and without coagulating. I diluted a portion of this juice with water, after being bottled up for nearly two months, and my own impression of it, as well as that formed by several friends who tasted it at the time, were strongly in favour of its agreeable and milk-like properties.

Probably the unpleasant flavour described by Mr. Bates may be due to tho juice being collected from a tin which has been filled for some time, and had lain exposed to the sun for many days, so as to have undergone slight decomposition.

The durableness of its timber in water has long been known to the Paraensees, who construct jetties and stages at their wharves principally of this wood, which they consider to be one of their most valuable woods for resisting decay under alternate exposure to air and water.

This should be a valuable wood for ship-building, since the durability of teak is said to be due to the existence of caoutchouc in its pores. The wood itself is very hard, and grows abundantly in the upland regions of the Amazons, but I am afraid the difficulty of transporting the trees when felled through the dense forests, among which it is always found, must remain an insurmountable barrier to its exportation on an extensive scale.

Several plants yielding milky juices have been noticed by travellers, among which may be mentioned, the cow-tree of Brazil, the Palo di vacca of the South Americans, and the Galactodendron utile of Kunth, the cow-plant of Ceylon (*Gymnema lactiferum*), the sap of which is used by the Cingalese for alimentary purposes, and the cream-tree of China.

Although travellers speak generally of these trees as being harmless, it is evident from the experience of Bates and others that the juices of such trees cannot be held to be innoxious. The cow-tree of Brazil belongs to the natural order *Artocarpaceæ*, a class containing many highly suspicious members. My specimen of the juice of this tree was much more limpid than that obtained from the siringia (*Siphonia clastica*), it was much lighter in colour, strongly resembling cream, and possessed a strong ammoniacal odour. In a tolerably close vessel it keeps much longer than the ordinary india-rubber juice without coagulating, which no doubt is due in a great measure to its more alkaline properties. It coagulates, however, under the same conditions as those which determine the coagulation of india-rubber juice obtained from the siphonia species. I obtained my specimens in the solid form by pouring the juice into a shallow dish and allowing it to stand for three or four days. The coagulation is rapidly accelerated by heat. The weight of solid india-rubber obtained from 22 ounces of juice was 14 ounces when dry. By destructive distillation it yields a large quantity of caoutchoucine mixed with other products obtained in the distillation of caoutchouc. Like ordinary india-rubber, it hardens by exposure to cold, and possesses great elasticity when soft. It does not melt without decomposition, and when melted remains soft and tarry. It is readily soluble in those menstrua which dissolve india-rubber, and is separated from its solution in ether on the addition of alcohol. The action of sulphur on it is precisely that which is so characteristic on india-rubber, and its behaviour to iodine, bromine, and chlorine is in every respect similar. It possesses very high insulating properties, and no doubt is highly suited for those manufactures which depend upon a clean and pure india-rubber. My specimen is much harder and tougher than any india-rubber I have met with.

As the massaranduba grows in more healthy localities than the different species of siphonia, it is a question whether it would not be desirable to draw the attention of the Brazilian Government to this important discovery. It deserves notice that this juice is quite as rich in caoutchouc as the siphonia, whilst its collection would be less pernicious to the health of the population. I have been told that this substance is so plentiful that, if a demand could be created for it, it could be obtained for about one-third to one-half the price of the best Pará india-rubber. It was this statement which led me to examine it.

The copiousness with which the juice flows from the tree when cut, may be gathered from the remarks which I have quoted from Mr. Livingstone's book. Being more limpid than the juice obtained from the different varieties of siphonia, one would have imagined that it should flow more freely. This, I am disposed to think, is due entirely to the larger quantity of ammonia in the massaranduba, for the amount of solid matter is even greater than in the juice of the siphonia elastica. I may mention that the juices of both these plants which I examined were collected at the same time, the massaranduba juice being gathered from trees in the forests in the neighbourhood of Belem (Pará).*

The percentage of solid caoutchouc from the massaranduba is about sixty-five, whilst the juice of the siphonia elastica yielded about 65 per cent., from which 20 per cent. to 25 per cent. would have to be deducted for water, so that approximately the siphonia would contain only 50 per cent. of dry, solid caoutchouc. I propose sending these specimens to the Museum of the Society of Telegraph Engineers, where anyone interested in the subject can examine them.

I cannot close this paper without expressing surprise that a substance which has so long and so frequently arrested the attention of travellers and naturalists should have remained without being examined before. Probably the other lactescent juices referred to in this paper may eventually be found to owe this appearance to an emulsion of caoutchouc, in which, in addition to ammonia, saccharine and mucilaginous matters contribute to its being so perfectly blended with the watery portion of the juice, and prevent its being so easily or readily separated, as is the case with the generality of india-rubber yielding plants.

* See note in article "On Collection and Preparation of Pará India-rubber," in the *Journal* for June 5th.

JUTE CULTURE IN BENGAL.

A Commission lately appointed in India, to inquire into the culture, &c., of the jute plant, has just presented a report to Government. As to the origin of the word *jute*, concerning which there has been so much dispute, it is suggested that the modern word is simply the Anglicised form of the Orissa *jhot*, and the ancient Sanskrit *jhat*. As to the precise plant which yields the fibre, the Commission has shown that the jute of commerce is yielded indifferently by two distinct species of *Tilaceæ*, the *Corchorus olitorius* and *Corchorus capsularis*. The plants are extremely alike in appearance, leaf, colour, and growth, and differ only in their seed-pods, those of the *C. capsularis* being short, globular, and wrinkled, while those of *C. olitorius* are the thickness of a quill, and about two inches long. Both plants are annual, and grow from five to ten feet high, with a stalk about the thickness of a man's finger, seldom branching except near the top. The leaves, which are of a light green colour and serrated, are four or five inches long, and taper to a point. Several other species of the same plant are said to yield *jute*, but are not cultivated for the fibre, the species already named alone yielding the real jute. This fact was established by the Commission, by a series of experiments in the Royal Botanical Gardens with seeds obtained from all the districts in which the fibre is grown. The result showed that the *jute* of commerce is the produce of one or other of the two plants named, and of them only. In Lower Bengal, the two species appear to be grown indifferently; but in the central and some of the eastern districts, the *C. capsularis* largely predominates, while in the neighbourhood of Calcutta it is the *C. olitorius* that is chiefly cultivated. The well-known Lukhipore jute of Hooghly and the 24-Pergunnahs, known also as *desi* jute, is the produce of this latter species. The plant has been cultivated from time immemorial in the Lower Provinces, but its export is a modern industry, although the fibre has been cultivated largely for home use and for the manufacture of gunny, from a very remote period. One or other of the two plants has been found in no less than forty-seven out of the fifty-eight districts of the Presidency. The attention of the Commission was especially directed by the Government to the importance of ascertaining what description of soil was most favourable to the growth of the fibre. The evidence collected upon the point is conflicting. A light sandy soil is not suited to it, and it seems most to flourish in a hot, damp atmosphere, with a heavy rainfall and rich alluvial soil. The seasons of sowing and growing appear to be generally the same as those for the early rice crop of Bengal. The oftener and more thoroughly the land is ploughed, and the more manure the better. The seed is sown broadcast from the middle or end of March to the beginning of June, and the plant cut from the middle of August to the middle of October, and in some of the districts earlier. The Commission direct prominent attention to the extreme carelessness of the cultivators in the selection of the seed. In most instances a corner of the field, or a few stunted wayside plants are left to produce it, not the slightest attempt being made to select it; and if in these circumstances, a real deterioration of the plant had taken place, a fact which the Commission doubt, little wonder could have been expressed. Neither selection nor change of seed seems to be restored to, and if the attention of Government is ever directed to improving the cultivation of the plant, its first step must be a reform in this fundamental point of good husbandry. The acreage under jute in the great producing season of 1872 was 921,000. The area is said to have been no more than 517,000 acres in 1873. The Northern and Eastern Districts may almost be said to engross the cultivation, showing a total area of 800,000 acres under the plant in 1872, against 125,000 only in the rest of the Presidency. The suggestions for the improvement of the staple are confined to the selection of the seed, to the observance of a more careful rotation in growing the crop, and to the improvement of the processes of cutting and steeping the fibre. The influence of the cultivation on the condition of the people appears to have been good. The testimony is uniform, that it has enriched the cultivators, while the deleterious effects of the manufacture upon their health seem to be very problematic. As to an alleged deterioration of the staple, the Commission attribute this belief to the fact that the high prices which have prevailed of late years have stimulated the production of large quantities of inferior or badly-prepared jute. It is not that there is less good jute produced than formerly, but that a larger porportion of inferior fibre grown on any and every soil has come into the market under the stimulus of prices; and that when the quantity grown is large, the care devoted to its preparation is comparatively small. The Commission record their judgment, that there is nothing to show that there has been any deterioration, *in se*, in the character of the jute, or any general falling off in the quality of the fibre. The local manufactures of the fibre into cordage and twine, and into gunny cloth and gunny bags, are described in their report at length; and the Commission have shown that it is used for paper making in several districts.

Sir John Hawkshaw has received a commission from the Emperor of Brazil to proceed to his dominions for the purpose of surveying the extent of coast (about 5,000 miles) from Pernambuco to Campos, with the view of developing harbours and of mapping out such lines of railway as may be conducive to the extension of trade on the south-east coast of America.

A resin embedded in the lignite of Dux, in Austria, has been analysed by Herr Fischer, and appears to be a new species, for which Dr. Doelter proposes the name *Duxite*.

DETERIORATION OF COALS THROUGH EXPOSURE.

It is a well-known fact, says *Engineering*, that coals when exposed for a long time to the influence of air, sun, or moisture, lose a certain quantity of their heating value, by changes which take place with their principal component parts, viz., carbon and hydrogen. This is done by the action of atmospheric oxygen, which penetrates the structure of the coal and combines with it, thus forming carbonic acid and water; in fact, the coal to a certain extent undergoes a slow, but constant, combustion. Highly bituminous coal also loses a part of its carburetted hydrogen, which escapes as gas and very often causes explosions in coal ships, when the hold has been held closed for a long time and is incautiously approached with a burning candle. The alteration of exposed coals differs, of course, very much according to their original quality. Gas coals, for instance, yield a much greater quantity of illuminating gas, as they come fresh from the mine, while after an unusually long exposure they may even lose all their hydrated carbon and become anthracitic. It was therefore of great importance to try by actual experiment to what extent such deterioration really takes place, as in case that this did not occur to a very great extent it would be convenient to large coal consumers, such as railway companies, gas works, or coke makers, to buy their supply from the mines in summer, when there is less demand and better transport accommodation, and to lay in a large stock for the winter. The German Railway Association had therefore certain quantities of different coals exposed for twelve months, and re-examined, when the following losses were determined:—

	Weight. per cent.	Caloric. per cent.	Yield of Coke. per cent.
Pease's West Hartley coking	0·0	0·0	0·0
Glucksburg seam, Ibbenbüren	1·4	6·0	4·6
Carl Mine, near Dortmund	—	2·6	2·1
Hibernia Mine, Gelsenkirchen	0·4	0·6	2 1
Constantine Mine, Bochum	0·4	0·4	0·0
Borglohe Mine, Osnabrück	2·0	6·0	0·5

These figures would prove that the losses which were sustained in weight, caloric power, and yield of coke, though appreciable after one year's exposure, are, in most instances, not so great as to counterbalance the profit arising out of laying in stocks at a convenient time. It is probable, however, that these losses will rapidly increase with a prolonged exposure to atmospheric influences. It would be interesting if such experiments were completed by chemical analyses, made after certain intervals, as they would show the gradual changes which inevitably take place.

The Chamber of Commerce of Beaune has discussed and approved the project of a navigable canal to unite the North of France with the Mediterranean. This canal is proposed to debouch in the Saone above Auxonne. The same chamber discussed the irrigation canal scheme of the valley of the Rhone, and arrived at the conclusion that such a canal would reduce the level of the Rhone, and therefore the project should be submitted to the consideration of the whole of the departments watered by that river.

A French patent has recently been taken out for the preparation of leather from tripe, intestines, and other animal membranes; these are soaked in milk of lime while still fresh, then washed and immersed in water, and finally in a paste made of starch and white of egg. The substance thus formed is to be used for glove-making, &c.; the material may also be tanned or curried.

NOTES ON BOOKS.

Practical Hand-Book of Dyeing and Calico Printing. By W. Crookes, F.R.S., &c., *Longmans*, 1874.

So elaborate and extensive a monograph as this is certain to attract considerable attention from those interested in its subject. It is undoubtedly true that no single volume could hope to comprise within itself a full account of all the recent improvements and inventions connected with this great industry. As Mr. Crookes says in his preface, "to give the briefest notices of every process tried on a practical scale, much more of every laboratory experiment on the production and application of colours, would require, not a volume, but a library." Still, that our author has grappled tolerably boldly with his immense subject may be judged merely from the fact that he has produced a book containing no less than 730 large octavo pages of closely-printed matter. More than the merest sketch of the contents of the book it is of course impossible to give here, but in view of the fact that the next series of the Society's Technological Examinations deals specially with the subject of Calico Bleaching, Dyeing, and Printing, it seems advisable to attempt such a sketch, incomplete as it must of necessity be. It will be remembered that it is not usual for this *Journal* to express any opinion on the merits of the books noticed in its columns, and that while it endeavours occasionally to describe such books as may treat of matters connected with the aims and objects of the Society, it always leaves its readers to estimate for themselves the value of the works thus treated.

Dealing, as Mr. Crookes does, with an art which, while among the most ancient known, has yet received a sudden and very great impulse from the discoveries of modern chemistry, he has before him a subject which has in part been treated exhaustively by previous labourers in the same field, in part been left almost untouched by any English writer. Scattered up and down in the scientific and technical journals of this and other countries, there are indeed materials for even a more copious essay than the present; but this very abundance of material rendered all the more obvious the necessity for some codification and digest, such as Mr. Crookes has undertaken. Throughout the book his aim has evidently been to supplement, rather than to supersede, his predecessors, and to dwell specially on what is comparatively recent, without devoting much space to matter of merely historical interest. For this reason, then, it probably is, that after a short introductory chapter on the early history of the art, he launches us at once into the scientific portion. The book is divided into two main parts, of which the first seems devoted principally to Fibres and Bleaching, the second to Colours, Mordants, and Printing. The First Division begins with a chapter on "The Art of Dyeing in relation to Chemistry." Then comes a chapter on "Textile Fibres and Tissues made therefrom—Thickenings and Plastic Mordants." After this are chapters on the various fibres, animal and vegetable, among which are also placed chapters on "Bleaching;" "The Means of Distinguishing Vegetable Fibres from each other;" "Vegetable Thickenings;" "Thickenings of Animal Origin;" and "Practical Receipts in connection with Woollen, Yarn, and Fabrics." The First Division is concluded by three chapters on "Potash, Soda, and Lime Salts;" "Alkalimetry;" and "Chlorine, Chlorides, and Chlorimetry."

The Second Division opens with a discussion of "The General Principles of the Fixation of Colouring Matters on Fibrous Tissues—Classification of Dye-Materials;" this is succeeded by six chapters, dealing at considerable length with the various classes of colouring matters. Then comes a chapter on "Mordants," and lastly one on "Printing," which concludes Part II.

An appendix treats the Bibliography of the subject,

giving, under classified headings, a list of books, articles in periodicals, &c., dealing with the principal materials and processes employed. In connection with this subject, it may be worth mentioning that a list of books, ancient and modern, on the subject, is given as an appendix to the "Abridgments of Specifications relating to Bleaching, Dyeing, and Printing Calico, &c.," published under the authority of the Commissioners of Patents.

That such a mere outline as the above can even convey any idea of the contents of this work, is, of course, impossible. It may, however, serve to show the nature of the book, and the line taken by its author. A marked feature is the illustration—after the plan of the old *Journal of Design*—of the processes, &c., described, by the insertion of numerous specimens of the dyed and printed fabrics themselves. Of these there are forty-seven examples, some of them showing processes in various stages.

CORRESPONDENCE.

SULPHUR IN SICILY.

Sir,—Referring to the paragraph in the Society's *Journal* of the 3rd inst., headed "Sulphur in Sicily," in which it was stated that Signor Parodi had "estimated that the sulphur in Sicily will be exhausted in from 50 to 60 years," will you permit me to say that, having inspected very many sulphur mines in the island, visited most of the sulphur districts, and been engaged for some years in directing the working of sulphur mines there, I am of opinion that the estimate of Signor Parodi is at least doubtful.

With very few exceptions, the ore is carried to the surface on the backs of boys, two to four of whom accompany each miner, and it is a well-known fact that the produce of a mine in Sicily is chiefly determined by the difficulty of getting boys. Moreover, as each boy carries a small load only, and makes several journeys per day up and down the difficult headings and shafts, the mines soon reach a depth at which they cease to be profitably worked.

This depth is in practice found to be about 400 feet, below which winding machinery is needed for hauling the ore to the surface, but has hitherto scarcely been tried. All the sulphur in the island, therefore, below 400 feet, is almost untouched.

That this quantity may be considerable must be inferred from the fact that many of the beds of ore are nearly vertical and improve as they descend.

I have the greatest respect for the opinion of Signor Parodi, who has done more than any one to record the facts as to the existing state of the sulphur industry, but I am confident that the data are insufficient on which to form an estimate limiting the duration of the field to fifty or sixty years.—I am, &c.,

W. Shelford.

7, Westminster-chambers, W.C., July 7, 1874.

GENERAL NOTES.

The Crystal Palace.—A testimonial was recently presented to Mr. George Grove, the late Secretary of the Crystal Palace Company, by his former colleagues. The committee of this testimonial consisted of Mr. James Fergusson, F.R.S. (chairman), Mr. W. Gardiner, Mr. W. Austin Hart (hon. treasurer), Mr. D. Hill (President Sacred Harmonic Society), the late Mr. Owen Jones, the late Mr. Joseph Leech, Mr. August Manns, Professor Owen, F.R.S., Mr. J. Wilkinson, Sir Matthew Digby Wyatt, and Dr. David S. Price and Mr. F. K. J. Shenton (hon. secretaries). The testimonial was presented in the Library, in the presence of a large number of Mr. Grove's old colleagues, Mr. Fergusson, chairman of the committee, presiding. It will be remembered that before his connection with the Crystal Palace, Mr. Grove was for some time secretary to this Society.

Columbia Market.—At a recent meeting of the Court of Common Council, a letter was read from the Baroness Burdett-Coutts, accepting the offer of the Corporation to restore to her the possession of the market if she desired to resume the possession of it, in the hope that she might be able to carry out her original plans.

The Cost of the South Kensington Museum.—It appears from a parliamentary return obtained by Mr. Dixon that the total cost of the South Kensington Museum, from its commencement to the end of the financial year 1873-74, was £1,191,709 19s. 4d. The cost of purchases made for the museum has been £281,672 9s. 1d., of which sum £30,220 18s. 1d. has been for reproductions, plaster casts, &c.; £38,642 6s. 11d. for the art library; and £18,009 2s. 11d. for the educational and scientific collections; the remainder—£194,799 18s. 2d.—has been expendended in the purchase of sculpture, wood and metal work, jewellery and goldsmiths' work, earthenware and stoneware, &c.

Patent-law Assimilation.—The British Committee formed in connection with the Executive Committee of the Vienna Patent Congress includes—Professor Abel, F.R.S.; Col. Anderson, D.C.L.; Major Beaumont, M.P.*; F. J. Bramwell, C.E., F.R.S.; T. C. Carbutt; L. L. Dillwyn, M.P.*; Geo. Haseltine, M.A., LL.D.; John Head; John Hicks, M.P.*; James Howard*; S. C. Lister*; J. A. Mundella, M.P.*; J. Hinde Palmer, Q.C.*; Dr. Odling, F.R.S.; S. Remington; Warren De La Rue, F.R.S.; B. Samuelson, M.P.*; Dr. C. W. Siemens, F.R.S; T. Webster, Q.C., F.R.S., and Dr. Wienmann. The committee propose the formation of a National Patent Association to co-operate with like associations which have been formed in America and Europe, for the purpose of securing the assimilation of the various patent systems on a liberal basis. Those marked with a star are members of the late Parliamentary Select Committee upon Letters Patent for Inventions.

Suez Canal.—The Council of the Suez Canal Company has made a report on the working of the canal during the past year, from which it appears that the income of the canal in that year was nearly one million sterling, and the expenses less than £700,000. The report says that the canal has been materially improved by the enlargement of the curves and the improvements of the stations. Commander Willoughby, R.N., chief agent of Indian transports in Egypt, is reported to have admitted that the large British transports made the transit from sea to sea without difficulty, but to have asked if more facilities could not be accorded to these great vessels of 4,500 tons' capacity, but M. de Lesseps says that the "illegal tariff" which had been forced upon the company prevents any such "generosity." The number of vessels which passed the canal last year is given at 1,178, and their capacity upwards of 2,000,000 tons. The increase in the size of the vessels is striking; in 1870 the tonnage averaged 1,338 tons, it now reaches 1,847 tons, an increase of 38 per cent. The *Cella* has passed through the canal drawing 7·39 metres, or 24 feet. The number of steamers have increased this year at the rate of twenty-two per cent. It appears by the report from Ismalia, that between the 11th and 20th of June, thirty vessels passed through the canal, paying in all a sum equal to £23,200, or an average of £773 6s. 8d.

Anthracene and Alizarine.—After Gräbe and Liebermann's celebrated discovery of the artificial production of alizarine, says the *Athenæum*, and the consequent introduction of dyes obtained from anthracene, the attention of chemists was directed to a number of substitution-derivatives yielded by this hydrocarbon. The nitro-derivatives, however, received but little attention, in consequence of the peculiar behaviour of anthracene under the influence of nitric acid; the re-action producing oxidised products, and not nitro-derivatives. The subject has been recently studied by Herr E. Schmidt, whose results are at variance with those of Phipson, Bolley, and other chemists who had previously worked in this direction. Schmidt has succeeded in preparing pure chrysene—a hydrocarbon obtained in tho dry distillation of organic bodies—and has sudied its behaviour with bromine, chlorine, nitric acid, and other re-agents. He obtained chrysene in rhombic tabular crystals, which, though colourless, exhibit an intense reddish-violet fluorescence. Schmidt's "Beitrage zur Kenntniss des Anthracens und Chrysens" will be found in the last part of the *Journal fur Praktische Chemie.*

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FRIDAY, JULY 17, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

INTERNATIONAL EXHIBITIONS.

A meeting of the Council was held on Monday, July 13. Present—Major-General F. Eardley-Wilmot, R.A., F.R.S. (in the chair), Mr. F. A. Abel, F.R.S., Mr. G. C. T. Bartley, Mr. Edwin Chadwick, C.B., Mr. Hyde Clarke, Mr. Henry Cole, C.B., Colonel A. Angus Croll, Major Donnelly, R.E., Mr. W. Hawes, F.G.S., Admiral the Right Hon. Lord Clarence Paget, K.C.B., Mr. Robert Rawlinson, C.B., Mr. E. J. Reed, C.B., M.P., Lieut.-Col. A. Strange, F.R.S., Mr. Seymour Teulon, and Mr. T. R. Tufnell.

Read the announcement of Her Majesty's Commissioners for the Exhibition of 1851, stating that it is not intended to continue the present series of Annual International Exhibitions at South Kensington after 1874;

Took into consideration a letter from Dr. J. Forbes Watson addressed to the Council;

Resolved that, the Society of Arts having taken an active part in originating the Great Exhibition of the Works of all Nations in 1851, and having raised the guarantee fund of £450,000, which enabled the Exhibition of 1862 to be carried into effect, it is the opinion of the Council that arrangements should be made for a Conference, about the end of October, to consider the desirability of holding International Exhibitions in this country, and what form, if any, they should take, and to invite the expression of the opinions of competent persons upon the subject, and further to consider the question of holding Provincial Exhibitions.

That a Committee, consisting of Major-General Eardley-Wilmot, R.A., F.R.S., Chairman, Mr. H. Cole, C.B., Major Donnelly, R.E., Mr. W. Hawes, F.G.S., Admiral the Right Hon. Lord Clarence Paget, K.C.B., Mr. E. J. Reed, C.B., M.P., Lieut.-Col. A. Strange, F.R.S., and Mr. Seymour Teulon, be appointed to carry out the foregoing resolution.

ESSAYS ON THRIFT.

The judges appointed to award the Prizes offered by Sir Joseph Whitworth for Essays on the above subject have reported to the Council that there is no Essay of sufficient merit to be entitled to the full Prize offered, but that the Essay with the motto "Labor omnia vincit" has very considerable merit, and is fairly entitled to recognition by the Society. The Council have, under these circumstances, and with the assent of Sir Joseph Whitworth, awarded £50 to the author of that Essay, Mr. Joseph Mason, of Fairview, The Holt, Birkenhead.

TECHNOLOGICAL EXAMINATIONS.

The programme for these Examinations is in preparation, and will shortly be issued. It will include the nine subjects of last year, viz., Cotton Manufacture, Silk Manufacture, Paper Manufacture, Steel Manufacture, Carriage Building, Cloth Manufacture, Glass-making, Pottery and Porcelain, and the Manufacture of Gas, with the addition of four new subjects, viz., Agriculture, Silk and Woollen Dyeing, Calico Bleaching, Dyeing, and Printing, and Alkali Manufacture.

IMPROVED RAILWAY LAMP.

The Society's Gold Medal, or Twenty Guineas, is offered for an improved lamp or means of illumination, suitable for railway passenger-carriages, that shall produce a good, clear, steady, durable, and safe light.

It must be simple in construction, and capable of being readily cleaned and repaired.

In judging the merits, cost will be taken into consideration.

Specimens, in a condition suitable for trial, to be sent in to the Society's House not later than the 1st of November, 1874.

The Council reserve to themselves the right of withholding the medal or premium offered, if, in the opinion of the judges, none of the articles sent in competition are deserving of reward.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

SCIENTIFIC INVENTIONS AND NEW DISCOVERIES.

Had the original expectations been fulfilled with which this class was originated in the scheme for the Annual International Exhibitions, there can be little doubt that it would have proved the most interesting, and in many respects the most important, of all the divisions of each exhibition. It cannot, however, be said that the specimens which have been shown in each of the exhibitions up to the present have in any sense been representative of the scientific or inventive progress of the year either

in England or abroad. If we compare for a moment the number and variety of the objects for which patents are taken out in a year with the insignificant collection of scientific novelties at South Kensington, it will be at once obvious that we cannot regard that collection as even attempting to give us any view of what has been done in science and the industrial arts during the past year. It must be considered as merely consisting of a small number of new inventions, possessing greater or less interest.

That inventors have not responded with greater readiness to the invitation of the Commissioners is a matter for regret, since a plan so promising in theory has in execution proved impracticable. The value of a typical scientific collection of the year, could such have been got together, would have been immense, and the consequent disappointment is the greater at the non-success of the scheme. It is, therefore, impossible to draw any general conclusions from the miscellaneous assortment which is shown, nor, indeed, is it any more easy to give a general account of it. Some slight account, however, of the different objects may be given, and this, it is hoped, may prove not entirely without value.

Under the name of the "Papyrograph," E. Wolff and Son exhibit an apparatus for copying letters, &c. The invention was originally that of an Italian, named Zuccato, and is carried out in the following way:—The document to be copied is written in an alkaline ink, on a prepared waterproof paper. This ink corrodes away the waterproofing material (which is applied only on one side), and, consequently, when the ink is washed away, the part on which the writing was is left plain, while the surrounding paper is waterproof as before. There is thus, therefore, a sort of stencil-plate formed of porous paper and waterproof paper. This sheet is then laid on a pad saturated with a certain chemical salt, and on the top of it is laid a sheet of paper saturated with another salt; pressure is applied, and the two salts being able to unite through the porous part of the intervening stencil-plate (as it may be termed), they there form a colouring matter which is deposited on the upper sheet in absolute *fac-simile* of the original writing on the stencil. As seen in action the process is easily comprehensible, more so, doubtless, than the above explanation can make it appear. It is applied by means of a frame, in which the pad, the stencil-paper, and the saturated sheet are held in proper position, and an ordinary copying press. It will of course be obvious to any chemist what salts might serve to produce the required result, but as this must be more or less a trade question, it is perhaps better not to enter upon the matter here. As the salts employed will only yield a blue colour, the plan is not so wholly satisfactory as if a black could be obtained, but there can be no question as to the absolute identity of the copy with the original, or of the ease and quickness with which the copies can be produced. The exhibitors state that about 300 impressions can be taken from each original, and that these can be worked at an average rate of five a minute. It is also said that the first impression can be obtained in less than ten minutes from the first writing of the manuscript.

At No. 6,919 Mr. Hill shows an example and a model of his Boat-lowering Apparatus. This is illustrated in figs. 1, 2, 3, and 4. The entire apparatus is shewn in figs. 3 and 4 as applied to a boat, fig. 3 as when the boat is hanging from the davit, fig. 4 as when it has just been disengaged from the falls. Fig. 2 shows the disengaging hook, with a small piece pivotted to the point for locking the ring (fig. 5) into the hook. This may be removed by hand or automatically by a line fixed to the davits. Fig. 1 shows the ring engaged in the hook; the ring is held in an inclined position by the point of the hook, so that when the strain is taken off the falls the ring drops into a vertical position, and slides off the hook stem. To prevent one end of the boat being disengaged by the other from a wave striking it, and so relieving the falls of one end only from strain, the two are united, as shown in figs. 3 and 4 by a "safety-line," which distributes the strain, and only allows the hooks to be disengaged when the boat is completely water-borne, and so the falls at both ends slackened.

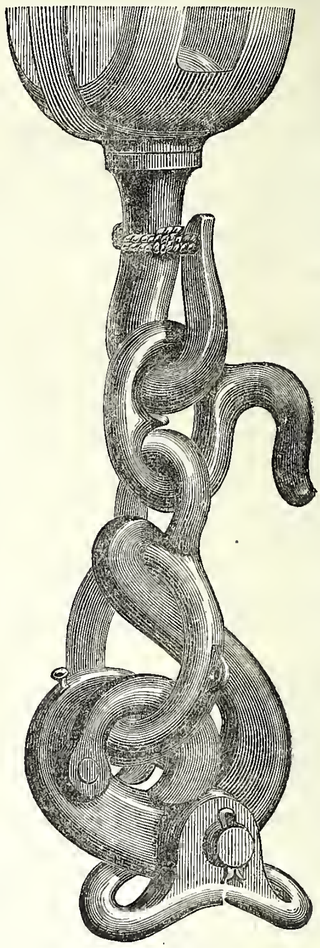

Fig. 1.

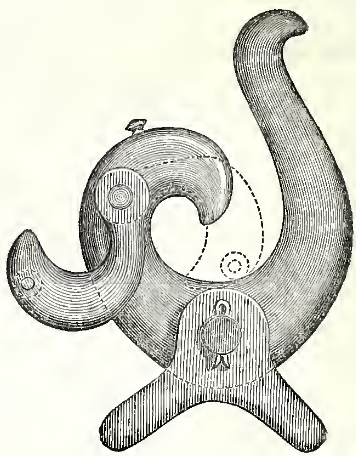

Fig. 2.

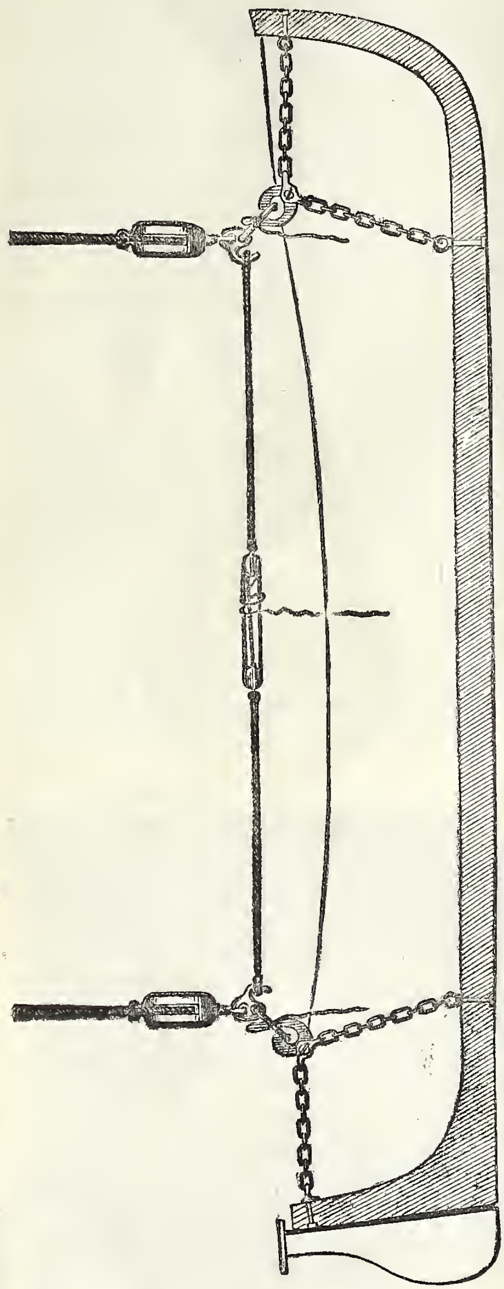

FIG. 3.—HILL'S BOAT-LOWERING APPARATUS.

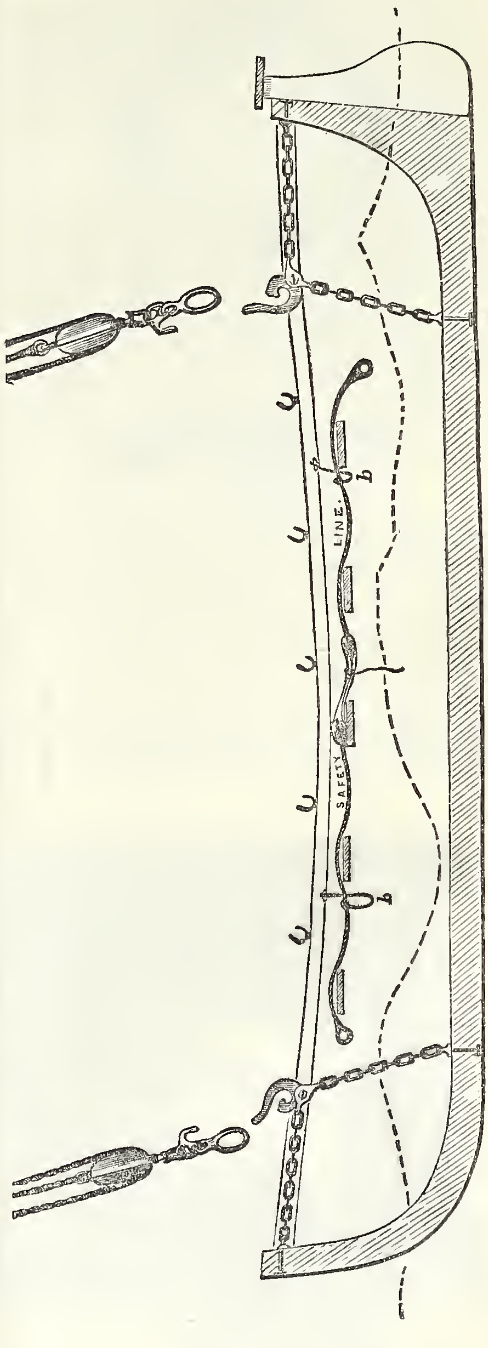

FIG. 4.—HILL'S BOAT-LOWERING APPARATUS.

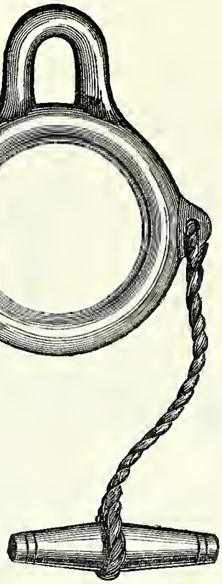

Fig. 5.

The same exhibitor shows (No. 6,919) a model of a railway carriage door, with a window-sash that will remain at any height to which it is raised. This is effected by loose pieces of india-rubber, working in a slot between the edge of the sash and a notched rod, which is forced against the frame by the weight of the sash pressing on the pieces of india-rubber, and these each on one of the notches of the rod so as to force it outwards.

Among the exhibits are no less than seven varieties of cattle trucks. These were all sent in in competition for some prizes offered by the Society for the Prevention of Cruelty to Animals, and were afterwards placed in the Exhibition. The exhibitors are W. J. Bonser. No. 6 902; J. Cabry, No. 6,903; C. H. Nassau, No. 6,932; R. Norfolk, No. 6,933; W. Reid, No. 6,941; C. Sullivan, No. 6,951; and A. Welch, No. 6,954. Of these two are illustrated below, that of W. Reid (figs. 6 and 7), and that of W. J. Bonser (figs. 8 and 9). Fig. 6 is a section, showing the construction of the truck; fig. 7 shows the exterior view and the untrucking of the cattle. In fig. 6, 1 is a water reservoir, from which troughs 3,3 are supplied through pipes, 6, 6; 2, 2 are racks for fodder; 4 is a space in which goods can be packed; 5, 5 are openings for ventilation. Beyond this the illustrations explain themselves. It should be added that the trucks shown in the Exhibition, and represented in the engravings, are of an old pattern, which the executors of the late inventor say has been recently improved upon.

In Bonser's truck (Figs. 8 and 9) *AA* represent upright standards supporting on pivots levers *c c*, to one end of which levers is suspended a trough *a*. This trough when empty is retained in an elevated position by the balance weights *e e*, as represented on the right side of Fig. 8. A truck *B* containing cattle being brought into the siding alongside the suspended trough, and the supply cock *g* being turned, water will flow through the supply pipe *d* into the trough *a*, which being, when filled, heavier than the balance weights *e e*, will move in the arc of a circle until it assumes a position level with and close to the opening in the truck *B*, through which the cattle can thrust their heads to drink, as shown in the left side of Fig. 8. The lever *c* being connected with the supply-cock *g*, when the trough descends, the supply of water will be stopped or regulated to keep the trough supplied as the water is consumed by the cattle. After sufficient time has been allowed for the cattle to drink, by turning the cock *h* the water will escape through the waste pipe, and the trough, again becoming lighter than the balance weights, will ascend and resume its former position, clear of the truck, and the train can proceed without delay. Above the trough *a* may be fixed a rack *b*, to be filled with hay previous to the arrival of the train. When the cattle have had sufficient water, by

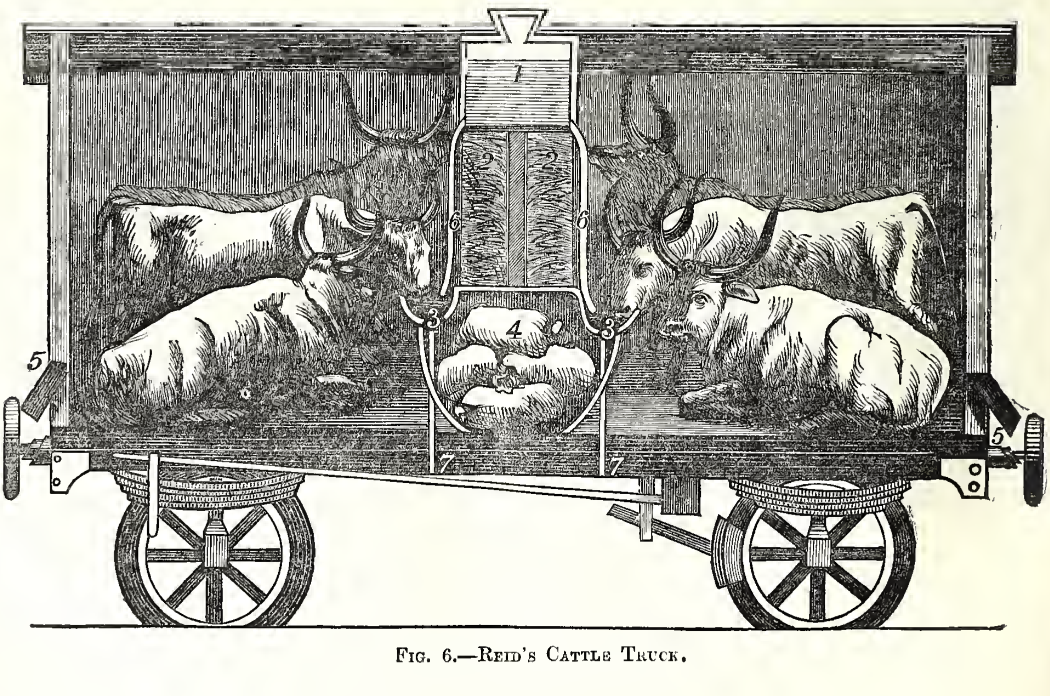

Fig. 6.—Reid's Cattle Truck.

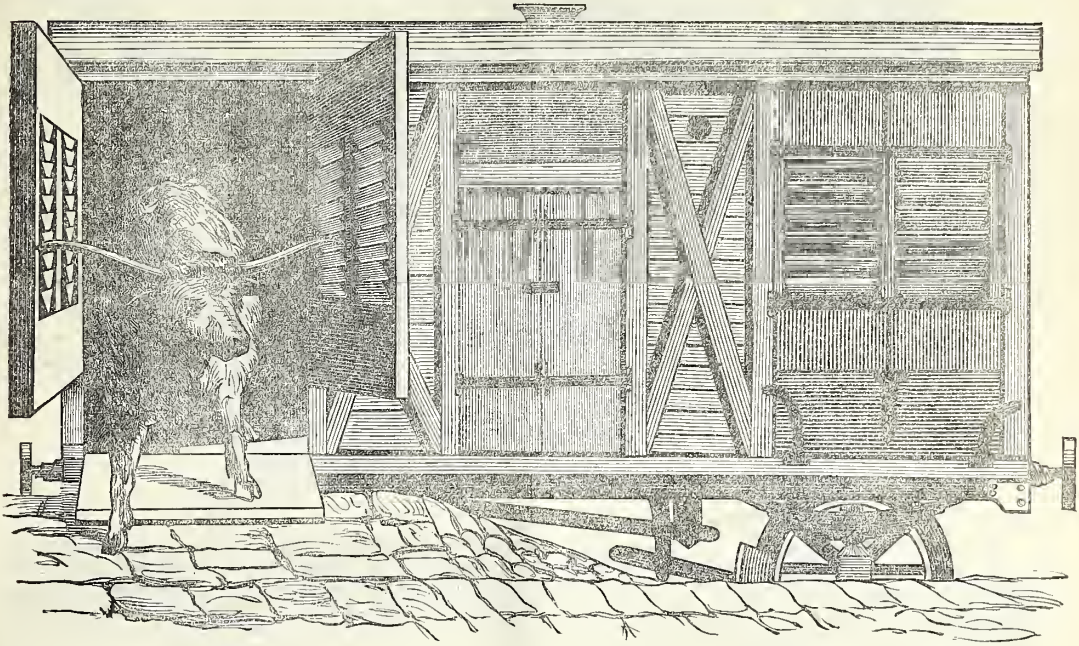

Fig. 6.—Reid's Cattle Truck.

the moving of a lever the trough will be allowed to descend sufficiently to bring the hay-rack level with the opening in the truck, and upon allowing the water to escape, the rack and trough will together ascend clear of the truck. Fig. 9 represents the same arrangements applied to a covered cattle truck. By the employment of a sufficient number of these troughs, and their connection with a main pipe, it is said that any number of trucks in a train may be simultaneously supplied by the turning of a single cock.

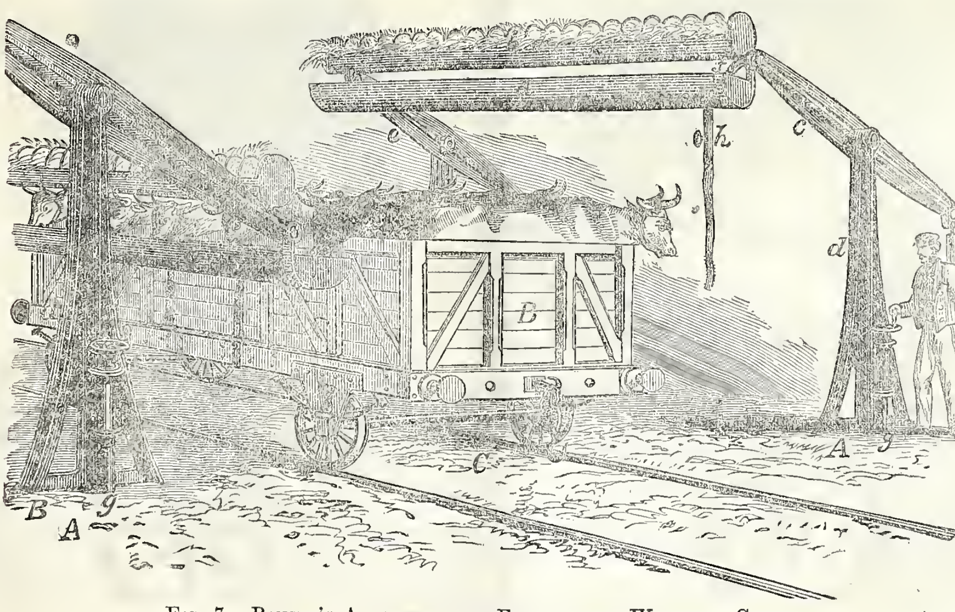

Fig. 7.—Bonser's Apparatus for Feeding and Watering Cattle.

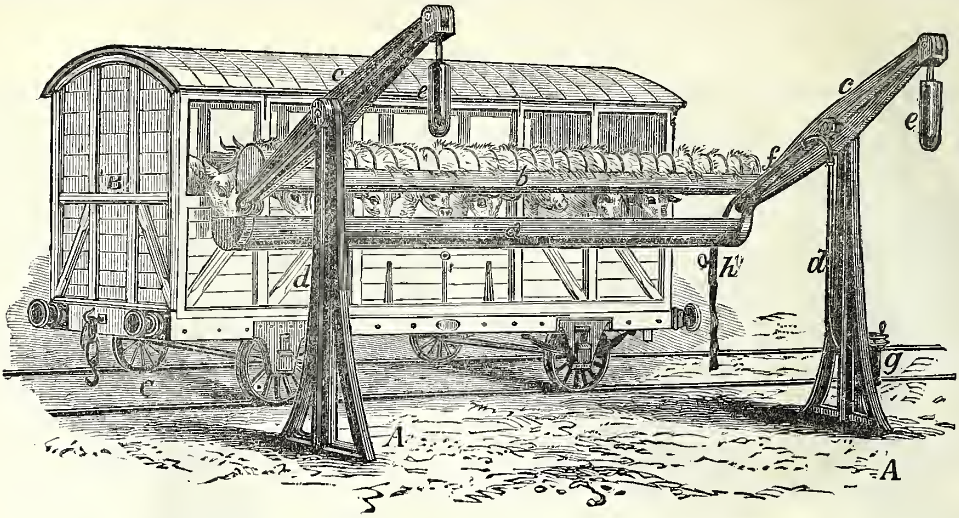

Fig. 9.—Bonser's Apparatus for Feeding and Watering Cattle.

Of Welch's cattle trucks, several models are shown; in all, however, the same principles are carried out. The trucks are capable of being divided by sliding partitions into stalls, and each is fitted with a fodder-rack, which has a cover, and a water-trough supplied from a cistern on the roof. An appliance is arranged by which the covers of the troughs, &c., can all be raised and closed at once from outside.

In Nassau's truck there are also stalls, each supplied with food and water troughs. It is arranged so that it is to be loaded from one side, and unloaded from the other.

In Sullivan's truck the fodder is supplied by means of racks on each side near the roof. The racks are filled through moveable flaps, opening from the outside. These flaps are made solid, to obviate the risk of fire from sparks from the engine, &c. The heads of the beasts are all secured to one side of the truck, so that the rack on the off-side can be used to carry a reserve supply of hay, and a locker can be fixed outside of the truck across the buffers, to contain a further quantity of hay.

The water is supplied by troughs, with turned-over lips, and sliding covers placed inside the the truck from end to end on each side. These can be opened or shut at will from the outside. The carrying capacity of these troughs is about 18 gallons on each side of the truck; they are filled from tanks placed on the outside of the truck, one at each end, each tank holding 36 gallons. The water is turned on from the tanks to the troughs by means of sliding levers placed at each corner of the truck, over the buffers. There are small troughs in the doors connected with the larger ones by means of flexible pipes. The tanks can be filled from a stand-pipe or water-column, through an inlet at the top of the tanks.

In order to keep the floor dry and to furnish an easy means of cleaning the truck, the floor is raised in the centre, and a gutter is placed the whole length of the truck inside.

A current of air from end to end of the truck is secured by means of louvres cut in the end boarding, and further ventilation is provided by means of moveable flaps in the side boarding, which can be opened or shut from the outside. A space of one foot deep is also left unboarded the entire length of the truck, at such a height as to secure a current of air immediately above the heads of the animals.

The "Seal Lock and Registering Pressure Gauge Company" (No. 6,946) show specimens of their various inventions. The seal-lock, as it is called, is an American invention. Its object is to prevent tampering with locks, or to show that such tampering has been attempted. There are several varieties of the lock, but they are all formed on the following plan:—The keyhole is covered by a sliding metal plate, which, when pushed into its place, is retained by a spring-catch. In this plate there is a small hole, through which the catch may be pressed back, and the plate can then be drawn down so that the keyhole is exposed. The plate is countersunk to receive the so-called "seal," which is a small square piece of

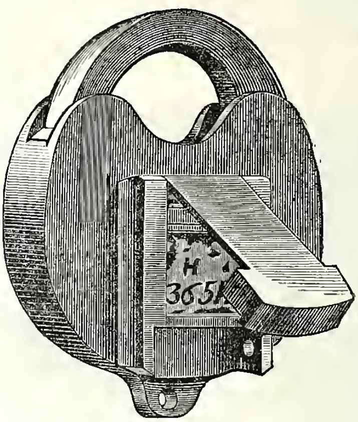

Fig. 10.

glass, held in position, when the plate is pushed home, by the grooves in which it slides. The seal, therefore, covers the hole through which alone the spring-catch is accessible, and this cannot be released until the seal is broken.

Figs. 10 and 11 show a padlock with the invention applied to it. In fig. 11 the lock is open and the plate drawn out, showing the keyhole; in fig. 10 the lock is locked with a seal in it. In both figures the flap shown is merely to protect the glass from injury. It is secured by a small spring-catch.

Fig. 12 shows one of the glass seals. Each of these has on it a series of numbers, which never repeat themselves. They are made in sheets, and besides the figures, the blots

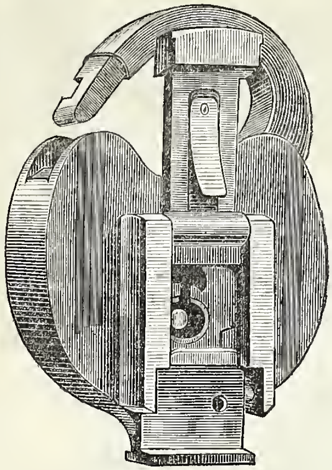

Fig. 11.

are sprinkled on, after which the sheet is cut up. Photographs of the sheets are taken, and these are cut up in like manner, so that each seal may have a corresponding photograph.

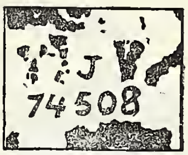

Fig. 12.

The same exhibitors also show a water meter (figs. 13 and 14).

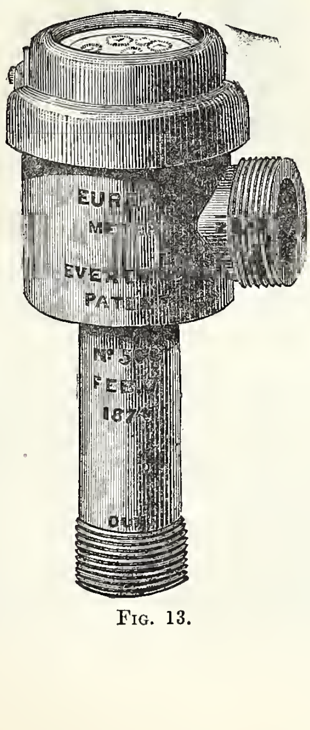

Fig. 13.

Fig. 13 is an exterior view, and fig. 14 a vertical section. The water flowing through the horizontal inlet pipe, descends the vertical one, and in so doing

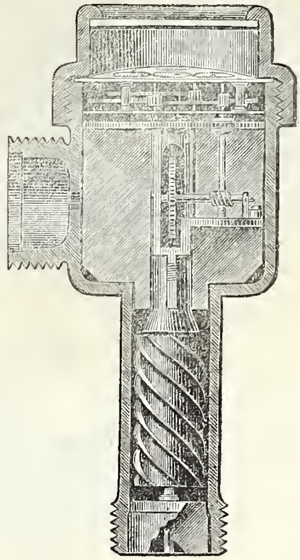

Fig. 14.

revolves the screw, which transmits motion to an ordinary index plate above. The speciality of the meter is stated to be that the composition of which the screw is made is so nearly the same specific gravity as water that the friction is reduced to a minimum.

Lastly, the same company show examples of their pressure gauges, of which fig. 15 shows an outer view, fig. 16 the interior mechanism. The large hand in this

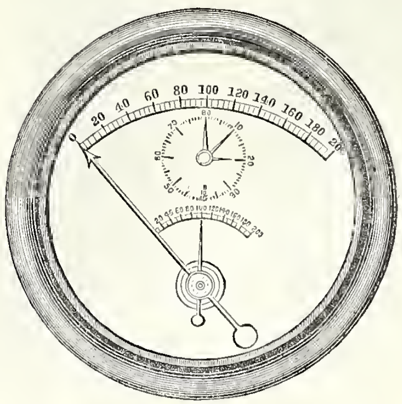

Fig. 15.

is the ordinary pointer, while the small hands show each time that the pressure has exceeded or fallen below a certain definite standard to which the gauge is set. This is effected by the levers shown, motion being transmitted by them from the spindle of the large pointer to a cog-wheel on the spindle of one of the small pointers, whenever the movement of the former exceeds a certain arc.

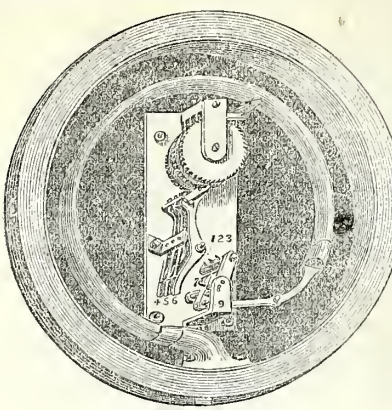

Fig. 16.

There are three exhibitors of miners' safety lamps. Cooke and Myhill (No. 6,905), J. G. Rowe (No. 6,944), and W. Yates (No. 6,959.) The first named show a "Geordie," or Sir George Stevenson's lamp, with improved ventilation and locking, and a "Dr. Clanny" lamp, with dioptric glass and improved hinge at top. These are of the sort shown in figs. 17 and 18.

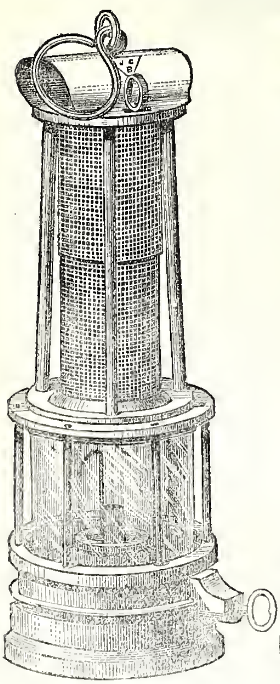

Fig. 17.

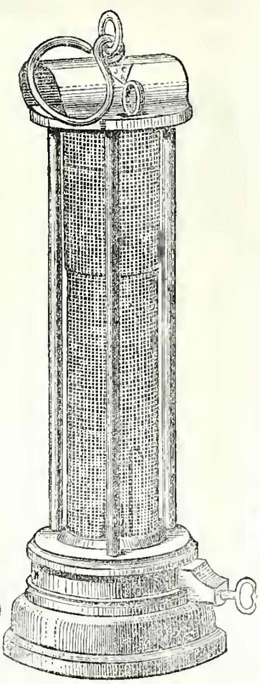

Fig. 18.

The Stephenson is a light strong lamp, and has the perforations for admitting air specially made with a view to preventing the lodgment of dust.

The second exhibitor, J. G. Rowe, shows a lamp which locks itself by heat, and cannot afterwards be opened without a key.

The speciality of W. Yates's lamp is that it cannot be opened without extinguishing the flame. The lamp is opened by unscrewing a button at bottom, on withdrawing which the wick-carrier is brought down through an extinguisher tube and the light put out. The same action withdraws a catch, and suffers the lamp to be opened.

Colonel Tomline (No. 6,593) exhibits a set of logotypes for printing. The combinations of letters are such as are said to be found in practice most useful. It is hardly needful to say that there is nothing new in the idea of employing types composed of words and syllables instead of letters. The speciality of these consists in their arrangement and in the cases in which they are placed. The types are arranged in rows with the face uppermost in trays, and these trays are arranged in a sort of cabinet, one above the other. They are placed at a slight angle, so that when one type is withdrawn from the bottom of a row the others slide down, and its place is immediately supplied by the next above it. The whole series is thus brought within a much smaller compass than in the ordinary compositor's case. The types have the letters in a reversed and consequently legible position on the foot, a device which, it is supposed, may assist a beginner, but as an ordinary printer's apprentice learns to read the types in common use in a few days, it would not appear that there is much gained by that.

Abrahams' "Perfumer and Deodoriser" (No. 6,900) depends for its action on the fact that a piece of platinum suspended in a vessel containing alcohol close above the spirit will, if once heated to redness, continue red-hot, without producing active combustion. The hydrogen liberated from the spirit combines with the oxygen of the air on the surface of the platinum, and thus evolves sufficient heat to keep the platinum glowing, and so continue the vaporisation of the spirit. The process is carried on by the arrangement figured (fig. 19.), in which a piece of

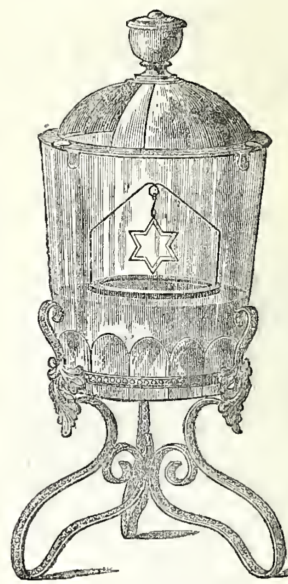

Fig. 19.

sheet platinum cut into the figure of a star, &c., is supported on a cork float over the surface of the spirit. The cover is made with openings to regulate the admission of air. For perfuming, any scent distilled with alcohol can be employed; for disinfecting, the disinfectant is dissolved in spirit.

J. H. Steward (No. 6,950*a*) shows an "Hourly self-recording Aneroid," represented in fig. 20. It consists of an aneroid and a clock, between which is placed, in a vertical position, a cylinder four inches in diameter. The circumference of this cylinder is furnished with a toothed wheel, which

works in an endless screw at the back of the instrument; it has a paper attached to it ruled to coincide with the barometer scale. This paper, besides being ruled horizontally into inches and tenths to correspond with the barometer scale, is divided vertically throughout its entire length of twelve inches into seven principal and seven minor divisions, indicated by darker and lighter lines. The dark lines represent the noon, and the lighter lines the midnight of every 24 hours. The paper thus lasts a week. Near the paper a point guided by a rod of metal is moved up and down as the action takes place in the aneroid, and at every hour the point is made to mark the paper by mechanism connected with the clock.

The main point in which this barometer is stated to be superior to those previously introduced are—first, the transposing of the clock and the aneroid, by which the chain from the latter goes direct to the point that marks the chart, and so reduces the friction to a minimum; second, it has a very open scale, so that the divisions to hundredths of an inch are clearly seen; third, there is an adjustment for making the perpendicular csale and chart exactly agree.

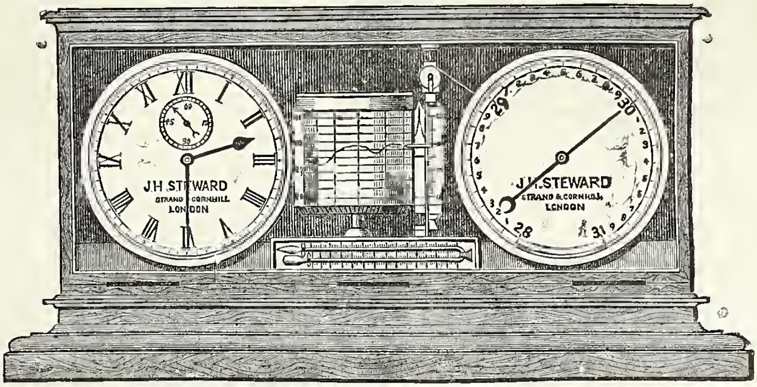

Fig. 20.—Hourly Self-Recording Aneroid.

The "Catoptric Lamp," for street lighting, exhibited by T. A. Skelton (No. 6,948) has already been described in a paper read by the inventor before the Society the 16th of April, 1874, and printed in the *Journal*, Vol. xxi., p. 402. In it the top of the lamp and the upper part of the sides are formed of slips of glass arranged so as to deflect the rays and throw them downwards, instead of allowing them to be lost. The bottom of the lamp is fitted with a slide working on a central pivot, and having a projecting stud, by means of which it can be turned aside by the end of a torch so that the lamp can be lighted, after which the slide can be reclosed.

A. Rae (No. 6,940) exhibits a model of a floating bath intended for use in the sea, or in rivers, lakes, &c. Bathing saloons have long been in use on the Seine and elsewhere, and it is probably only the impure nature of the Thames water that prevents their adoption in London. This objection the inventor proposes to get over by the use of large filters, through which the water is driven by hydraulic pressure from without, the barge being capable of being raised or lowered by pumping water into or out of suitable receptacles. By this means the bath can be emptied or filled. As shown in the Exhibition, the apparatus is fitted with Atkins' filters, formed of plates of compressed charcoal. In construction, the saloon consists of twin barges, having between them a central hull, which constitutes the bath. Dressing-rooms, &c., are arranged at the ends of the bath. The saloon is also intended to be utilised for other than bathing purposes, such as to form a concert-room, &c.

No. 6,947 is a Gas Machine by A. Sington and Co. This is an apparatus for carburetting atmospheric air, and thereby producing an illuminating gas. The oil used is preferably that known as gasoline, which has a specific gravity of about 700°, its boiling point being 86°. It is not said that any other liquid hydrocarbon could not be equally available, but this is probably used from its cheapness and from its extreme volatility, which makes it dangerous for employment in lamps, but adapts it all the more readily for conversion into the mixed gas required.

The oil is stored under pressure in a suitable reservoir, which is by preference buried under ground. This is connected with a retort, into which a portion of the oil is driven by pressure; it is there utilised, and the additional pressure of the vapour in the retort drives back into the tank the remaining oil. Connected with the retort is a gasholder of the ordinary construction, and so arranged that when it is full the connection between it and the retort is closed, but as it falls it opens a valve, and thereby establishes the connection again. This valve being open, the vapour of the hydrocarbon rushes through a small jet into the mouth of a tube leading to the holder, and thereby induces a current of air, with which it becomes mixed, and with which it passes on into the holder. By regulating the size of the air-tube, the quantity of air, and consequently the richness of the gas, is regulated. As soon as the holder is filled, the supply is cut off, and remains off until the holder is again emptied, when the valve is re-opened and the process repeated as before.

There are also automatic appliances by which the supply of oil is cut off if the machine ceases to work regularly, and a device by which its action can at once be stopped from a distance, and without the necessity of going to the machine itself.

The principal advantages claimed for the machine are that the relative proportions of air and vapour can be regulated so that the gas is of a uniform quality, and therefore capable of being burned in any ordinary burner as well as in an Argand.

Mitchell's "Cork Sizing Machine" (No. 6,930), is intended to perform work previously done entirely by hand. The corks as cut are of various sizes, according to the size of the cork-wood. These are placed singly by hand in a feed tube, below which is a revolving disc fitted with boxes, each of which takes one cork. A lever pressing against the cork holds it until it is brought over the one of a series of baskets containing corks of the same size. The end of the lever then strikes against a pin set at the proper distance, according to the position in which the lever is retained by the cork; it is

thus set free, and the cork drops into the basket. It is stated that by this machine a child can do the work of three skilled operatives.

Under the title of "Adam's Universal Glass Cutter," R. E. Macfarlane (No. 6,928) exhibits an implement for cutting glass, intended to supersede the ordinary glazier's diamond. This instrument consists of a small wheel made of very hard steel, which has a sharp yet very obtuse edge, the edge forming an angle of about ninety degrees, and the diameter not greatly exceeding that of a large pin-head. This revolving cutting disc is mounted in a steel handle, with rests for the ends of the thumb and middle finger, to facilitate holding the instrument in a proper position; and it has a couple of grooves to assist in the removal of narrow strips of glass not easily divided, after cutting, by the fingers.

The Rev. E. L. Berthon (No. 6,901) shows a "Collapsing Dinghy for Small Yachts." This is a boat constructed of a skeleton framework of longitudinal timbers, pivotted at stem and stern, so that they may collapse and lie flat against the keel. Over these timbers is fixed a covering of strong canvas, which stretches tight when the boat is distended, and folds up in a sort of umbrella fashion when the boat is collapsed.

Louis Cornelis (No. 6,906), of Belgium, shows some bottles with desiccating stoppers, for preserving substances liable to be affected by damp. They are ordinary bottles with hollow globular stoppers containing a desiccating material, confined within the stopper by means of a piece of wash-leather tied over its lower opening, which admits of communication between the atmosphere of the bottle and that of the stopper. The same exhibitor also has a barrel for preserving gunpowder in.

No. 6 913 (E Dyer) is a life-escape, having in addition to the ordinary ladder arrangement a line carried over a pulley at the top, by which a bag may be raised and lowered. The apparatus is also different in some other respects from those generally in use.

J. Gregory (No. 6,916) also shows an improved fire-escape.

No. 6,914 (Capt. C. Fairholme, R. N.), non-lubricating rolling bearings for axles, which apparently do not differ from those described in numerous patent specifications, old and new. A shaft has its bearings upon a number of cylinders or spheres.

No. 6.925 (C. H. Lea) is a model of a mantlet for rifle shooting, the door of which is so connected with the target, as to turn the latter edgewise to the line of fire, when opened to allow the marker to leave his cover.

J. Snowdon (No. 6,949) exhibits a bolt and screw-pointing and rounding tool, by which the two operations of pointing and rounding bolts are performed at once.

C. W. Richter, of Hungary (No. 6,942), shows a case containing the materials used for a new process of corrosion of horn, and samples of horn objects before and after corrosion; also a pair of shooting spectacles in which the aiming eye of the spectacles is opaque, with a small hole for limiting the direction of vision and keeping it in line with the mark and gun sight.

The following is the return of admissions for the week ending July 11th—Season tickets, 2,153; payment, 10,497; total, 12,650.

The last return shows that the population of Japan amounts to 33,000,000; the country contains 717 districts, with 12.000 towns, 76,000 villages, including altogether 7,000,000 of small and large houses, and 98,000 Buddhist temples. The population is divided into 29 princes and princesses, 1,300 noblemen, 1,000,000 peasants; of whom 500,000 are labourers, 800,000 merchants, tradesmen, and shopkeepers.

The prospects of Tasmania, as an iron-producing country, are said to be improving. Some new discoveries of tin have also been made, but little actual tin-mining appears to be now proceeding.

EXHIBITIONS.

Industrial Exhibition at Dundee.—The trustees of the Dundee Working Men's Club propose to inaugurate in the autumn an industrial exhibition confined to working men, and which shall furnish an opportunity for fair rivalry. The articles exhibited must be the workmanship of men who have been members of the club for three consecutive months previous to October. They must be useful or ornamental—of iron, wood, stone, cloth, or leather, and must be the product of the designer's pencil or the silversmith's graver.

BRITISH ASSOCIATION.

The usual programme of the forthcoming (the 44th) meeting of the British Association at Belfast has been issued. The first general meeting will be held on Wednesday, Aug. 19, at 8 a.m. precisely, when Prof. Williamson, F.R.S., will resign the chair, and Prof. Tyndall, F.R.S., President-elect, will assume the presidency, and deliver an address. On Thursday evening, Aug. 20, at 8 p.m., there will be a *soirée;* on Friday evening, Aug. 21, at 8 p.m., a discourse by Prof. Huxley, F.R.S.; on Monday evening, Aug. 24, at 8.30 p.m., a discourse by Sir John Lubbock, Bart, M.P., F.R.S.; on Tuesday evening, Aug. 25, at 8 p.m., a *soirée;* on Wednesday, Aug. 26, the concluding general meeting will be held at 2.30 p.m. The following are the officials of the various sections: A, Mathematical and Physical Science.—President: Rev. Prof. J. H. Jellett, M.R.I.A. Vice-Presidents: Prof. Everett, F.R.S.E.; Prof. Purser, M.R.I.A. Secretaries: Prof. W. K. Clifford, F.R.S.; J. W. L. Glaisher, F.R.A.S.; Prof. Herschel, F.R.A.S.; Randal Nixon; G. F. Rodwell, F.R.A.S. B, Chemical Science.—President: Prof. A. Crum Brown, F.R.S.E. Vice-Presidents: Prof. Maxwell Simpson, F.R.S.; Dr. Debus, F.R.S. Secretaries: Dr. J. F. Hodges, F.C.S.; W. Chandler Roberts, F.C.S.; Prof. Thorpe, F.R.S.E. C, Geology.—President: Prof. Hull, F.R.S. Vice-Presidents: Prof. Harkness, F.R.S.; Prof. Geikie, F.R.S. Secretaries: Louis C. Miall; R. G. Symes. D, Biology.—President: Prof. Redfern, M.D. Vice-Presidents: Dr. Hooker, C.B., Pres. R.S.; Sir W. R. Wilde; J. Gwyn Jeffreys, F.R.S. Department of Anatomy and Physiology.—Prof. Redfern (president) will preside. Secretaries: Dr. J. J. Charles; Dr. P. H. Pye-Smith. Department of Zoology and Botany.—Dr. Hooker, C.B., Pres. R.S. (vice-president), will preside. Secretaries: Prof. W. T. Thiselton-Dyer; Prof. R. O. Cunningham, F.L.S. Department of Anthropology.—Sir W. R. Wilde (vice-president) will preside. Secretary: F. W. Rudler, F.G.S. E, Geography.—President: Major Wilson, F.R.S., Director of the Topographical Department of the Army. Vice-Presidents: Sir Bartle Frere, G.C.S.I., K.C.B., F.R.G.S.; Vice-Admiral Erasmus Ommanney, C.B., F.R.S.; Major-General Strachey, F.R.S. Secretaries: E. G. Ravenstein, F.R.G.S.; E. C. Rye; J. H. Thomas, F.R.G.S. F, Economic Science and Statistics.—President: ——— Vice-Presidents: W. Donnelly, C.B.; Prof. T. E. Cliffe Leslie. Secretaries: F. P. Fellowes, F.S.A.; E. Macrory. G, Mechanical Science.—President: Prof. James Thomson, F.R.S.E. Vice-Presidents: Sir John Hawkshaw, F.R.S.; Sir Charles Lanyon. Secretaries: James Barton; E. H. Carbutt; J. N. Shoolbred, F.G.S.

It is said that M. de Lesseps is inclined, at least for the present, to give up his project of a line of railway to connect Russia and Central Asia with India, in favour of one between Russia and China.

EARLY ENAMELLING.

The most recent researches have led to the conviction that enamelling was practised by the Egyptians and the Greeks, and that it was not only on earthenware and bricks that they used the *émail*, but that they were also acquainted with enamelling metal; although they cultivated at the same time another process, by which they filled with a coloured mastic, or with gems and glass pastes, the ornaments which they had cut in their metallic utensils and ornaments. It was not, however, before the beginning of the third century of our era that a classical writer, the Greek philosopher Philostratus, living at the court of the Emperor Severus, mentions the art of enamelling for the first time as "practised by the barbarians near the ocean;" this was the encrusted enamel, called *émail cloisonné*, in use by the Celtic nations in the conquered Roman provinces. When an easily melting glass, coloured by means of certain metallic oxides, is by heat vitrified on the surface, or in the cavities of gold, silver, or copper, it is called enamelling, and the coloured glass itself *émail*. In the earliest manner, called *champ cloisonné*, the outlines of a design were formed by placing wire, or thin plates of gold, edgewise to the object that was to be enamelled, and soldering them to the base, thereby forming cells, which were filled with the powdered enamel, a paste of which had been previously prepared by mixing it with pure water. So prepared, the work was exposed to a high degree of heat that melted the glass. This *technique* was practised from the seventh to the tenth century in various parts of the Continent, when a second improved method was invented, whereby the outlines were no longer soldered to the main body, but in which they remained in the solid of the vessel, and those parts that had to receive the enamel were cut out, and then filled with the glassy substance. Gold was no longer used, but red copper, of which the outlines were gilt. This manner is known by the French term *champ levé*; it flourished most at Byzantium about the tenth century, and was thence transplanted to Italy by Byzantine goldsmiths, apparently by their transferring the celebrated *pala d'Oro* to Venice, which had been acquired for the Doge Faliero at Byzantium, in 1105.—Professor Gruner, in the *Art Journal* o July.

NOTES ON BOOKS.

Technical Training. By Thomas Twining. *Macmillan & Co.*, 1874.

Among the many objects to which from time to time the energies of the Society have been devoted, there has perhaps never been one of greater importance than the promotion of Technical Instruction. The need of such instruction has now become a truism, but it is only within very few years that it has been even an admitted fact. That this great and pressing necessity is estimated as it should be is, to a very great extent, due to the energy with which some of the most foreseeing among the principal directors of the Society's labours persisted in continually forcing on the question. Among these the author of the book whose name heads this notice was one of the most zealous. The results of many years continued and unremitting labour is what Mr. Thomas Twining has here put forward in a treatise designed to sketch out the precise wants of the industrial classes in the matter of technical instruction, and the methods by which those wants should be supplied. Without attempting to go too deeply into the details of the book, it may be briefly said that Mr. Twining begins by stating and explaining the main arguments for the establishment of a Central Technical University. He next proceeds to draw out with considerable minuteness a scheme for such an institution, then he proceeds to elaborate a systematic plan for practical and scientific instruction, going on to examine in succession the requirements of our various industries, and finishes with some general remarks as to the best means for carrying into effect the conclusions at which he has arrived. It may be worth notice that the book has several copious lists of technical works likely to be useful to the student.

CORRESPONDENCE.

THE SOCIETY'S LIBRARY.

Sir,—If I had been able to attend the recent annual meeting of the Society, I would have endeavoured, as a member of the Society, to endorse the opinion that a printed catalogue of the Society's books should be prepared, and placed in the reading-room, for the information of the members. The fact that there is a reading-room in the Society's house for the members, which is supplied weekly and monthly with a variety of useful periodicals, is one that should be known more generally than it is by the members in town and country. As to an annual dinner for the members, the summer conversazione at South Kensington was instituted, I believe, in lieu thereof, and this popular entertainment has the advantage of including female guests, instead of excluding them, as is the case, generally, at public dinners.—I am, &c.,

Chr. Cooke.

London, July 1874.

OBITUARY.

Sir Charles Fox.—This eminent civil engineer was the youngest son of Dr. Fox, of Derby, and was born in that town in 1810. He intended when a young man to enter the medical profession, but his natural bent lay in the direction of engineering and constructive design. He was articled to Mr. John Ericcson, at Liverpool, and assisted at the trial of locomotive engines at Rainhill, on the Liverpool and Manchester Railway, in the year 1829. He was next engaged on the London and Birmingham Railway when in course of construction; first at Watford, and afterwards in charge of the Extension Works from Camden-town to Euston-square. Upon the completion of this work he joined the late Mr. Bramah in the manufacturing firm of Bramah and Fox; and some time afterwards, upon the death of Mr. Bramah, became the senior partner in the firm of Fox, Henderson, and Co., of London, Smethwick, and Renfrew. Since the year 1857 he had practised in London as a civil and consulting engineer. During the forty five years of his professional life, Sir Charles had been engaged in works of magnitude in all parts of the world. He was the inventor of Fox's safety switch, and contributed largely to the improvement of the permanent way and fittings of railways and of ironwork construction generally. In connection with his brother, Mr. Douglas . ox, he was instrumental in introducing the use of glue or elastic moulds for casting architectural, natural, and other objects. His chief work, however, was the building in Hyde-park for the Exhibition of 1851. The late Sir Joseph Paxton having suggested the idea of a structure of iron and glass, up to that time never applied on a large scale, Sir Charles (then Mr.) Fox at once grasped the importance of the proposal, and proceeded to work out most of the details. His firm took the contract for the erection of the building, and, work having commenced towards the end of September, 1850, the Exhibition was opened on May 1st, 1851. In connection

with this event, Sir Charles, in conjunction with Sir W. Cubitt and Sir Joseph Paxton, received the honour of knighthood. His firm afterwards removed the building from Hyde-park, and re-erected it, with many alterations and additions, for the Crystal Palace Company, at Sydenham. Sir Charles became a member of the Society in 1843, and for long took an active part in its general management and direction.

GENERAL NOTES.

Coffee Cultivation in Brazil.—It is said that the cultivation of coffee in Brazil has so much extended during the past fifteen years, and the quality so much improved by the introduction of machinery and of more perfect processes, that more than half the produce of Brazil is sent to Europe and sold under the names of Java, Ceylon, Martinique, San Domingo, and even Mocha. It is calculated that 530,000,000 coffee-trees, covering a surface of 574,992 hectares (a hectare is 2·471 acres), exist in the empire.

Emigration to America.—According to official tables, recently published in America, the number of emigrant iron-workers who arrived in America during the past year was 968, composed of dressers, 5; founders, 21; manufacturers, 2; moulders, 722; puddlers, 55; turners, 13; workers, 150. The number of miners is set down at 6,290. Among workers of iron, not included above, are the following:—blacksmiths, 1,582; boiler makers, 110; cutlers, 82; engino builders, 51; file makers, 90; gunsmiths, 43; machinists, 334; nail makers, 9; steel makers, 4; tool makers and grinders, 25; saw maker, 1; and safe maker, 1. Nearly all departments of metal working are represented, in some instances very fully; for example, 473 tinkers and tin workers, and 272 plumbers are reported. Of those styling themselves simply mechanics there are 1,594, and of male labourers, 96,607.

Iron and Coal Deposits in Central India.—Mr. Walter Ness, who is now superintending the working of the collieries in the Warora district, Central India, has written a letter, in which he states that the mineral deposits of the country in which he now finds himself are marvellously rich. He writes:—"We have now in one field of about 1,000 acres, a couple of seams, one of which is fifteen, and the other twenty feet thick. Sometimes the two seams are close together. They have a great resemblance to the Staffordshire thick coal. There are other parts of the coal field where the seam is from fifty to sixty feet thick. So you see the bulk is all right. I have just got a few tons of coal, and shall be able to know more of its quality by and by. But I was recently out on the iron ore about forty miles east of Warora. I never saw anything like them. The ore yields over seventy per cent. of metallic iron, being magnetic. If the coal and iron ore can be converted into iron, or the one made to convert the other, it will be a great thing. There are millions of tons of this ore on the surface."

Yield of the Pacific Coast.—Returns just made up of the product of the mines of the Pacific coast in precious metals show that the yield of the last quarter of a century reached a total of £317,000,000. Of this California produced three-fourths, nearly all of which was in gold. Nevada has produced £44,000,000 in gold and silver, chiefly the latter. Utah, although known for many years to be rich in precious metals, has only lately been made to produce them, and the yield has been no more than £3,700,000. Montana has added £24,000,000, and Idaho £11,000,000. Colorado has been only lately developed as a mining region, but its yield has already reached about £6,000,000. Oregon and Washington territory have together produced £5,000,000; British Columbia about £2,000,000, and Arizona a small sum; but the latter territory has not been worked to any great extent. The production of the Pacific slope has been steadily increasing from year to year, and the increase of last year was about 14 per cent., the actual yield being £16,000,000, against £14,000,000 in 1872. About £8,000,000 of the entire total remains on the Pacific slope in coin and in jewellery, and a portion has been absorbed by the general business of the country. But the great bulk has been exported, and chiefly to England, China, and Japan, England having had nearly £220,000,000.

Fruit Preserving in London.—Messrs. Crosse and Blackwell state in the *Gardeners' Chronicle* that in 1873 they preserved 1,100 tons of fruits; namely, 300 tons of raspberries, 200 of strawberries, 100 of red currants, 100 of black currants, and 400 of other kinds. These fruits are mostly grown within twenty miles of London, chiefly about Bexley Heath and its neighbourhood. Although this is the largest quantity put up by any single manufactory, it forms only a small fraction of the whole amount preserved in London and other parts of the country.

Economy of Fuel in Furnaces.—M. Foucault, in a report to the Industrial Society, at Rheims, combats the idea that the smokelessness of a fire can effect a notable saving in the amount of fuel burnt. He alleges also, on the other hand, that a considerable loss of economy is produced by smoke-consuming apparatus. He brings in support of his opinion the long series of observations made by the Industrial Society of Mulhouse, which have proved that, with the ordinary boiler furnaces, it is only necessary to consume from 125 to 150 cubic feet of air for each pound of coal, while for the most part furnaces pass twice that quantity. If the draught be reduced in quantity much smoke is evolved, but the products of combustion, circulating more slowly, part with their heat more readily to the boiler flues. It is further proved that the best means of reducing the loss of heat by the chimney is by the use of feed-heaters in the flue, so as finally to reduce to 200 deg. the products of combustion, which are often discharged as hot as 400 deg. Feed-water heaters, well set, will produce an economy of from 11 to 20 per cent. with a reduced draught. The conclusion is that furnaces with large area and suitable feed-heaters are the most economical in all respects. But in order to obtain the best results much care is needed in stoking. A little at a time and often, should the coal be spread over the front of the fire, and the bright coal pushed back to the bridge. At the same time, the least possible quantity of cold air should be admitted.

NOTICES.

SUBSCRIPTIONS.

The Midsummer subscriptions are due, and should be forwarded by cheque, Post-office order, or Cheque Bank cheque, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

Report of the British Association for the Advancement of Science, 1873—Bradford. Presented by the Association.

Cocoa and its Manufacture, with remarks on the working of the Adulteration Act, 1872. By John Holm. Presented by the Author.

Economics of Construction in relation to Framed Structures. By Robert H. Bow, C.E. Presented by the Author.

The Journal of the Royal Geographical Society. Vol. 43. Presented by the Society.

Twenty-first Report of the Science and Art Department of the Committee of Council on Education. Presented by the Department.

Technical Training, by Thomas Twining. Presented by the Author.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Tues....Working Men's Club and Institute Union, at the House of the Society of Arts. 3 p.m., Annual Meeting. 8 p.m., Annual Conference of Delegates from Clubs.

Fri.......Quekett Club, University College, W.C., 8 p.m. Annual Meeting.

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FRIDAY, JULY 24, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ENDOWMENT FUND.

The following subscriptions have been received towards the establishment of an Endowment Fund for the Society :—

	£	s.	d.
G. T. Saul	5	0	0
W. R. Spicer	5	0	0
Colonel A. Angus Croll	20	0	0
G. W. Hart	2	2	0
Charles H. L. Woodd, F.G.S.	5	0	0
John E. Evans	2	2	0
Sir Walter E. Trevelyan	50	0	0
E. T. Blakely	1	1	0
W. R. Sandbach	50	0	0
Thomas Dixon	1	1	0
W. Atkinson	50	0	0
John Noble	20	0	0
James Bentley	20	0	0
J. Jonas	1	1	0
Samuel Jackson	5	5	0
Charles Goding	20	0	0
F. Mocatta	10	10	0
Jonah J. Wells	10	10	0
Charles Downes	2	2	0
G. T. Saul	2	2	0
Mrs. Charlotte Holmes	10	0	0
John Knowles	25	0	0
Sir John Le Couteur	1	0	0
John Peckover	5	5	0
Frederick Braby	2	2	0
Decimus Burton, F.R.S.	5	5	0
Percy Rowlands	2	2	0
The Right Hon. Lord Hatherley	20	0	0
Colonel John Thomas Smith, R.E.	2	2	0
Ardaseer Cursetjee, F.R.S.	5	0	0
H. V.	25	0	0

The Council will be glad to see further contributions to this fund. Members can receive full information as to its nature and objects on application to the Secretary.

TECHNOLOGICAL EXAMINATIONS.

The programme for these Examinations is in preparation, and will shortly be issued. It will include the nine subjects of last year, viz., Cotton Manufacture, Silk Manufacture, Paper Manufacture, Steel Manufacture, Carriage Building, Cloth Manufacture, Glass-making, Pottery and Porcelain, and the Manufacture of Gas, with the addition of four new subjects, viz., Agriculture, Silk and Woollen Dyeing, Calico Bleaching, Dyeing, and Printing, and Alkali Manufacture.

IMPROVED RAILWAY LAMP.

The Society's Gold Medal, or Twenty Guineas, is offered for an improved lamp or means of illumination, suitable for railway passenger-carriages, that shall produce a good, clear, steady, durable, and safe light.

It must be simple in construction, and capable of being readily cleaned and repaired.

In judging the merits, cost will be taken into consideration.

Specimens, in a condition suitable for trial, to be sent in to the Society's House not later than the 1st of November, 1874.

The Council reserve to themselves the right of withholding the medal or premium offered, if, in the opinion of the judges, none of the articles sent in competition are deserving of reward.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

FRENCH SECTION.

The contributions from France have formed a notable portion of these Exhibitions, and they are the more welcome now from the fact that we were deprived of them last year on account of the Vienna Exhibition.

The arrangements of the French Section are the same as formerly; the principal works of Fine Art occupy two compartments of the picture galleries on the Eastern side of the Exhibition, while the remainder occupy the staircase, the arcade adjoining, and the three rooms which form the special French Annexe.

The oil paintings, sculpture, and objects of art occupy room No. 20, at the top of the south-eastern staircase. As, however, these have been noticed in a previous number of the *Journal*, there is no need to dwell on them.

The sculpture is of necessity distributed. In the picture gallery will be found a delightful group in bronze, reduced from a larger work, of the "Finding of Moses" (405), the work of M. Allasseur; a fine seated figure of the "Spinuer of Megara" (407), by M. Barrias, in bronze silvered; the "Amusements of Peace" (409), by Bartholdy; a bronze group of a Roman warrior watching his wife sewing, while a boy clasps his brawny leg; at the head of the stairs a fine figure by Madame Léon Bertaux, the "Girl at the Bath," in bronze (411); the "Woman taken in Adultery" (413), a bronze reduction of a beautiful work in marble, by M. Cambos; a finely modelled figure, in bronze, of a boy mounted on a tortoise (423), by M. Delaplanche; a pleasing group in marble, of two girls returning from gleaning (426), by M. Dumaige; a beautiful semi-nude figure seated, in green bronze of great purity of surface, by M. Franceschi, not in the catalogue; an interesting series of small bronzes of animals, &c., by M. Frémiet; a small group, in bronze, of "Orestes and Iphigena" (436), by M. Gregoire; statuette of a young woman of Syracuse (451), by M. Maillet; "La Frileuse," marble statue (461), by the late Pierre Travaux; and some admirable terra-cottas.

The second compartment of the gallery, the room No. 19, is almost entirely devoted to the drawings produced under the directions of the Commission which has

the entire control of the historical monuments of France. This Commission, which was established in 1837, with a credit to the amount of £8,000 per annum, now expends £44,000 a year. It consists of the Minister of Fine Arts (President), the Director of Fine Arts, M. Du Sommerard, M. Soubeyran, M. de Longpérier, of the Institute, M. Viollet-le-Duc, and several other eminent architects. The Commission is not only entrusted with the care, preservation, and restoration of the recognised historical monuments of the country, but is also invested with the power of taking, by purchase, out of private hands, any such monuments or ruins. This power was put into operation only the other day, when the Commission gave notice that it would take into its hands the great Druidical monuments of Carnac in Morbihan, a large tract of land with about 5,000 stones.

The collection of drawings exhibited by the Commission is remarkable not only from the historical point of view, but from the admirable manner in which they are executed; but the non-professional student must remember that they are not perspective views, but geometrical elevations, that is to say, they do not present a picture of the monuments as they are seen, but only show the forms and proportions of the various parts. Amongst the most remarkable monuments illustrated are the Amphitheatre, and the Theatre at Arles, the Flavian bridge at St. Chamas, the Temple of Augustus and Livry at Vienna, the great Abbey of the Mont St. Michel, many of the most ancient ecclesiastical monuments, the famous Chateaux of Gien, Blois, St. Germain, Ambroise, Vitré, Pierrefonds, and the fortifications of Carcassonne. In addition to these is a fine collection of mural paintings and mosaics, copied from monuments dating from the eleventh to the eighteenth centuries.

The drawings, engravings, and architectural designs, with the exception of those already noticed, are placed in the adjoining arcade which looks upon the Horticultural Gardens. They are too numerous for special mention, but they present a large amount of artistic feeling and technical skill, and deserve careful study. The drawings in charcoal (*fusain*) by M. Dardois, M. Lalanne, and others deserve special attention. It is a style much cultivated in France. Fusain is fine small charcoal, made, it is said, from the wood of the vine.

In the same arcade will be found a few machines and other industrial exhibits, including a series of compact apparatus for lifting weights, with safety arrangements; illustrations of the various applications of asphalte to road making, and mixed with stone as mastic; specimens of peat charcoal; an excellent illustrative series of plaster of Paris and its applications; a set of machines for shoe-making; a project for an overhead railway for Paris; and some examples of decorative painting.

The Annexe comprises three rooms. In that nearest the staircase and arcade is a collection of models and drawings sent by the City of Paris. It includes a number of maps and plans showing the former condition of Paris, and the alterations which have been made during the last 23 years; models and drawings of bridges and roads, steam roller, sweeping machine, &c.; illustrations of the parks, promenades, and gardens; drawings and models of the principal public buildings, churches, theatres, fountains, &c., built or restored during the last 20 years; drawings and photographs of paintings, sculptures, and stained glass windows; beautiful specimens of modern Aubusson tapestry; and books and illustrations of the general topography of Paris from the Roman period. The second section consists of a series of models and drawings on a large scale and minute and careful execution, of the common and superior schools, colleges, and drawing schools, with the warehouses of the educational department, and of the principal hospitals and asylums of the city. Another section is devoted to the waterworks and sewerage, illustrated by large and excellent models. The whole forms a very striking illustrated history of the chief public works of a great city.

The largest room of the Annexe is devoted to decorative objects of the highest class; and here the taste and delicacy of execution of our neighbours are strikingly apparent. MM. Braquenié exhibit a fine collection of tapestry (776) in the form of hangings, and of furniture covered with tapestry work in the style of Louis XV. and XVI., profusely yet chastely decorated. M. Philippe (803) a collection of works in enamel, chased, engraved, &c., of great artistic merit, from the simplest article of jewellery to the tazza carved out of a block of lapis lazuli. M. Philippe's productions are all original of their kind, and executed in the precious metals, stones, &c. Amongst them are some remarkable specimens of cloisonné enamels after the Chinese method, but with this difference, that whereas every little cell formed by the wire partition in the Chinese work contains but one kind of enamel, in the enamels produced in France there are often two, three, or more tints of the same colour in one cell. In small objects of art the latter method, which presents great difficulties and calls for much skill, produces great delicacy, but it is ill-adapted for larger works, which require the broader treatment of the Orientals. MM. Hunsinger and Wagner (794) and M. Mazaroz-Ribalier (799) exhibit some beautiful examples of decorated furniture. MM. Susse (813) have a fine show of bronzes and of decorative works in metal, &c., of all kinds. M. Dulud (787) shows good specimens of modern figured leather for hangings and furniture. M. Pottier (806) exhibits beautiful enamelled wares in several styles. There is a good show of decorative china and faïences of various kinds by MM. Fournier, Brianchon, Barbizet, Parvillée, Pillivuyt, Sergent, and others.

M. Brocard has brought to great perfection the revived art of enamelling on glass (778); the difficulties to be overcome were great, the amount of heat required to fix the enamels often causing the vessel to melt or lose its shape, but the examples now shown are as perfect in shape as they are brilliant in decoration. M. Pfulb (802) exhibits similar works. M. Poussielgue-Rusand shows specimens (805) of the highest class of gold, silver, and metal work for churches. M. Haas (852) exhibits a collection of watches, from the lowest price in aluminium bronze cases to the most costly jewelled trinket. M. Cornu (784) shows a number of charming objects of decoration in bronze, gilt, &c., in which the translucent onyx, as it is called, of Algeria, is introduced with much taste. M. Houry (793) illustrates the application of painted earthenware to the decoration of furniture; the beaten brass work of M. Baquès (770), large plateaux, lamps, &c., hammered up in the old fashion, deserve special notice.

The remainder of the space in this and nearly the whole of the adjoining room is occupied by a multiplicity of small decorative articles, amongst which the fans and the artificial flowers are remarkably beautiful. In the latter room, M. Paz (846) exhibits gymnastic apparatus for home use, and for those who suffer from deformities.

In the garden contained within the Annexe is a plaster caste of a fine figure of a soldier of the Garde Mobile, by M. Millet (958), executed in bronze for the Department of the Eure to the memory of those who fell in the late war; the *pose* of the figure and the treatment of the uniform are remarkably fine. In the garden also is a fine work by the late sculptor Pradier, "The Soldier of Marathon" (458).

In the corridor near the garden is some pierced metal work by MM. Delong (827), remarkable for elegance of the design as well as perfect execution. This work in iron, bronze, brass, or zinc, is pierced like wood with fine saws, and specimens have been executed, as curiosities, two inches in thickness. The method has been employed in this country, but it is claimed as the invention of the exhibitors. In the same corridor are clever imitations of old tapestry, painted on canvas for hangings, by M. Trinocq (816); and a number of artificial plants calculated at first sight to deceive the eye.

THE INDIAN COURT AT THE INTERNATIONAL EXHIBITION.

(From the *Times*.)

The Indian Court at the International Exhibition, which this year, as on former occasions, was not ready at the same time as the rest of the building, contains a variety of textile fabrics, including carpets, kincobs, shawls, and embroidery on net, muslin, cloth, and silk; metal work of many kinds, a small display of pottery, a collection of harness and other leather work, some lace, cases of ancient and modern arms, and many miscellaneous articles. The things exhibited are mostly good of their kind, and some few are excellent; so that the Exhibition fairly maintains the character it has already earned, and, as a whole, presents a series of highly interesting illustrations of Indian art and industry. In addition to the contributions obtained through the India-office, there are several private exhibitors, among whom Messrs. Vincent Robinson and Co. and Messrs. Farmer and Rogers are conspicuous. Messrs. Robinson have converted the first side court, the one at the eastern end of the building, into the semblance of an Eastern interior. At the back of the apartment a screen is so arranged with coloured silk as to give the effect of a stained glass window. A raised divan runs round three sides of the room; and a lay figure, wearing a robe of Beloochistan embroidery, is seated amid cushions of antique needlework. A brass lamp, engraved and inlaid in silver, with inscriptions from the Koran, is suspended from the coloured roof; the walls are hung with fine Bengal mattings of a curious design, and the floor is covered with prayer carpets of rare kinds and great beauty. The furniture is completed by an inlaid coffee table, a hookah, and some brass and other vessels upon a shelf over the window. The exterior front is copied from a Cairene original, and is draped with some curious fabrics of coarse texture, but great beauty of design and colouring. The harmony of the successive bands of colour in the drapery to the left of the spectator is especially worthy of notice, as well as the peculiar shade of green in the middle stripe of the curtain. The second side court, occupied by Messrs. Farmer and Rogers, is arranged only with a view to the display of its contents, which are various, include some articles of carved Bombay furniture, textile fabrics of many kinds, among which there are some low-priced Scinde rugs of good design and colouring, a fine salver, and a pair of vases of antique Chinese cloisonnée enamel. The third side court contains, as usual, Messrs. King's Indian Intelligence Department; and the fourth, which has not been let, is devoted to the reception of models.

The carpets, as in former years, are suspended from the walls, and four among them are especially noteworthy. Of these, two are exhibited by Messrs. Robinson and Co., and two by the India-office. Messrs. Robinson's principal carpet is at the eastern end of the court, and is of extraordinary size. It is of Malabar manufacture, and shows the skill of the native weavers in arranging on a large scale, and with the gayest colours, a perfectly harmonious design of almost colossal proportions. The other is a carpet of a kind that is no longer produced, and this specimen is supposed to have been made for a mosque about the end of the last century. It has a ground of a curious lion-coloured or tawny yellow, with a centre medallion filled with a beautiful design, and is surrounded with a border of arabesque on turquoise blue. The same firm exhibit many other carpets, the productions of the caste weavers of Malabar, Madras, and the Deccan, all of purely Eastern origin, and woven by the same methods that have been employed for centuries. They have also a variety of rugs from Afghanistan and Peshawur, as well as examples of those made by the Kurds, Turcomans, and other nomads of Persia and Central Asia, some of which are antique. The prayer rugs of these varieties and of the finest colouring are becoming rare, and they present a curious contrast to the hideous manufactures of some of the Indian gaols, which have of late years been so largely imported. But a still more impressive warning against interference with native Indian handicrafts is furnished by the two carpets which are exhibited by the India-office. These are both on the south side of the court, one of them over a case of articles in brasswork, the other over a case of Madras carving; and the visitors will feel some difficulty in deciding to which of them the palm of ugliness should be awarded. They are both examples of imported patterns (one of them being Persian), worked in local colours wholly unsuited to the designs.

The central line of the court is occupied, and somewhat obstructed, by some large, not to say unwieldly, cases brought from Vienna, and containing textile fabrics of the lighter kinds. The first case has some good kincobs and turbans, one of the latter a superb specimen of gold embroidery. In another will be found a specially beautiful scarf of a beautiful creamy yellow cotton fabric, embroidered in gold, and with a richly coloured border, together with some good gold and silver embroidery on net and some embroidered caps, one of which, from Scinde, in gold upon tortoise blue, is specially noticeable. A case parallel to the last contains a fine series of Rampore chuddahs in different colours, some exquisite Cutch embroidery in silk upon cloth, and a singular suit of clothing, the property of the late Guicowar of Baroda, who was sufficiently proud of it to send it to Vienna. It consists of a swallow-tailed coat literally covered with silver and gold embroidery, a helmet of the same character surmounted by a drooping plume of white and red feathers, and a pair of blue trousers with embroidered stripes down the sides; altogether as odd a piece of barbaric splendour as it is possible to conceive. Another case contains shawls, all of which are deplorable examples of the destructive effects of European notions upon Indian work, and which have been made chiefly after French or Russian suggestions.

There is a fine collection of articles in metal, in brass, copper, gold, and silver. The objects in the precious metals have been brought together by the exertions of Mr. Rivett-Carnac, well seconded by Lord Ralph Kerr, who contributes a curious set of grotesque figures in silver, some of them from his own designs. In the same case with these, the central one, will be found some Bidree work (silver patterns inlaid upon a black alloy of zinc and lead), which furnishes a new and unexpected illustration of the sensitiveness of native art. The patterns of Bidree work, usually speaking, have a certain freedom, the expression, so to speak, of the mind of the artificer; but in this case there are some specimens that have been copied to order from photographs of good originals, and in which this freedom has been utterly quenched and superseded by the hardness of servile imitation. The remaining metal work is of the usual kind, but of excellent character.

In a case opposite the entrance to Messrs. Robinson's side court will be found a piece of ancient metal work of a very curious and interesting character. This is a Greek patera, or shallow bowl, of silver gilt, with a design in bold relief representing a procession of Bacchus. The deity is seated in a car, drawn by two female figures, attended by three grotes, and followed by a dancing Heracles. A paper contributed by Dr. Birdwood to the Royal Society of Literature gives what is known or conjectured concerning this patera and its history. It was discovered in Badakshân by the late Dr. Lord, about 1838, and General Cunningham, in the 10th volume of the *Journal* of the Asiatic Society of Bengal, says that it had been an heirloom in the family of the Meers of Badakshân, who claimed to be descendants of Alexander the Great; and that it was sold by them in their distress, when they were conquered and imprisoned by Meer Morad Bey of Kunduz, to his Dewan Beghi, Atma Ram. Accord-

ing to Sir Alexander Burnes, it was from Atma Dewan that Dr. Lord obtained it; but Dr. Lord was killed in action in November, 1840, and although, shortly before his death, he had given Sir Alexander Burnes permission to present the patera to the Museum at the India House, yet his own narrative of its discovery does not seem to be in existence. Sir Alexander Burnes possessed, together with the patera, a second silver dish of Persian work; and this dish Dr. Birdwood has vainly endeavoured to trace, although he expresses a hope that it may be in the possession of some of Alexander Burnes' surviving relatives or descendants in Scotland, and that it may yet be heard of when greater publicity is given to his inquiries. Concerning the patera itself, he says, in the paper referred to:—"On the face of it, from the thickness of the silver, especially in the raised figures, its debased style and slovenly workmanship, it belongs to an age when art was fast sinking in the pollution of superabundant wealth and luxury. The composition of the subject is good, as is also the modelling and composition of the panther and crater, notwithstanding their somewhat slurred execution. It is, perhaps, the best modelled panther to be found among all the remains of ancient art; and the feline avidity and truth to nature with which the beast presses its head into the wine jar are truly admirable. The general feebleness and carelessness of the design and its execution cannot, however, be mistaken, and stamp the patera as a degraded copy from some happier work of a period before ancient art had fallen from the service of the gods to be prostituted to the ostentation of the vulgar rich—the upstart speculators and contractors of Rome."

Of kindred interest to the patera, and therefore fitly mentioned in this place, are the coins, sculptures, and other articles brought by Dr. Leitner from that "neutral zone" of Northern India which intervenes between the British and the Russian territories. Dr. Leitner's collections will be found in the gallery of the Albert Hall, but placards calling attention to them are placed in the Indian Court. They comprise 184 specimens of ancient sculpture, excavated by himself on the frontier of the Punjab, or obtained from the contiguous districts; 1,000 Bactrian and other coins, 37 rare manuscripts in different Oriental languages, and a great variety of modern industrial and domestic articles. Many of the sculptures are of very great merit; and appear to prove either the original identity or common descent of Greek and Indian art, or at least a perfect familiarity in the one country with the works executed in the other. The dates conjecturally assigned to the different sculptures, if correct, make the collection cover a period of eleven centuries, from 300 B.C. to 800 A.D.; and there can be no doubt that Dr. Leitner has provided materials for researches of a most important and interesting kind, which archæologists and anthropologists will be eager to undertake.

Returning to the Indian Court, we come next to the manufactures in leather, and find that Cawnpore contributes some capital harness, of good materials and workmanship, both for artillery and for private use. There is a case of specimens of bookbinding from Vizagapatam, extremely well done and well and tastefully ornamented. This collection, or the bulk of it, has been already secured for the South Kensington Museum. There are also many small articles in leather, among them some hookah bottoms, decorated with brass and with leather of various colours, which are of very great merit, and pleasingly illustrate the effects which may be obtained from simple materials united in judicious combinations.

A small collection of pottery excites sensations of acute regret that it was not, by some fortunate accident, lost or destroyed upon its passage to this country. There is a shelf full of meretricious stuff with a pattern in red and gold upon white, which must have been sent over by mistake; and there are a number of pieces in coarse red ware, covered externally with a brilliant glaze of dark green, and looking as if they had been painted and varnished, which have a melancholy history. Placed with them are two vases, of good design, and bold and simple colouring and ornamentation, the work of a potter in Scinde. These vases were exhibited and commended on a former occasion, and the unfortunate potter, probably as one result of the praise bestowed upon him, was induced to go the Bombay School of Art, and there to receive instruction from European teachers. The endeavour to graft European upon Indian ornamentation has always been so destructive to both, that it is marvellous how persons endowed with the ordinary complement of senses can continue to fly in the face of experience with regard to it; but the inevitable result has seldom been so dismal or so conspicuous as in the case of this poor potter. The same man who made the vases before he was "instructed" was guilty of the green things afterwards. Their general character of vulgarity and ugliness places a difficulty in the way of any detailed examination of their demerits; but such an examination shows that the maker has lost his feeling for design as well as for colour, and that he has destroyed the simplicity of his original patterns by breaking them up into intricate and unmeaning subordinate forms. Some years must elapse, it is to be feared, before an Indian exhibition, other than the Museum, will again be opened in London, and in that time, if the process now going on is suffered to continue, irreparable injury may be done to every kind of Indian art manufacture. On questions of form and colour, and especially with regard to the colours adapted to sunshine, our designers can no more rival the natives of India than our sculptors can rival the best works of ancient Greece; but Englishmen uninstructed in the elements of art take out with them things and patterns of unutterable hideousness, and give them to be copied by Hindoo workmen, over whom they exercise the potent influence of a governing race. Last year the collection of metal work contained a silver tea service, founded upon one originally made in Britannia metal at Birmingham, and this year we have the Europeanised shawls and the portentous pottery. It is a question worthy the consideration of the Government of India by what means this process of debasement may best be stayed.

The manufacture of lace furnishes, perhaps, the only example within modern knowledge of the successful introduction of foreign industry into India. The work is thoroughly well suited to the tastes and habits of the people, and the specimens exhibited, which are from Madras, are such that they probably could not be excelled in any country. The European patterns have been copied intelligently, or rather have been adopted, and the unbleached thread employed gives an extremely pleasing colour to the work. The examples of tatting and crotchet are coarser and in every way less meritorious.

A very fine assortment of antique arms, containing some quaint matchlocks and a few sword blades of the best temper, has been contributed by a private gentleman, and occupies a case near the eastern entrance. An adjoining case contains modern arms, exhibited by the India-office, and has several good specimens of kooftgari work on the hilts and scabbards.

Among miscellaneous articles mention may be made of a curious trophy—the gilded head of a fish deity, with horsetails pendant from it, and mounted upon a pole, which was presented to General Lake, after one of his victories, by Shah Alum. There are also some interesting models of native houses, one in process of building, and two complete. Of the latter, the smaller is copied from the house of Dr. Bháudágí, an eminent native physician in Bombay, and is remarkable for the elaborate carving in wood with which it is ornamented in front. In the north-east corner of the Court will be found a window-frame, in which carving of the same character is shown of natural size. There are also a few smaller carvings in ivory and pith, some inlaid

work in coloured marbles, some miniatures and other paintings, which are chiefly interesting as showing that the art which they represent is not at present likely to be naturalised in India.

The medal for the Exhibition of 1874 will be of bronze. On the obverse will be the head of his Royal Highness the Prince of Wales, the President of the Royal Commission, and on the reverse a view of the Royal Albert Hall and the Exhibition Buildings. The design for the head of his Royal Highness has been entrusted to Mr. J. E. Boehm, whilst the design for the reverse is the work of Mr. Gamble, of the South Kensington Museum. The medal will be struck by Mr. George Morgan.

The following is the return of admissions for the week ending July 18th—Season tickets, 1,110; payment, 7,691; total, 8,801.

PUBLIC MUSEUMS AND LIBRARIES.

The following returns of the numbers of visitors for June have been received up to the present date:—

	Number of Visitors.
British Museum	(no return)
National Gallery (Trafalgar-square)	81,947*
Kew Gardens and Museum	
South Kensington Museum	
Bethnal-green Museum	
Geological Museum, Jermyn-street	2,813
Patent-office Museum	
Edinburgh National Gallery	12,884
Edinburgh Museum of Antiquities	12,832
Edinburgh Museum of Science and Art	22,232
Royal Dublin Society:—	
Natural History Museum	5,694
Botanic Gardens, Glasnevin	39,773
Dublin National Gallery	
Zoological Society, Dublin	12,373
Museum of Irish Society, Dublin	
Tower of London	15,653
Royal Naval College, including Greenwich Painted Hall	28,679

PATENT MUSEUM.

In the House of Commons on Monday last,

Mr. Mundella asked the First Lord of the Treasury whether her Majesty's Government was aware that, owing to the want of space and suitable accommodation, the Patent Museum was losing constant opportunities of acquiring models of original inventions of the greatest interest to the country; and whether the Government was prepared to take immediate steps to provide a suitable building for the Museum, capable of being made one of the most valuable schools of instruction in mechanical science in the world.

Mr. Disraeli—I am very sorry to say that the Patent Museum is not the only public institution which is suffering from want of space and suitable accommodation. That is now a crying grievance with respect to all our public buildings, collections, and offices. In regard to the Patent Museum, however, I am aware, from a communication which I have received from my noble friend the First Commissioner of Works, that the matter is at present engaging attention.

Later in the evening, in answer to **Mr. Edward Reed**,

Lord Henry Lennox said it was quite true that the abandonment of the series of International Exhibitions at South Kensington would leave vacant a great deal of space which might be with great advantage occupied by some of the national collections. He intended to propose to her Majesty's Government a scheme which, if it were agreed to, would enable him to offer the Patent Museum suitable accommodation in the southern block of the exhibition buildings.

* Six months' total, 449,898.

BARYTA—ITS MANIFOLD USES IN THE ARTS.*

By Dr. Lewis Feuchtwanger.

The various salts of baryta have long been employed in pyrotechny; as admixture to white lead; as material almost indispensable to card makers for a permanent white; in sugar refining; in chemical operations, &c.

In nature we find but few varieties. The sulphate, composed of 66 per cent. baryta and 34 per cent sulphuric acid, is abundant in England, France, Germany and the United States, where it most generally is found in connection with beds or veins of metallic ores, as gangue, or veinstone. Sometimes, however, it forms distinct veins, in company with secondary limestone, and very often in fine crystals, along with calcite and celestite. Crystals of large dimensions occur in Westmoreland, Cornwall, Cumberland and Derbyshire, in England. Beautiful specimens of septaria, cut and polished for table and other ornaments, having lining of brown heavy spar, are wrought in Durham, England, in Hungary, at Freiburg in Saxony, Clausthal in the Hartz, in Bohemia, and in Auvergne, France.

The localities in the United States are very numerous. The States of Connecticut and Missouri have long furnished abundant material for the arts. Next come Virginia, New York, New Hampshire, Massachusetts, Pennsylvania, Kentucky, and Tennessee. In Canada fine crystals occur, and massive baryta in a 27-foot vein. It is reported from New Mexico also.

The Bologna spar is the ornamental stone, of a brown colour and concentric rings, originally found in a bed of clay near Bologna, where it formerly was considered a great curiosity, on account of its phosphorescence, displayed after heating with charcoal, and it was called the Bologna phosphorus. The common name of sulphate of baryta is heavy spar or barytes; specific gravity 4·5 and hardness 3. It is found in nature in large crystals weighing 100 lbs. and more, and in slender needle crystals; also in massive aggregations of tabular crystals, likewise columnar and radiated, and in globular and and nodular concretions; also lamellar and granular, earthy and stalactitic.

The sulphate of baryta often occurs associated with lime and some silica and alum, and is then called calcareobarite; and if it is associated with strontia, it is called baryto-celestine. If the sulphate of baryta gives out a fetid odour on striking or rubbing it, it is called fetid baryta. The name of baryta is derived from the Greek language, βαρός, heavy.

Witherite is a carbonate of baryta, having a specific gravity of 4, and a hardness of 3·2, and consists of 78 per cent. of baryta and 22 per cent. of carbonic acid. This is found in considerable quantities in England, at Alston Moor in Northumberland, in Silesia, Hungary, Styria, Sicily, Chili, but not much in the United States. It is extensively employed in manufacture of plate glass and the manufacture of beet-root sugar in France, and for the production of *blanc-fixe*, or permanent white; it is much used of late for paint, particularly in combination with soluble glass and white oxide of zinc.

The metallic base of the baryta salts is called barium, and is obtained from the carbonate of baryta or chloride of barium, if put in a platinum dish and connected with the positive pole of a strong galvanic battery, in order to decompose it, mercury being placed in a hollow made in the baryta and connected with the negative pole. The

* A paper read before the Polytechnic Club of the American Institute.

result is an amalgam, which may be distilled in a bent tube filled with hydrogen. Barium is a white, malleable and fusible metal, which oxidises easily in the air and decomposes water at common temperatures. For the purposes of obtaining the pure baryta or barium oxide, the nitrate is calcined at a red heat in a silver or porcelain crucible, or the carbonate is mixed with pulverised charcoal in a covered crucible, and exposed for an hour to a strong heat. If oxygen gas is passed over it, it will absorb that gas with avidity and become a peroxide. This is the substance used at the present day for production of the peroxide of hydrogen, which is much recommended as a medical reagent, and employed in the arts for bleaching animal tissue, or converting brown into blonde hair. To prepare it, the peroxide of barium is treated with hydrochloric acid, and the liquid, previously decomposed with sulphate of silver, is carefully evaporated to a syrupy consistency, when it yields a slight chlorous odour. It decomposes easily into water and oxygen, and it is therefore almost impossible to prepare it properly in hot weather. At 212° F. it decomposes with violence.

The oxide of barium, or caustic baryta, unquestionably rivals in its causticity, potash, soda and ammonia, and may be easily employed in the compounds with chromic acid.

The chloride of barium is obtained by fusing the sulphate of baryta, or native heavy spar, with chloride of calcium (the residue from the preparation of ammonia) in a reverberatory furnace, and subsequently extracting with hot water, leaving the sulphate of lime undissolved.

The chlorate of baryta, which is now extensively used for producing a green flame in the manufacture of fireworks, is prepared by dissolving artificial carbonate of baryta in chloric acid solution, when it forms beautiful shining tabular crystals. It is dangerous to keep on hand when mixed with charcoal or sulphur.

Nitrate of baryta, which is likewise used in fireworks, may be easily prepared by dissolving the native carbonate in nitric acid and evaporating the solution, whereby octahedral crystals of the nitrate are deposited.

The native sulphate of baryta is generally used for the adulteration of white lead or paint, to the extent of 25 to 50 per cent. Of this mineral 4,000 tons are produced annually in Connecticut, and 2,000 tons in Missouri, while 10,000 tons are imported in England and Germany The native mineral, if very white and free from iron coating, is finely ground and floated with water. But most of the native mineral contains fine particles of iron, and hence requires a different treatment, namely, calcination for some hours, in order to oxidise the iron to a higher degree, when hot water and, if necessary, a little sulphuric acid, will take up all the iron, and a beautiful white heavy powder is deposited, which is then dried, either by steam or in the same manner as whiting is dried, in the atmosphere. White oxide of zinc, as well as white lead, may be mixed with sulphate of baryta in linseed oil to a pigment, which is then fit for in and out-door painting, and spreads well.

The artificial sulphate, called white or *blanc-fixe*, which is now largely manufactured in France, England, and the United States, is used in the manufacture of a paper of the purest white, in imitation of linen and used for cheap collars, skirts, and cards. It was formerly manufactured from the native carbonate of baryta, but is now prepared from chloride of barium, which is obtained in England as a waste product at a reduced price. This is decomposed with sulphate of ammonia, and pure sulphate of baryta is precipitated. Another process for obtaining the chloride of barium, in order to prepare the permanent white, is by the decomposition of the native sulphate of baryta with chloride of sodium in a strong fire, and the subsequent solution of the fused mass in boiling water. The result is chloride of barium and sulphate of soda or glauber salt. About 5,000 tons of permanent white are annually manufactured in this country and Europe.

In the chemical laboratory, the barium salts are indispensable for the determination of sulphuric acid, which forms the sulphate as an insoluble precipitate. The carbonate of baryta is a strong poison to animals, and is used for killing rats, &c.

A green paint, composed of manganese and caustic baryta, under the name of manganese green, has been brought to market from abroad, but was soon superseded by the beautiful Guignet green, a composition of aniline and iodine.

The beet sugar refiners of France have very successfully employed both caustic baryta and the carbonate in their operations. They treat, first, the saccharine juice with lime and then with carbonic acid, in order to clarify it. Afterwards they add baryta in order to obtain an insoluble precipitate, a saccharate of baryta. After passing sufficient carbonic acid gas under pressure of about half an atmosphere upon this precipitate, a separation takes place, and, without any evaporation, the hot solution is left to crystallise.

In copper metallurgical operations the sulphide of barium has latterly been employed for the purpose of precipitating from an ammoniacal copper solution the copper as a sulphide, which is treated in the usual method for reduction, either by caustic lime, or by borax, or by a galvanic current.

The artificial carbonate of baryta, obtained by passing carbonic acid gas through a sulphide of barium, whereby the carbonate of baryta is precipitated, is much used in Europe in glass making for producing an achromatic glass. In 1826, I assisted in Jena my teacher, Koebner, in experiments for this object.

THE INDUSTRIES OF GOTLAND.

Gotland is the largest and most important island belonging to Sweden, and constitutes, together with upwards of 20 adjacent islets, amongst which Faro and Gotska Sando are the most prominent, the Lau, or province of Wisby, so denominated from the only town existing within its borders, which comprise an area of about 1,080 English square miles. The geological formation of this island belongs to the Silurian age, the soil, which is generally very fertile, being for the most part calcareous, while the sandstone, which in all probability is subjacent to the limestone, is seen cropping out alone in the southernmost part. Marble of various kinds, as well as orratic blocks of gneiss and granitic gneiss, occur in many parts, and the island is also very rich in fossils peculiar to the more recent Silurian formation. Its height above the level of the sea is from 80 to 130 feet, though occasional cliffs, for instance, Thorsburg, Hoburg, &c., attain the elevation of 200 feet. Gotland is still tolerably well wooded, with the exception of the southern part, timber of various descriptions having hitherto formed its chief article of export; but the reckless felling of the forests has at last caused the Swedish Government to interfere and introduce protective measures and restrictions, in order to prevent their total destruction, Gotland being hitherto the only province in Sweden where a similar law has been carried into effect. There are no lakes, properly so called, but numerous marshes and bogs, occupying one-twelfth of the entire area. Several unimportant rivulets running from the marshes to the sea are generally dried up in the course of the summer. There are several harbours suitable for smaller vessels on the western coast, while on the eastern side, Slito and Farosund are well adapted for those of large burden, the combined fleets of England and France having wintered in the latter harbour during the Russian war.

As far back as the eleventh century, Gotland's commerce with the East, by way of Novogorod, was already of much importance, and in 1158 Wisby was declared a free city by the Emperor Lothair. England, France, Holland, Russia, Lubeck, and Rostock had warehouses

there, and King Henry III. of England, by a letter dated 1237, granted the merchants of Gotland liberty to trade over all England free from duty. Whilst a member of the famous Hanseatic, her wealth grew almost fabulously, and the maritime code of Wisby, framed in the twelfth century, has served as a model for all the navigation laws of Europe. The valuable and yearly recurring finds of oriental coins and ornaments, as well as of Anglo-Saxon and German coins, bear witness to the former commercial intercourse between the East, England, Denmark, and Germany, and this island. The fall of Wisby is commonly attributed to its subjection to the Danes in 1361, but with greater justice to the discovery of the new passage to India by way of the Cape of Good Hope, in 1498. During the period of Danish dominion, however, the prosperity of Gotland continued to decline, and although restored to Sweden at the peace of Bromsebro in 1645, the mother country proved equally neglectful, nor was it until within the last fifty years that proper encouragement and assistance of various descriptions were granted to this isolated and distant island, which well merits its appellation of "The Eye of the Baltic."

The province, according to the description given by Consul Perry, numbers 54,237 inhabitants, who, besides agricultural and pastoral pursuits, occupy themselves with coasting and foreign navigation fisheries, lime burning, stone quarrying, &c. The fisheries furnish chiefly the stroimning, an excellent variety of the herring, measuring from six to eight inches in length, and peculiar to the waters of the Baltic. The produce consists of barley, rye, wheat, and oats, all, however, of a middling quality. The potatoes are considered of a superior description. The cattle are generally of an inferior kind, both as to size and quality, owing to want of sufficient care of pasture lands and proper selection of breed. There is, however, a useful breed of small, though good and hardy, horses. The sheep are of a coarse and hardy breed, and the salted mutton, which is shipped in considerable quantities to the mainland, is much approved by the Swedes. There are peat bogs in the island capable of producing valuable fuel, but as yet they have been turned to very little account, owing to the want of capital and enterprise. The temperate climate allows grapes to ripen, and the mulberry and walnut tree to thrive well in the open air. The architectural remains spread over tho entire island are of great interest and beauty, and imperatively demand the traveller's attention. The inhabitants still glory in and cherish these memories of fallen greatness; and although Gotland may never recover her former magnificence and prosperity, there is every reason to expect an increasing development of her agricultural and commercial resources.

Peru now possesses, or will shortly possess, 22 lines of railway, in all 2,030 miles, constructed at a total cost of about £36,000,000 sterling. The most remarkable of these lines are—that from Callao and Lima to Oroga, about half-finished, which crosses the Andes at a height of 15,000 feet above the level of the sea; that from Cuzco to Juliaca and Puno, 230 miles, on the plateau of the Andes, at a mean elevation of 14,000 feet; and that from Mejia to Arequipa and Puno, 339 miles, establishing a communication between the Pacific Ocean and Lake Titicaca, 13,902 feet above the level of the sea.

The *Tanner's Journal* states that during the month of May last no less than 31,363 dozen pairs of boots and shoes were exported from the United Kingdom, representing a value of £104,260. According to the same journal these figures, compared with the corresponding period of 1873, show a falling off of 15,550 dozen pairs, or a decrease to the extent of £41,330, in the trade for one month.

Australian papers state that a company has been formed to work the sulphur deposits at White Island, a marine volcano 140 miles from Auckland. It is estimated that 100,000 tons of sulphur in an almost pure state are lying on the island ready for shipment.

JAPANESE VEGETABLE WAX.

The *Japanese Mail* contains an account of the manner in which this article of commerce is obtained. The trees from which wax is made are the *urushi*, or lacquer tree, the *yama-urushi*, the *hage-urushi*, better known as the *ronoki*, and the *koganoki*. The wax is made from the rind of the fruit. In places where the wax is manufactured to any great extent, the *urushi* is not availed of for its lacquer. As the trees are not cut for several years, they may be seen in the wax-producing districts growing to a height of 35 or 40 feet. In districts where the trees are used for their lacquer or varnish, they are cut every seven or ten years. The mode of obtaining the wax from the *urushi*, or lacquer tree, is as follows:—

Late in the autumn the branches, heavy with fruit, are lopped off and taken into the house. The fruit is pounded with a pestle, and then shaken in a basket-sieve, so as to separate seed from rind. From this rind the wax is made. The mode of expressing it differs here and there, but in no very important particulars. The following brief description is taken from the mode as followed out in Sendai and Aidzu:—Boiling water is got ready in an iron cauldron, over which a lattice-work of sticks is placed, and on these some matting. The sifted rinds of the fruit are then laid out on the matting and steamed, after which they are placed in hempen bags and again steamed. The bag, with its contents, is then put in a wooden trough, wedges or blocks are inserted in the trough, and driven home into the bag with heavy blows from a mallet. An aperture at the bottom of the trough provides for the egress of the wax. The trough and wedges are made of *kiaki* wood, and the mallets and blocks of wild mulberry, a very hard wood, and well suited for the purpose. A small quantity of oil, in the proportion of about one-tenth, is added to the wax, to allow of its being expressed more easily. It then goes through another steaming process, and is again pounded in the trough.

Wax from the *yama-urushi*, or wild lacquer tree, is obtained thus. The fruit is collected at the latter end of summer, and is at once steamed, without being pounded with a pestle, as is the case with the *urushi* wax. The wax is purified by melting. A large tub of cold water is taken and placed under a wooden tank having a small aperture close to the bottom. The melted wax is then poured into this tank, and escapes through the aperture into the tub beneath; while doing so it is stirred rapidly with the hand, after which it is placed either in matting or shallow boxes, and dried in the open air for about fifteen days.

The *hage-urushi*, from which wax is largely obtained, grows in the south-western part of Japan. This tree was first brought from the Loochoo Island to Sakura-jima, an island near Satsuma. Its production has so increased that there are now no less than seven different species. The *hage-urushi* tree is raised from seed or from slips. *Koga* wax is made from the fruit of the *koga* tree, which differs from the *urushi* and *hage-urushi* trees. It is an evergreen, and is largely grown in Ossugori, in the northern part of Nagato. It flowers in the middle of summer, the fruit ripening in autumn, when it is plucked and soaked in water for four or five days, after which it is trodden out with the feet, thus separating the outer rind. The *koga* wax contains a large proportion of natural oil, which in a measure restricts its use to cold and temperate districts. Candles made of it show a very bright light, and if some contrivance could be hit upon for extracting the oil, the consumption of this wax would be increased, as it is very cheap compared with the other kinds. Refuse wax is used for manuring purposes.

The Black Sea telegraph cable between Constantinople and Odessa has been opened at a charge of 12f. for 20 words.

A NEW MOTOR.

According to the laws of the mechanical theory of heat, any difference of heat may be employed for production of mechanical work. If a cold body, then, be situated in air that is hotter, the passage of heat to it should be capable of giving mechanical work. The solution of this problem, M. Enrico Bernardi, an Italian physicist, has recently sought to realise in the following way. ("Il Nuovo Cimenti," Sec. 2, T. XI., p. 27.)

Two similar glass balls are connected together by a thin glass tube, the ends of the tube passing into the balls being bent at a right angle. One ball contains a small tube, by which ether can be poured into the apparatus; the ether is brought to boiling, and when all air has been expelled this small tube is closed by fusing. The quantity of ether inclosed in the system should be such as to fill about three-fourths of one ball. At the middle of the connecting tube is fixed a piece through which passes a metallic axis, round which the system can turn. When the ether is equally divided between the two balls, the apparatus is in unstable equilibrium. The bearings for the axis are supported on the cover of a rectangular case, and in this cover is a slit through which the turning system passes. The case is filled with water, into which the balls dip alternately on their being turned round the axis. Each ball is covered with a very fine veil. It is easy to see that this apparatus will take a see-saw motion.

"In this apparatus," says M. Bernardi, "there is a continuous flow of heat from the surrounding parts to the case, as the water in this is kept at a lower temperature through the balls, which, cooled by evaporation, periodically sink into it. If we were to draw a comparison between my apparatus and a steam-engine, we should assign to the surroundings the *rôle* of the fire, to the case that of the furnace, to the under ball that of the steam-boiler, to the upper that of the condenser. In this way it would be readily understood, that the work developed in the apparatus is a transformation of a portion of the heat which continuously passes from the surroundings to the case."

It would be rather troublesome to utilise this thermomotor seesaw mechanically; and M. Bernardi has, therefore, preferred to alter the apparatus in the following way: The two balls of the above described system are connected by a tube, the ends of which are bent round (at right angles) to opposite sides. Three such systems are formed into a sort of wheel, the middle points of the six balls and the tubes being in one plane. This wheel is supported at its axis, on the cover of a rectangular case in such a way that, in its rotation, it is always half within the case and half in the air. The balls are covered as before, and so much water is poured into the case that, in turning the wheel, one ball is always immersed. By giving the wheel a turn, it can be set in continuous rotation, and, with a suitable arrangement of pulleys, it can be made to raise a weight, or do other work.

Such a thermo-motor wheel has, for two months, been working a clock in M. Bernardi's laboratory. The balls have a diameter of 2 centimetres; the distance of the middle points of two opposite balls is 8 centimetres, and the quantity of ether in each system fills three-fourths of a ball. The clock maintained in motion by this wheel consumes, in 24 hours, 0·035 kilogrammetre. The water level is, by a special arrangement, kept constant.

In both see-saw and wheel the dissolved salts of the constantly evaporating water must gradually be concentrated. The less soluble appear crystallised on the surface of the balls and in the case; the soluble delay the evaporation, and so lessen the quantity of heat withdrawn from the balls, and therewith the work furnished. The evil is remedied if distilled water, rain-water, or snow-water are used; otherwise the apparatus must now and again be cleaned by means of dilute muriatic acid or nitric acid. Using the ordinary drinking water of Vicenza, M. Bernardi has had his see-saw working for three months without its becoming necessary to renew the water or clean the balls.

The author has tried to calculate the quantity of heat which is removed by this apparatus from the surroundings. To this end he so arranged a see-saw that each time when the balls passed through the opening of the cover this opening closed, and the water was thus always in a closed space. This space was further protected against variation of temperature by means of a water-jacket. As the water, by this arrangement, was guarded against all loss of heat, the work of motion furnished could be estimated from the heat consumed. In a window not exposed to the sun observations were made from the middle of February to the middle of March, and there was an average of 60 see-saw motions in 24 hours. Calculating, from the weight of the ether and the change of the centre of gravity at each turn, the work done in 24 hours, this was found to be equal to 0·018 kilogrammetre, or about half of the work consumed in the same time by the clock.

As to the "moments," which affect the amount of work furnished by these apparatuses, they depend, first of all, on the quantity of heat, which in a unit of time is removed through evaporation of the water of the upper ball, and so on the temperature and moisture of the air, and of the moistened surface of the balls. Further, the thickness of the balls is of influence, and under conditions otherwise similar the number of units of heat which the contents of the ball lose in a unit of time is less the thicker the glass. The rapidity with which the see-saw movements follow one another is, lastly, influenced by the somewhat rapid variation of the air; the movements become more frequent if the temperature of the surroundings falls, and more rare if it rises; for the water in the case cannot follow so quickly the variations of temperature.—*English Mechanic.*

MOLDAVIA AND ITS PRODUCTS.

There is probably less known respecting Moldavia and the condition of its inhabitants than about any other country in Europe, and Vice-Consul St. John has endeavoured to supply this deficiency of information. He observes that although its present aspect presents nothing very remarkable, yet it affords peculiar interest in the fact that few countries have made such rapid progress in everything that makes up the civilisation of the people. Only a few years ago they had to learn the very rudiments of civilisation. They were to all intents and purposes, though living in Europe, Asiatic in their habits and customs, their immobility, and their secluded mode of life; but all this now belongs to the past. A total and radical change has been accomplished, and with such rapidity that old men are still to be met with, though they are fast dying out, who are fair representatives of the former state of things. The people of these principalities claim to be the descendants of a colony of Romans, located there by the Roman Emperor Trajan, hence the name of "Roumania," which during the last few years has been introduced, and is now universally adopted by the natives as the name of the united principalities. From time immemorial this country was the battle-field of nations—Scyths and Romans, Huns and Bulgarians, Hungarians and Poles, and, last of all, Turks, to whom they were in the sixteenth century glad to submit, in order that, having only one master, a stop might be put to internal feuds, and a safeguard placed against foreign aggression. From that time the country was governed by Hospodars, appointed by the Sultan, who were always strangers, till at last, some forty years ago, a native boyard, or nobleman, was created Hospodar.

Under his government endeavours were made to found schools, construct roads, and to encourage foreign

settlers. But as the country subsequently possessed only a few schools, and those of a very inferior order, the literature and language being too poor to form a proper vehicle of instruction, the wealthy classes had to send their children to foreign countries to be educated, more especially to France. Boarding-schools were opened by private enterprise for the children of those whose means did not permit them to be sent abroad. All the schools were conducted by Frenchmen, and the French language, consequently, became the only medium of instruction. This system consistently carried out for a number of years, resulted in the language being spoken by the upper classes with great fluency and purity. During the last few years national schools and gymnasia, for the higher branches of instruction, have been founded in every town. These are conducted entirely after the French model. At present boys and girls' national schools are to be found in every sub-division of Jassy, besides two gymnasia, one academy, and twenty-four private institutions. In order to ensure the highest efficiency attainable and to attract the greatest number of pupils, the professors and teachers are liberally paid; much more so indeed, than any other staff of officials.

The instruction at all the public schools is entirely free. There is also one university at Jassy, but the instruction there is confined to law and literature. The whole system of jurisprudence has been changed. Formerly, an official called "Aga" undertook the duties of judge, head of police, and mayor. Now, however, at Jassy, there is a prefect, a commissioner of police, and a mayor, assisted by a corporation, whose duty it is to attend to the wants of the town. For this purpose he has the power to impose taxes, the maximum, however, being clearly fixed by law. By far the most important change introduced is the formation of the new courts of law, consisting of a tribunal or court of first instance, of which one is found in the principal town of every district; courts of appeal, of which there are two in Moldavia, one in Jassy, and the other at Fokshani; and a court of cassation at Bucharest, for both principalities. The whole system is an exact copy of the French and the Code Napoléon. Another important change is the emancipation of the peasants. Of real slaves there have long been none in the country, except a not inconsiderable number of gipsies, who had become the property of the boyards, or landed gentry, and were chiefly employed as domestic servants or mechanics.

The country is purely agricultural. It exports large quantities of maize, wheat, and other cereals, besides cattle, hides, wool, bristles, and salt. The staple food is Turkish maize, which is said to grow better than in any other country. The common beverage is wine, which is produced in immense quantities; but for want of care and skill in preparing it, very little, if any, is exported. Great as the produce of the country is, it might be more than doubled, as scarcely one-half the soil, which is almost everywhere exceptionally good, is under cultivation. This is owing chiefly to the want of hands and capital. In order to secure labourers to take in the crops, peasants must be engaged sometimes three years in advance, by which means a heavy burden is thrown on the landowners, and the peasants find themselves in a continual state of indebtedness. The estates also are nearly all heavily encumbered. Manure is scarcely ever used. In a few instances it has been used with most satisfactory returns. Owing to the great want of labour, the system adopted is to till only a small portion of land, and to leave the rest for some time to nature. Threshing, sowing, and other agricultural machines are being gradually introduced. The country can scarcely be said to have any industries. All it can boast of in this respect are a manufactory of very rough cloth, chiefly used for the army, one for soap, and one or two for rough papers. Lately another has been erected for finer paper, used for printing purposes. The want of a more extensive industry is much felt, as in years of partial drought, which frequently happens, there is little to export in return for the immense quantity of articles of use and luxury imported.

Jassy, containing nearly 90,000 inhabitants, of which 55,000 are Jews, was, before the union of the two principalities, the capital of Moldavia. It was evidently originally an agglomeration of large houses, tenanted each by a rich boyard, and surrounded by huts of his dependents. These latter have now disappeared to make way for regular streets, but the houses of the boyards have remained. The town is situated on two hills, the one rising so gradually as not to impede circulation, while the other so precipitously as practically to detach it from the rest of the town. As both hills are covered with trees, intermingled with the houses, the town in general presents a picturesque appearance. The country surrounding it being hilly, with here and there an ancient monastery in view, and the Carpathians in the distance, it is not devoid of attraction. The streets are ill-paved, some not at all, although progress is said to have been been made during the last twenty years.

THE PARIS ASSAY OFFICE.

Few persons are aware that the Bureau d'Essais, established in 1845, assays all mineral substances presented by mine-owners, ironmasters, and manufacturers, without any charge whatever.

The Bureau is in the School of Mines, and the director of that establishment has made his report on the working of the Bureau during the year 1873. According to this report, the alloys tested comprised bronze for bells, phosphorus bronze for artillery, yellow metal for sheathing, and white metal containing between nine and ten per cent. of nickel for electro-plated goods.

The growing demand for nickel has created an active search for ores of that metal; many specimens from Piedmont and Spain were assayed, but found to contain a very small quantity of the metal. Many attempts have been made to find a substitute for nickel in alloys composed of it with copper and zinc, but apparently without result.

Grey ores of copper from Alger and Constantine were analysed and found to contain in some instances mere traces of silver, while others yielded 800 to 2,200 grammes of that metal per ton of the ore. Some grey copper ore, containing a small quantity of copper pyrites from St. Etienne de Baigorry in the Basses-Pyrenées, yielded 310 kilogrammes of copper and 10·550 kilogrammes of silver per ton. A collection of old copper scoria brought from the neighbourhood of Huelva was found to contain copper varying from a mere trace to 1·60 per cent.

An important series of minerals of copper pyrites from Japan was analysed. The specimens from the mines of Betchi, situated to the west of the island of Sitkokf, consisting of quartz and talcy chlorite with copper pyrites, contained neither gold, silver, arsenic, nor antimony, and the metallic copper melted in the country itself was found to contain 3·420 per cent. of lead, 0·012 of tin, traces of iron, and very slight traces of arsenic and antimony. The large percentage of copper is attributed to additions of that metal during smelting, and not to accident. (It is a fact, as was recently noticed, that the remarkable Chinese and Japanese dark bronze contains ten per cent. of lead, and sometimes even twenty per cent.)

Numbers of iron ores from the great oolithic formation of the north-east of France were analysed, but furnished no new facts. The specimens sent from the three provinces of Algeria, oxydulated iron, oligiste, red oxide, and brown hæmatite, were found in some cases to contain a very sensible quantity of manganese, and to resemble pretty closely certain rich Spanish ores.

Numerous examples of lead ore were also received

from Algeria. They consist principally of mixtures of galena and blende, and the sulphites are replaced partially or entirely by carbonate of lead or calamine. Many deposits of lead ore are found with those of grey copper, but they contain very little silver, the yield of many samples not exceeding twenty grammes of silver per 100 kilogrammes of lead; others yielded from fifty to eighty grammes. In the regency of Tunis, lead ores are also found associated with zinc ores, and generally poor in silver, the highest per centage of silver found being 125 grammes per 100 kilogrammes.—*Iron.*

THE TOBACCO INDUSTRY IN INDIA.

Amongst the papers published by the India Office there is one respecting the cultivation of tobacco, an article which has long been an established industry, but which at the present time remains in a most primitive condition, and capable of indefinite improvement. Generally speaking, nearly the whole of the tobacco produced in India is consumed in the country, and the great bulk of it in the district in which it is grown. The inland trade is quite insignificant. Small quantities are transported from some places where the plant is largely grown to neighbouring districts where the cultivation is not extensive, the climate and soil not being adapted for the purpose. The foreign and coasting trade is larger, and is extending. Of the exports, the quantity sent to Great Britain or other European countries is extremely small. So little is Indian tobacco known in the English market that it is not quoted in some of the best mercantile returns of prices current, though they quote China, Japan, and Java tobacco. The truth appears to be that Indian tobacco is so badly prepared that English dealers will not look at it. There are many parts of India where tobacco can be and is produced at least quite equal naturally to other Asiatic kinds, but no attention has been given to the improvement of its quality by careful cultivation and preparation, and as long as there is no demand in the European market, and the consumption wholly confined to the natives, so long may we expect to find India produce nothing superior to the coarse, rank, ill-flavoured tobacco for which it has already acquired an unfortunate reputation. The natives of the upper classes disguise the natural flavour of the tobacco they smoke by the admixture with it of perfumes, such as patchouli, or conserves of roses and apples, and other confections. The lower classes take their tobacco *au naturel*, and the stronger and ranker it is the better they like it.

Undoubtedly a considerable time may be expected to elapse, even after Indian tobacco generally has been improved up to the point when it will be fit for export to the European market, before any such very extensive demand will arise as to make a development of the area of cultivation necessary; but the actual extent of cultivation is very great, and it is desirable to consider whether efforts might not with great advantage be made to improve the quality, as well as to increase the yield of the cultivated area. In the first place, any well directed effort to improve the method of cultivation now pursued must re-act upon the general agriculture of the country. Tobacco is essentially a crop which requires high cultivation, and the example given by the successful growth of tobacco will of necessity have a most beneficial effect upon native agriculturists. In Ceylon, we have the testimony of Sir Emerson Tennant to the improvement effected in the conditions of native agriculture generally by the careful cultivation of tobacco in the Jaffna district.

The crop already occupies an enormous area, but to what extent, or the amount of produce, it is impossible to say with exactness, for there are as yet no trustworthy agricultural statistics in India, nor does any agency exist for their collection. But there certainly cannot be less than two millions of acres under tobacco, and probably much more. The yield generally is low. Even in those provinces which are best suited for the purpose the yield is far below that of good tobacco lands in America. The deficient yield, as well as inferior quality of the produce, are equally the result of ignorant an bad methods of cultivation and curing. It may be hoped that now that the local governments have been entrusted with the immediate charge of the model farms, which have already conferred great benefits upon agriculture, the cultivation of tobacco should have, in these model farms, a prominent place. No crop so speedily and so largely repays the care bestowed upon it; no crop is more profitable when due attention has been given to its growth.

The growth of tobacco in accordance with the principles of modern science is not enough, however, for the production of tobacco which will be good for consumption. After all the processes have been successfully carried out, the planter has still to go through the labour of curing and preparation before he can send his tobacco to market. The best grown kinds will be fit for nothing but to throw away if they are not properly cured. Here the natives fail more egregiously than they do in the growing. It is thought by competent parties that the most inexpensive way of teaching the natives would be to engage the services of experienced curers from America or from the Philippines. When the culture of tea was first introduced, the services of Chinese manufacturers were engaged to teach the processes of manufacture to the natives, and with success. Since then the Government has not hesitated to act as a pioneer, and incur great expense in the introduction of chinchona, rhea, and cotton, all new industries. But tobacco has been grown in India for 250 years, its cultivation is widely diffused; in some places the produce enjoys good repute among Europeans as well as natives. The improvement of the quality, and the development of the industry, so as to make it a profitable article of export to the European market, now seem to lie with the private capitalist rather than with the Government. The question for consideration seems to be, how far the Government can and should encourage and sustain the well-directed efforts of individual or associated capital and energy in working out and extending an industry which has taken deep root in the country.

Building in concrete is now acquiring a considerable degree of importance in various parts of Scotland. Messrs. Drake and Co., concrete builders, have undertaken to build in concrete certain portions of the new Epidemic Hospital, which it has been resolved to erect in the city of Aberdeen. The total cost of the hospital will be £8,000; and by employing concrete instead of stone it is stated that a saving of £1,600 will be effected.

The question of the water supply in connection with fires in Glasgow was again the subject of discussion, both before the Corporation Water Committee and the Police Board. Both of those bodies now seem to be aroused to a sense of the danger to property that exists from the want of sufficiently large distributing mains, especially on the south side of the city.

A new petroleum car for a line between Toronto and the oil regions at Parkersburg, Virginia, has been built. It is intended to be fitted with a large iron tank, 25 ft. long by 5 ft. in diameter. At each end moveable head blocks are placed, so that the tank when in position upon the truck can be firmly fastened by bolts, so as to avoid the possibility of its shifting about. By this means it is expected that oil will be carried more steadily.

The quantity of nitrate of soda exported from Peru rose from 1,300,000 quintals in 1860 to almost 4,000,000 in 1872, while the guano exported, of the value in 1863 of 65,000,000 francs, had risen to 225,000,000 francs in the two years 1871-1872, or an average of 112,500,000 francs per annum.

THE TOWN OF SUEZ.

The latest representative of the towns which history informs us have from the earliest period successively flourished and disappeared at the Egyptian extremity of the Red Sea, is Suez. The silting-up of an anchorage has compelled the craft to remove further south, and thus to follow the receding head of the gulf. There is reason to believe, from the configuration of the shore and position of the present harbour, that this process of removal has attained its limit, and that the existing site of Suez will, for any period of time we can practically contemplate, be that of the Egyptian Red Sea entrepôt, best suited for the trade between Egypt and the countries about and beyond the Red Sea. A new importance has been acquired from the development of the overland route to India, and consequent opening of the Red Sea and its Egyptian terminal port to British mail steamers. Steam has exerted its all-powerful sway, and one of the transition scenes of the past, once seen to be remembered, was the extraordinary bustle occasioned by the galloping into and out of the town, often by torch-light, of four-horse vans of overland passengers and the shouting and screaming of the Arab drivers, and by the sorting of the mails and cargoes brought and despatched across the desert on a thousand camels. In 1845 a good hotel was erected for the convenience of the India passenger traffic by the Egyptian Government. It has been under English management from the time it was built. Several years ago it was improved and refurnished by the Peninsular and Oriental Steam Navigation Company, by whom it is held on lease from the Egyptian Government. This company, to whom England and India are much indebted for the organisation of efficient steam communication between the two countries, was also the first to cause to be erected, in 1849, a commodious and respectable building for offices and stores. General improvement had crept on slowly till 1860. In that year the same company, in aid of their increasing sea and passenger traffic to and from Suez, erected a powerful condensing apparatus for the purpose of supplying its vessels with potable fresh water; and subsequently, in 1862, a large ice-making machine with accessories, and in 1863 a steam washing machine, a capacious workshop, and stores for their increasing requirements, on ground granted to them, free of cost, by the late viceroy Saïd Pasha. Other buildings also began to appear along the sea-front of the town after 1860. The walls and gates of the old town gradually disappeared bit by bit. At French suggestion, and in connection with works under French superintendence, broad streets were traced and European dwelling-houses and various tenements and shops built on the outskirts of what was previously the town of Suez. The Messageries Maritimes Company erected houses and rows of dwellings—since become tenantless—for their mechanical superintendents and workmen. The area of the town was by 1868 nearly doubled, and the population quadrupled. By the census taken last Mohammedan year, terminating 9th March, 1872, the population of Suez, including the new port, known as Suez and its dependencies, was estimated at 11,400 natives, with an addition of 1,600 Europeans and foreigners; total 13,000. In the bazaars may be seen natives of Turkestan, India, Persia, Turkey, Syria, Arabia, and Egypt, of nearly every part of the Red Sea, of Africa, of Greece, and of most European countries. There is, however, a population proper of native race, neither Egyptian nor Arabian in feature but partaking of the two: men of good stature and strength, and capable, when well paid, of doing without over fatigue, a hard day's work. The women are more square and larger featured than those of Egypt, and fall short in figure and comeliness of those of Cairo and the larger towns of the Delta. The natural harbour known as the Suez Roads, is the best in the Red Sea. It is formed by a spacious bay, which bites four miles into the land, to the west, just south of the town, and is so ample that it would contain in complete safety a thousand ships of any draught and tonnage. The depth of water over the whole area, with the exception of a coral rock in the centre, varies from four to nine fathoms; the bottom affords good holding ground, and ships can enter in all winds and at all times of the tide by day or night.

The future of Suez depends mainly upon whether the Egyptian Government adopts a policy for encouraging the growth, between Egypt and the East, of private commerce and of the carrying trade by Egyptian ship-owners. There were times when more intercourse between India and Egypt, both directly and through the intervening ports of the Red Sea, subsisted than at present. The wants in many respects of the people of Egypt, Syria, and Western Turkey, and of India, might admit of being reciprocally supplied. Egypt is well placed as a depôt for Eastern supplies to the Mediterranean, if Egyptian merchants knew how, or were encouraged to take advantage in that respect, of their excellent position. The story is as old as the time of Alexander the Great, and his founding of Alexandria. Egypt, indeed, might become, within its limited Mediterranean sphere, what Great Britain by commercial enterprise has become to the whole world.

CORRESPONDENCE

IMPROVED WATER SUPPLY.

Sir,—The present supply of water is stated at 33 gallons per day per head of population in the metropolis, but it is badly arranged on the intermittent system, instead of being under constant supply and high pressure, with hydrants provided in every street. But the actual supply of water daily in London is not so abundant, for a large proportion (estimated at nearly one-half) is wasted by leakages in the ground. A supply of pure, soft water in abundant quantity might be obtained by sinking a series of artesian wells into the lower greensand strata, ranging at about two thousand feet below the London street levels. Fifty of these artesian wells (at a cost of about one million sterling) spread over the metropolitan area, of about 120 miles, would supply pure waters, in place of the present hard chalk waters from Kent, &c., and the filthy liquid obtained from the Thames and Lea rivers, which have a large composition of sewage and other organic matters in them. The present supplies of river water might be maintained for street watering, sewer scouring, and many other commercial uses, and for extinguishing fires. We shall soon be in great want of water from the recent droughts, but we let all our water run away, instead of attempting to catch and store it during the seasons of rain.—I am, &c., W. Austin, C.E.

SCIENTIFIC INVENTIONS AT THE EXHIBITION.

Sir,—Might I be permitted to supplement the notice in your last week's *Journal* on "Scientific Inventions and New Discoveries" exhibited at South Kensington by the remark that my safety lamp with the glass all round displays an equal light on every side, and has been tested by Dr. Charles Heisch, F.C.S., Gas Examiner to the Corporation of London," &c., who certifies that "The Yates' lamp gives for equal consumption of oil twice the light of the Clanny, and four times that of the Davy." I should also prefer that the fastening device be called a locking pin, which it is, rather than a catch, which would indicate something more flimsy and fragile than my bolt.—I am, &c., William Yates.

14, Princes-street, Storey's-gate, Westminster, S.W.
21st July, 1874.

GENERAL NOTES.

Aquarium in London.—The success of the Brighton Aquarium, and that at the Crystal Palace, has caused several attempts to institute similar establishments in provincial towns. Now it is proposed to provide one for London, and a scheme is projected for the building of a large aquarium, in connection with a winter garden and other means of popular amusement and instruction, in a readily accessible part of the west end.

Application of Sewage.—Some time since the Paris authorities set up a large steam-engine at Clichy to supply the sandy plain of Gennevilliers on the opposite side of the Seine with sewage water. The experiment has proved successful. The market gardeners are now eager for a full supply, and the machinery is not powerful enough for the extension of the service. On the other hand, the complaints of the increasing foulness of the river from the sewage still turned into it, have become so loud that it has been determined to erect another engine at the same place, so as to draw off 1,000 to 1,200 litres of sewage per second, which is about half the quantity brought by the collector; at the same time large conduits in masonry are to be constructed to carry the sewage to points which it has not yet reached. The cost of this work will be about £40,000.

Impermeable Paper and Cardboard.—According to Dingler's *Polytechnisches Journal*, if a sheet of paper be immersed in an ammoniacal solution of copper (liqueur de schweitzer), prepared by treating copper filings with ammonia of 0·880 density, in contact with air, the paper becomes entirely impermeable to water, and maintains its consistency even under the influence of boiling water. When two sheets of paper thus prepared are passed together through rollers they adhere completely to each other, and by placing a number of such sheets together board of great solidity is obtained, which may be still further strengthened by the interposition of fibres or tissues between the sheets; boards thus formed are quite equal to wood in solidity.

Growth of Madder in England.—Mr. T. Sidebotham publishes the results of some experiments on the cultivation of madder-roots, made some time ago in England. A piece of rich land in Derbyshire was sown with seed from fine madder, early in the spring of 1868; in the autumn the madder plant came into flower and the roots of some pulled up measured 13 in. The plants came up in the spring of 1869 very strong and healthy, and so on until August, 1871, when they were dug up. To produce the best results, the roots should have remained another year in the ground, but for experimental purposes this growth was considered sufficient. The quantity produced was small, in appearance and size the roots were about equal to fine French roots, but on breaking them, instead of the deep red colour in the best French roots, they were orange or yellow. The dyeing properties were of a very disappointing character; the colours after soaping were loose and similar to Dutch madder, pinks and reds being loose and weak, and the purple element entirely wanting; probably the cause of this is deficiency of sun and heat in this climate.—*Practical Magazine.*

The India-rubber Trade.—The extensive demand for india-rubber, and the comparative scarcity of the supply, has augmented the price until it now stands, says a New York journal, at nearly 1 dol. per lb. in that market. The crude matter comes from tropical regions, and is derived mostly from certain trees. A variety of attempts to find substitutes for rubber or new sources of supply have been made. In the matter of substitutes, several valuable compositions have been invented, which are used in place of rubber for specific purposes. Among the new sources of supply are the fruits, seeds, and juices of various plants, which have been successfully treated. By fermenting the *Asclepias*, or common milkweed plant, followed by pressure and evaporation, a gummy liquid is separated, having the characteristics of rubber, and, like it, capable of vulcanisation. From the bamboo berry grown in the South, from flax seeds and other seeds, is also obtained in this manner a similar gum, from which, it is said, a good article of vulcanised rubber may be made, and also an excellent waterproof varnish. It is alleged that these substances may be produced at a cost not exceeding 20 cents. per lb., and that a company with a large capital subscribed is about to introduce the manufacture.

Palm Paper.—An American inventor has brought out a process of making paper from varieties of the palm. The material is cut or torn into pieces of suitable size, then cooked in a close digester, with thorough agitation and under steam pressure, in a weak solution of alkali, naptha, benzine, or soap; then it is completely ground, while steam passes freely through the grinder and intermingles with the stock, reducing, bleaching, and finally washing it.

Ebony from Sea-Weed.—An American periodical gives a process for making artificial ebony from sea-weed. It consists in first treating the plants for two hours with dilute sulphuric acid, then drying and grinding them up. To sixty parts of this product, five parts of liquid glue, five parts of gutta-percha, and two and a half parts of India-rubber are to be added, the latter two being first dissolved in naphtha. Afterwards ten parts of coal-tar, five parts of pulverised sulphur, and five parts of pulverised resin are added, and the whole heated to about 300° Fahr. When cooled, a mass is obtained which in colour, hardness, and capacity for receiving a polish, resembles ebony, and is much cheaper. A process for obtaining a product of this sort from sea-weed was patented some years ago in this country by Mr. T. G. Ghislin, but there was never much commercial result therefrom.

Esparto or Alfa.—The Franco-Algerian Company obtained from the French Government, in April last, the concession for ninety-nine years of more than 800,000 acres of land, the greater part of which is to be devoted to the production of alfa. The company calculates in a minimum production of 100,000 tons per annum. A ton of alfa costs 90 francs at Arzew, and is worth 140 francs at an Algerian seaport. The company believes it will be able to reduce the price of the fibre to 130 francs. In order to enable the company to carry out its important work of supplying material for paper-making, the French Government has authorised it to lay down and to work for 99 years a railway from Arsew to Saida, with branches, in all about 130 miles in length. The alfa grounds are those known as the Hauts-Plateaux; the other lands conceded to the company lie about fifty miles to the east of Oran, on the line of the Alger and Oran Railway.

New Joint.—A method for making joints to unite the sides of boxes and other matters has been recently patented by Mr. W. M. Beaufort. The two pieces of wood to be fastened together are first mitred in the usual manner, and a hole is then drilled vertically in each piece, from the bottom upwards, at a short distance from the mitred edge. A channel or groove is then cut by a saw or otherwise, from the mitred edge to the drilled hole. This channel is of a less width than the diameter of the hole, and may be cut either parallel to the sides of the piece of wood, or at right angles to the mitre, so that when the two pieces are put together a continuous channel shall be formed between the two holes. The two pieces are then held tightly together, and a key is formed by running metal, such as lead or "fusible metal," into the channel; by this means, the key is cast in the place which it is to occupy. The key may also be made separately, of solid metal, and driven home into the channel.

Tobacco in France.—The increase of the selling price of tobacco in France has produced a diminution in the consumption of smoking tobacco, while that of cigarettes has largely increased, and the cost of making these being considerably more than that of tobacco for pipes, it has been found necessary to increase the vote to the factories. At present the amount of tobacco manufactured is 400 tons, but it is proposed to be doubled next year. The manufacture occupies on an average 1,200 bands; they commence work at six in the morning in summer and at daybreak in winter, and during the greater part of the year they continue at work till eight at night, but sometimes the pressure on the works makes it necessary to run the machinery all night. The purchases of raw tobacco amount generally to about £560,000 for French grown tobacco, £720,000 for foreign, and £240,000 for cigars. This year the credit for indigenous tobacco is to be carried to £660,000 in order to encourage the growers, who complain sadly of the low price paid them by the Government. The receipts on account of tobacco and cigars amount annually to about £11,600,000, and the total cost of manufacture and management to £2,520,000, thus leaving a nett revenue of £9,080,000.

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FRIDAY, JULY 31, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ENDOWMENT FUND.

The following subscriptions have been received towards the establishment of an Endowment Fund for the Society:—

	£	s.	d.
G. T. Saul	5	0	0
W. R. Spicer	5	0	0
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The Council will be glad to see further contributions to this fund. Members can receive full information as to its nature and objects on application to the Secretary.

TECHNOLOGICAL EXAMINATIONS.

The programme for these Examinations is in preparation, and will shortly be issued. It will include the nine subjects of last year, viz., Cotton Manufacture, Silk Manufacture, Paper Manufacture, Steel Manufacture, Carriage Building, Cloth Manufacture, Glass-making, Pottery and Porcelain, and the Manufacture of Gas, with the addition of four new subjects, viz., Agriculture, Silk and Woollen Dyeing, Calico Bleaching, Dyeing, and Printing, and Alkali Manufacture.

IMPROVED RAILWAY LAMP.

The Society's Gold Medal, or Twenty Guineas, is offered for an improved lamp or means of illumination, suitable for railway passenger-carriages, that shall produce a good, clear, steady, durable, and safe light.

It must be simple in construction, and capable of being readily cleaned and repaired.

In judging the merits, cost will be taken into consideration.

Specimens, in a condition suitable for trial, to be sent in to the Society's House not later than the 1st of November, 1874.

The Council reserve to themselves the right of withholding the medal or premium offered, if, in the opinion of the judges, none of the articles sent in competition are deserving of reward.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The first course of Cantor Lectures for the past Session was "On Spectrum Analysis as aided by and aiding the Arts," by J. Norman Lockyer, F.R.S.:—

Lecture II.—Monday, December 1st, 1874.

On Spectroscopy in its Quantitative Relations.

The object I have in view in these lectures is twofold; in the first place, I am anxious to show the intimate connection between scientific research and the arts. You will recollect that in the last lecture I showed the connection between the art of photography and the art of spectroscopy, quite independent of the scientific importance either of photography or of spectroscopy. To-night I have to show you that as the art of photography has helped spectroscopy to an enormous extent, so also it may not be too much to say that in future, if not indeed in the present, the art or science of spectroscopy will render that aid to the other arts which it has received from photography. That is one point, and the second point is this; whether you deal with such subjects as photography or spectroscopy, in this point of view, or in their application to other arts, you will find that in both cases, the purer your science is to begin with, the richer it will most probably be in practical applications.

What I have to do to-night is to show you that possibly, in the future, work done by the spectroscope will not only be useful in matters of pure science—and you all know how useful it has been up to the present time, although spectroscopy is, so to speak, but the child of yesterday—but in various ways in which the application of science to the arts is concerned.

Now, in the quantitative relations of spectroscopy to which I shall have to draw your attention to-night, I shall deal with work that has been done in England, but I do not wish you for a moment to imagine that this is the only work of the kind that has been done. On the contrary, both in France and Germany, attempts have been made to apply the spectroscope to the quantitative determination of the substances with which the spectroscope can deal so well, but I shall, in the present lecture, not attempt to cover the whole ground which has been thus opened up, but simply to give you one little bit of scientific history, showing that inquiries which were undertaken, from the point of view of pure research, have

really resulted in a practical application scientifically interesting at present, but possibly useful in the future.

All of you, I am quite sure, are perfectly acquainted with the first generalisation which those two distinguished German chemists, Kirchhoff and Bunsen, got out of their earliest spectroscopic observations—observations connected with Stokes's generalisation, which dates as far back as 1852, when Stokes first gave the clear indication of researches that was then so far in the future. You recollect that a "continuous spectrum" is such a spectrum as I threw on the screen in the last lecture—a spectrum, that is to say, in which all the light is absolutely complete so far as it goes, from the extreme red to the extreme violet—and that a discontinuous spectrum means a spectrum in which the light is not complete, but in which there are gaps. I say if you thoroughly recognise this distinction you understand the importance of Kirchhoff and Bunsen's statement, when they told us that if you had to deal with the light from a liquid or solid substance, then the light when analysed with the prism, would give you a continuous spectrum, and on the other hand, that if, instead of taking a solid or a liquid, you take a gas or any of the elements in a state of vapour, then instead of having a continuous spectrum—instead of having the light continuous from the red to the violet—you get it simply here and there along the spectrum, it might be in the red, it might be in the yellow, it might be in the green, or the blue, and so on.

Here, you see, was an enormous advance, and then they went on to show us that although in the case of solids and liquids you always get the same spectrum, and that, therefore, *pro tanto*, spectroscopy could not help you to an analysis of anything that existed in the solid or liquid state, still, when you got the elements into a state of gas, the lines were never the same for any two substances; so that this generalisation of Kirchhoff and Bunsen gave us a new power, a new method of analysis, so long as the thing which we analysed was in a condition of vapour.

Now that, of course, was a generalisation of extreme importance, and a thrill ran through the whole scientific world when it was announced. Many of you will recollect that this work has since then been very much extended by researches in our own country. Many of you will remember that Dr. Frankland, very soon after this, showed that in the case of hydrogen gas (and let me remark that this very beautiful abstract consideration came out of an inquiry which had for its object the gas illumination of our metropolis), which, of course, exists as gas at all known temperatures, Kirchhoff's generalisation was not true, if the gas were at a high pressure. Dr. Frankland showed, in fact, that at a pressure of ten or twenty atmospheres the spectrum of hydrogen was as continuous as that from burning coal, or any other burning substance, provided always that that substance was in a liquid or a solid state. Here, you see, was an apparent anomaly. Now, whenever you hear scientific men talking about an anomaly, in nine cases out of ten you will find it is because they do not know the law. And I shall have to show you that this anomaly was really no anomaly at all, the moment we got a higher generalisation. Now, what was that higher generalisation? Before I state it, let me refer, for one moment, to some other work done by Plücker and Hittorf, also on hydrogen, the upshot of which was that, under certain conditions—the pressure they employed being far below that employed by Frankland—the well-known lines, the one in the red and the other in the green (there are others, but we need not discuss them), were sometimes seen very thick, sometimes very thin. Plücker and Hittorf did not see exactly the cause of this variation, but that the variation existed was absolutely undoubted. So that you see at the time that we had Kirchhoff's generalisation, Frankland's work, and Plücker and Hittorf's work, we had a horizon something like this. Solids and liquids give us a continuous spectrum; the gases give us a discontinuous spectrum, that is to say, they give us bright lines. Then Frankland's work comes in—at a very great pressure hydrogen does not give us bright lines at all; all the bright lines are absolutely lost in a beautiful continuous spectrum; and Plücker and Hittorf come in and teach us that, from some cause or other, which is indeterminate—it may be pressure or it may be temperature—the hydrogen lines, observed at a much lower pressure than that employed by Frankland, vary their thickness.

Now, if you will allow me, I will take you to the sun. In the year 1868 a new method was for the first time employed by which we could observe the various gases which surround it; and, as you all know, among these gases this very gas, hydrogen, preponderates to an enormous extent. This, of course, gave us an opportunity of studying the hydrogen of the sun; and I propose now to throw on the screen some diagrams showing you exactly how the hydrogen at the sun behaves. You will allow, I think, after you have seen these drawings, that the sun can help us in this attempt to explain Kirchoff's generalisation, to which I have already referred. The first drawing which I propose to show you is one of the red part of the spectrum, which contains the absorption of one of the lines due to hydrogen. The red streak represents the spectrum of the sun, the continuous spectrum of the solid or liquid sun, as it was then pictured; and above, in continuation of the blackest line which you see on the screen, there is a bright line. That is the spectroscope's verdict as to the composition of the atmosphere round the sun and of the sun itself, at that particular part of the spectrum. You see we have here below, the spectrum of the sun, in which the dark lines indicate vapours which are absorbing, and above we have the spectrum of the vapours which are radiating. The line is one of the lines of the spectrum of hydrogen.

Here is another slide which will show you the other hydrogen line to which I referred, the line in the green. You will recollect that the other line was a perfectly straight line, but this diagram shows that there is a difference between this line and the other one. You will find that the line widens as we get towards the sun; in fact, it is trumpet shaped. Now, the question was, when that observation was first made, how to reconcile the thickening of that line with Frankland's, Plücker's, and Hittorf's work, to which I have referred. Nothing was more easy. We know perfectly well if we go up a mountain that the pressure of the air is reduced; and similarly we may imagine that far above the sun the pressure of the hydrogen, which practically is the equivalent of our atmospheric air, will be very much less than it is at the sun's surface; and all you have to imagine is, that at the sun's surface the pressure of the hydrogen is very much greater than it is at a considerable distance above the sun. Take that in connection with Frankland's work, and Plücker's and Hittorf's work. Frankland's work shows us that increase of pressure gives us a continuous spectrum; this is an approximation to a continuous spectrum,—and the doubt which resulted from the indeterminateness, so to speak, of Plücker's and Hittorf's work, is resolved, by this solar observation, in favour of the hypothesis, that in the spectrum of hydrogen, as its pressure is increased, its lines widen, until at a pressure of twenty atmospheres we get a continuous spectrum.

That, you see, is pure abstract science brought down to us from the sun, in the case of solar lines due to hydrogen. I will next call your attention to another diagram, in which we are no longer dealing with hydrogen—no longer with a substance which exists here ordinarily in the state of gas, but in the solid state, though at the sun it exists in the state of a gas. I refer to magnesium. The two very thick lines in the middle of the diagram are due to the absorption of magnesium vapour round the sun. To the right you see another rather thin line, which is also due to the absorption of magnesium vapour. But please to notice this, that when we determine, as we can by this new method, the spectrum of

the magnesium vapour which surrounds the sun, as the hydrogen does; then we find that the various lines of magnesium vapour do not come up to the same height. You see there three lines, two of them very long and one of them short. The two to the left, and the one to the extreme right are the lines due to the magnesium vapour above the sun, and you see they come to different heights. Now, how can we reconcile this? How can we square this observation, so to speak, with the observations of the hydrogen spectrum, to which I have referred?

In this way. Increase of pressure, in the case of hydrogen, widens the lines. Increase of pressure, in the case of magnesium vapour, not only widens the lines but increases their number. These are the two observations of the solar chromosphere, which form the basis of the work I have to bring before you to-night. Now it would never do to rest content with this observation of the hydrogen and the magnesium at the sun. What must be done in order to bring these home to us? Laboratory experiments were perfectly simple which would enable us to see whether the hypothesis was right or wrong. All we had to do in the case of hydrogen, and what has been done, is to take a tube, connect it with an air-pump, to fill the tube with hydrogen, then to pump out the hydrogen, and to see whether the lines get thinner as the pressure of the hydrogen were reduced. They did get thinner.

Another series of experiments was to take a tube like the former one, but, instead of pumping hydrogen out, to pump hydrogen in until we get a great pressure, in which case the lines ought to thicken, and thicken until you got a continuous spectrum. That, also, has been done. But how about magnesium vapour? Many of you will see that that was perfectly susceptible of being determined by a simple experiment. Still taking a similar tube, having the electrodes of magnesium, put these electrodes in an atmosphere, the pressure of which is being constantly reduced, and then, if it be true that the magnesium spectrum gets simpler and simpler as the pressure is reduced, we shall find the magnesium lines, which we see at a pressure of one atmosphere, considerably reduced either in thickness or in number, or in both, at a pressure, say of a millimetre, or ten millimetres. That has also been done. In fact, I may say now that, not only with hydrogen but in the case of a great many substances, there is a very large series of observations tending to show that reduction of pressure is the thing that we must look to in these inquiries.

Now, what does reduction or pressure mean? In this room there is atmospheric air. What is atmospheric air? Let us assume that it consists of an aggregation of molecules. In this room suppose you reduce the pressure, what would you do? You would separate the molecules, and if you increase the pressure you will make them come nearer together than they were before.

Now the experiments I have referred to show that, in fact, the moment you so deal with the molecules that any two molecules come nearer together, the spectrum of those two molecules gets more complicated, the lines get thicker, and increase in number; whereas, if the molecules are separated, the lines will get thinner and the spectrum will be simpler.

I shall show you that we have abundant proof of this. But before I do that, let me show you the important bearing of this on the first generalisation I brought to your notice. We now exactly understand why it is that solids and liquids give a continuous spectrum and that gases do not; that gases, instead of giving us a continuous spectrum, give us only lines here and there. And we may go very much further; we may go, in fact, as far as this: If it were possible physically to lay hold of a single atom of any chemical substance, and by means of its spectrum observe its vibrations we should get one line from that single atom. That you may call the "fundamental line" of that particular atom, whether hydrogen, sodium, barium, chromium, calcium, or anything you like. By separating the atoms of that particular chemical substance you get one line. What do you do by bringing the atoms nearer together? You thicken the lines, or bring in more lines. You go on increasing the complexity of your spectrum, either in the case of some chemical elements by thickening the lines, or in the case of others—and this is an excessively important distinction—by increasing the number of the lines, until, as in the one case, you begin by a single line, in every other case you end with a continuous spectrum. This is the result where the *molecules* are close together, and if we go to the other end of the series we have a single line for each chemical substance upon which we experiment.

When spectroscopy was, so to speak, put on its legs again by Kirchhoff and Bunsen's work, we were content to say that if you got certain lines in certain positions you were dealing with gases or vapours, and that you would know you were dealing with arsenic, lead, copper, or whatever it was. But, of course, if you had a continuous spectrum you only knew you were dealing with a solid or liquid, and did not know what that solid or liquid was. But you will see in a moment that if, when you get the atoms or molecules of a substance to separate you have a continuous scale, from a single line to a continuous spectrum a great advance has been made. Let us deal with the case of iron. From the condition of iron, which gives us a single line, to that condition which gives us, as we know, and as we have mapped, 460 lines, the spectrum tells us of the existence of stages where you get something between one line and 460. That is quantitative analysis.

Before I go any further, I will, if you will allow me, throw on the screen a photograph with the object of pointing my subsequent remarks, which will show you how this work was first undertaken with reference to the solar spectrum, and how it has struck out from that region, and deals now with very many things which are absolutely unconnected with the solar spectrum. I throw this diagram on the screen, in order that you may at once see that in the real solar spectrum there is an immense, so to speak, *individuality* in the lines. The lines are not all equally thick. I am showing you that particular part of the solar spectrum which contains two lines of calcium. Those two thick lines in the middle are due to the absorption of calcium vapour in the sun's atmosphere, and the intermediate lines, and the lines to the right and left are, as we now know, due to the absorption, not of calcium, but of cobalt, nickel, aluminium, and other solar metals.

You see at once that some of these lines are excessively thin. I have already told you, that in passing from the atom undisturbed to the atom which is, so to speak, subject to reflex action, we multiply the lines in the spectrum, and thicken them, until we approach the condition at which we get a continuous spectrum. Now, when Kirchhoff and Bunsen had stated their generalisation, with regard to solids and liquids, giving us a continuous spectrum, and gases giving us a discontinuous spectrum, it was in reference to the solar spectrum that that inquiry was undertaken; and in the same memoir they showed that a great many substances, with which we are perfectly familar, are present in the sun; hydrogen, sodium, magnesium, iron, nickel, cobalt, chromium, and the like. But they also showed that when you come to get—to try to get, rather—a complete correspondence between the bright lines you can get from the vapour of any of these metals in the sun, and the dark lines in the sun's spectrum, that this very curious effect came out, that not all the lines were reversed. For instance, in the case of iron, we have 460 bright lines. But in the sun we find about 455 dark lines corresponding, and five, let us say, do not correspond. In the case of the bright line spectrum of aluminium, only two are observed to be reversed in the sun. How was this? Kirchhoff guessed that probably it was simply due to the fact that only the brightest lines

were reversed. That if certain lines were observed to be faint, then that probably those faint lines, for some unknown reason, would not be observed in the solar spectrum. Angström took up the question afterwards, and placed some more metals in the sun, but was unable to explain how it was that in the case of aluminium, two out of about thirty lines, let us say, were reversed, all the others absolutely leaving no trace whatever in the solar spectrum. Now, some of you will already see the connection between that statement and one of the diagrams which I have shown you. You recollect that I told you that in that particular part of the solar spectrum where magnesium lines occurred, we have three dark lines due to the absorption of magnesium vapour, and I also showed you that when you got magnesium vapour produced not on the sun, you got the two least refrangible lines going verymuch further from the source of the supply of the vapour than that other fainter more refrangible line. Now, suppose, for instance, that the pressure of the magnesium vapour in the sun's chromosphere were reduced; what would happen? You would not have that dark line of magnesium absorption in the sun's spectrum at all, and that is the explanation of the fact, that in the case of some substances known to exist in the sun, we do not get above ten per cent. of the lines.

Let me explain to you how that fact has been arrived at. The method which has been employed to investigate these last questions which I have brought to your notice, is as follows:—In the work that was done by Kirchhoff and Bunsen, a spark stand, by which I mean a stand which contains certain metals, the constitution of the vapours of which we wish to investigate by the bright lines which these vapours gave out, is used: these vapours were observed by simply putting them in front of the slit of a spectroscope. They were put in front of the spectroscope at indeterminate distances, sometimes nearer, sometimes further away, but the ultimate result was, that when you got, say, iron as the one pole, and brass, say, as the other, in air you get a spectrum in which the iron lines and brass lines, and air lines were so mixed up together, that it was very difficult to separate one from the other. Now it will be perfectly clear to you, in a moment, that if, instead of getting all those lines mixed up in this way, as you must do if you observe an object without any special reference to the position of the slit of the spectroscope, you put between the object and the slit a lens, you will get something quite different. The rays coming from the lower pole passing through the lens will be concentrated on the upper portion of the slit, and those coming from the upper pole will, in the same way, be concentrated on the lower part of the slit; so that if there is any special virtue, so to speak, about the vapour at the top or the bottom, that special virtue will not be mixed up as it was before, but the lower part will be thrown on the upper part of the slit, and the spectra of each pole will be distinguished and brought out at the upper or lower part of the slit. I have said special virtue, because I do not wish to commit myself. We have a spark going from one pole to the other, and that spark is luminous, because it has volatilised the metals of which that pole is composed, it will be perfectly clear to you, therefore, that that pole must be considered as the source of supply of the vapour which is passing from one pole to the other, and that being the source of supply, the vapour close to the pole will always be much denser than the vapour in the intermediate position, because the atmospheric air is always surrounding the poles, and the temperature is reduced the moment you get out of the spark region, so that you have not only the source of supply at the pole itself, but a distinct cause of waste the moment you leave the pole. The history of the spark going from one pole to the other, say from A to B, is that tho vapour is densest close to A, and that it gets less and less until it gets to B; whereas, the vapour which comes from B is densest close to B, and gets less and less dense until it reaches A. What should happen in a spectrum thus obtained? Why, this—that if denser vapours, as I have before told you, give us more lines, and thicker lines than rarer vapours, then the spectrum of B, say, will show lines of different lengths; that is to say, the denser vapours of B will give the whole of the lines close to the B pole, and only a few long lines at the greatest possible distances, while the denser vapours of A will give us some long lines reaching upwards to B, and a great many shorter lines due to the greater density of the vapour close to the pole.

That is not all. See how very easily, in this way, we can account for the presence or absence of lines in the solar spectrum, due to a metal which we knew to be there. For instance, here I will draw the lines of the spectrum due to the vapour of aluminium. It consists of two long lines in the violet, and a great many short lines in the other parts of the spectrum. That is the spectrum obtained at atmospherie pressure. Now, suppose a line at the bottom of the spectrum to represent the upper surface of the sun's photosphere, and that the aluminium vapour exists above the sun's photosphere at atmospheric pressure. Then all the lines in the spectrum of aluminium will be reversed. But suppose that the aluminium vapour, instead of existing at a pressure of one atmosphere, is existing at a pressure of half an atmosphere. We represent that eondition of things by drawing a line half way down the longest lines. You will then see that the aluminium vapour around the sun is no longer competent to reverse its lines. These are only reversed by a pressure greater than any pressure which exists in the case of the aluminium vapour around the sun.

Now, the quantitative result of this work comes out as follows: We have, by observations of this nature, an easy method of determining the long lines and the short lines of any particular vapour we wish to examine. I have shown you the long lines on the screen, and I will now show you some long lines and short lines which have actually been photographed by the methods which I brought to your attention before. There you have the long and short lines of cadmium and lead. You will see that the lines are of three kinds. The lines which go right across are due to the air, which is constant from pole to pole. At the top you see certain lines; those are the lines of one of the substances present in one of the poles. The lines below are the lines of the lower pole. I will next show you the lines of lead and cadmium, and you will see exactly similar phenomena. We have the upper pole of lead and the lower pole of cadmium; you will see that some of the lead lines go nearly right across the spectrum; there are two excessively short lines due to the exceedingly dense vapour of zinc. In the same way the cadmium lines come down from the upper part, and meet the zinc lines about half way. If then these long lines are simply due to the fact that when atoms of vapours are rare, we get a simple spectrum, and that when they are denser we get very much more complicated spectra, the lines always being added to, it will be perfectly clear to you that if there is any truth whatever in this hypothesis, and if it is true to say that there is a great deal of calcium in the sun, because the calcium lines are thick, and if it is true to say that there is not much aluminium in the sun, because all the aluminium lines are not reversed, and what are not reversed are thin; I say if there is any truth in that hypothesis, these effects instantly follow. If you take a substance such as strontium, say, and observe its spectrum, and if you get certain lines from the dense vapour of the pure metal, and that then under exactly conditions, instead of using the pure metal you use a chemical combination, let us say a chloride or iodide, then you ought not to get so many lines from the combination as you got from the pure metallic vapour. Now, that experiment has been tried. And it is perfectly true that under like conditions you do not get so may lines from the spectrum of any of the salts of strontium as

you get from pure strontium, and that fact is not only true of strontium, but of everything else. Now, which lines ought you to get? Ought you to get the long lines or the short ones from the salts of strontium? You ought to get the long lines, and you ought not to get the short ones, because the short lines are only given by a dense vapour. And so true is it, that you can, as it were, roughly predict the spectrum of the salts of a metal, knowing the atomic weight of the metalloid with which you chemically combine it; provided, always, that the volatility of the compounds is equal. That is one stage. We have got the same spectrum now by a chemical combination, which we formerly got by a reduction of pressure.

Now, you will all see in a moment, there is no particular magic in chemical combination. Why not mechanical mixture? It is found that the results of mechanically mixing metals with one another, may be also roughly predicted on this hypothesis. Suppose, for instance, that I have a substance which gives me one hundred lines; then I alloy it with something else until it will only give me ninety-nine, and I can observe the quantity of that something else, which is requisite in order that the ninety-nine lines only should be obtained. I can reduce the ninety-nine to ninety-eight by alloying it with some more of the same element, and so on.

This has been a long story, and if you will permit me, I will, before going further, throw on the screen some actual photographs of supposed pure vapours, in order that you may see exactly what I mean. I will now throw on the screen four different spectra, in which, curiously enough, we have a substance common to all. The upper spectrum is that of aluminium, those being the two lines of aluminium I have before referred to. The next spectrum is that of iron, the next that of cobalt, and the next that of nickel. Now if you will look down these spectra, along those lines, you will find that in the case of each spectrum you have two lines coinciding with these excessively thick lines which you see at the top. Now that means, that in the specimens of iron, cobalt, and nickel which were photographed, a trace of aluminium was present; the trace being indicated by the extreme thinness of the line, in the case of the spectra in which it exists as an impurity, as opposed to the great thickness of the line where it exists as say ninety-nine parts in one hundred. What is true for aluminium is true also for other substances, and I might show you a great many other facts of exactly the same nature, in which you find that a particular substance indicated by a particular line really exists, in almost, I may say, every other chemical element of the same class, but at different degrees of molecular separation, or of different degrees of impurity, as determined by the thickness or the excessive thinness of the line due to that particular substance.

I have here a lamp so arranged that I hope to be able to show you the spectra of some alloys of magnesium prepared in this way. The magnesium has been alloyed with another substance, so that in some of the alloys we have a very large percentage of magnesium, whilst in others there is a very small percentage. In the first specimen we have ·01 per cent. of magnesium, and then I propose to show you a spectrum in which we have 10 per cent. of magnesium. If the experiment succeeds you will see exactly the kind of phenomenon the observation of which will be most valuable in this new quantitative spectrum analysis. In fact, it is a question not only of the disappearance of certain lines with the decrease of that particular constituent which gives the lines, but it is really a question of the length of the line. I am afraid I shall not be able to show you on the screen the length of the line, but I shall be satisfied if I can show you that in the two alloys, one containing ·01 per cent. of magnesium, and the other 10 per cent., there is a great difference in the magnesium lines. Afterwards I will show you two alloys of lead and zinc, beginning with ·1 per cent. of zinc and ending with 50 per cent. That is not a very delicate matter, and possibly I may not be able to show it on the screen, but on the wall are some diagrams which will show you that these gross quantities are by no means a measure of the quantities which quantitative analysis already enables us to lay hold of with some degree of accuracy and firmness. You now see on the screen a single line in the green due to ·01 per cent. of magnesium, and you notice how faint it is. If instead of looking at the screen, I could provide each of you with a spectroscrope you would see in this case the well-known triple line in the spectrum of magnesium reduced to one faint line; whereas, when there is 10 per cent., you would have seen all the lines of magnesium visible in the spectroscope, and an increase or decrease in the 10 per cent. would have lengthened or shortened the lines, according to the volatility of the substance with which the magnesium is mixed. We will now try the lead and zinc alloy, and here again you see there is a very sensible difference in the spectrum according to the proportion of the metals in the alloy. Of course, in the case of lead and magnesium, no one wants an alloy of these metals true to 1-10,000 part, and, therefore, if I were to make them nobody would be able to test them for me, and no one would care for them if they were true. But there are alloys used in the parts in which an accuracy to 1-10,000 is easily determined, and must be determined a great many hundred times a day. You will see, then, how beautifully this requirement of industry lends itself to a scientific investigation which otherwise would have been perfectly barren.

I need not tell you that in order to carry it out more precisely, it was necessary to take something which is known to be true to 1-10,000. Now that is the case with the gold and copper alloy used in the coinage. And here I must express my very great obligations, first to Mr. Fremantle, the Deputy Master of the Mint, who, the moment I told him what I wanted to do, gave me as many specimens as I wanted,—and also to Mr. Roberts, the Chemist of the Mint, who has joined me lately in a research which we have just communicated to the Royal Society; showing that the spectroscope is as competent to take up a difference of 1-10,000, as what is called the ordinary parting assay. That is just a preliminary laboratory experiment, and as such, I think it is rather remarkable.

I will tell you exactly what has been done in the case of the gold and copper alloy. In the first place, there is here a diagram showing the position of the gold, silver, and copper lines in a certain part of the spectrum. This region contains copper and gold lines, these lines being so close together that one can easily see them in the same field of view of a spectroscope telescope, like the one on the table. All we have to do in order to estimate the quantity of gold and copper in the alloy, is something like this. We have to determine upon some conditions which we will examine in each case. For instance, if the copper and gold lines visible in the gold and copper alloy were always of an equal height, as you see them in this diagram, and if the increase of any one constituent carried them up or down, then we should measure the longest of the lines, the going up of the lines meaning either the increase or decrease in the gold, and the going down of the lines meaning the increase or decrease of the copper. That brings out a vey beautiful physical fact in connection with these researches, viz., that the reason that the spectroscope is of any use at all is this. If you deal, say with the gold and copper alloy, about which one can speak with certainty, a difference of 1-10,000 either of the gold or copper makes that a different physical thing. Now among the different physical properties which that different physical thing has, is the property of volatility. If I add more copper the specimen is more volatile, and not only more volatile as a whole, but the copper becomes more volatile than the gold. If on the contrary, instead of adding 1-10,000 of copper I add 1-10,000 more gold, the thing is not

only less volatile as a whole, but the copper is less volatile than it was before, and the gold is more volatile than it was before; and so we can get any changes almost that we require, in the varying lengths and thicknesses of these lines, by changing the constitution of the alloy by 1-10,000. What we do is this. We choose a part of the two adjacent lines which is equally bright, or equally thick, as the case may be, and to a spectroscope like that, we add a micrometer eye piece, so that we can determine with the most rigorous accuracy, the position of that phenomenon in any particular specimen.

We then get a micrometer reading. Now here are micrometer readings for specimens of gold and copper, while the percentage composition of the copper and gold have varied from 900 in 10,000 in one specimen, to 922 in 10,000 in the other. As we start with 922 parts of gold, you see our micrometer reading is shorter, because that mixture is less volatile, and the lines therefore shorter. As we go on increasing the volatility of the mixture by adding more copper, instead of getting a reading of 200 for the particular thing which we observed in any particular series of observations, we get a reading of × 1,400 for a specimen the composition of which only varies ten ten-thousandths or 1-1,000 part from the first specimen which we used in that particular series. But you see that this series is rather rough—you begin with 900 and end with 922. Here is another series in which the coarseness is not so great; in fact all these differences represented by horizontal lines are differences of only 1-10,000, that is to say, you begin with 916·2 parts of gold, ascend with 916·3 and so on, until at the extreme term of these observations we get 916·7, that is to say, a difference of only five ten-thousandths. You will see that these observations, to a very large extent, follow this former curve, the curve deduced from observations of standards. I may tell you that if the diagram were perfectly correct it would show that in only one case did the spectroscopic assay make a mistake of ·0001; that is to say, apparently, and, in that particular instance, on re-assaying by the ordinary parting method, it was found that the ordinary assay was wrong, and that the spectroscope was right. But as you will see, the spectroscope knows nothing of these jumps; the spectroscope record is absolutely continuous. But the specimens which we can employ for comparing the spectroscopic results with the ordinary results, only read to 10,000th parts, and, therefore, a specimen which may be half way between ·0007 and ·0006 will have to be thrown to one or the other, and I should be very glad if a new parting assay could be got at which would give us the thing true, not to ·0001 but to ·00001, and then I think the results of the spectroscope would be very much more easily determined than they are at present.

Having shown you the spectra of the lead that zinc alloys on the screen. I will explain the precautions which are necessary in these observations. In order to get these exceedingly accurate quantitative determinations we have to be careful in our experiments.

One of the first things we have to do, and the most important, is to see that the striking distance between the specimens is absolutely the same in each case. In order to obtain this, all the specimens we wish to observe are placed in a wheel which is capable of being brought within the field of view of a powerful microscope. The apparatus is here. This wheel is capable of holding about 50 or 60 specimens. Each is in turn brought within the field of this microscope, and as it is brought within the field by means of an exceedingly fine screw, which gives us variations of 10,000th of an inch, all we have to do in order to analyse the gold and copper alloy—and the same thing applies to anything else—is simply by means of a micrometer in the observing telescope of the spectroscope, to measure the length of the line in the unknown mixture, and then by means of such curves as you see in this diagram, to determine in about five or ten seconds the quantitative analysis of a mixture of any two metals.

I will only detain you a few minutes longer, whilst I conclude my lecture by asking you to consider the extreme importance not only of the industrial applications of science, but of pure scientific investigations. If this question had not arisen as a mere matter of abstract inquiry, it is very difficult to say how in the world it could have arisen at all. The quantitative determination was not included in any way in Kirchhoff and Bunsen's hypothesis; so far, indeed, as they went, it would have remained qualitative merely to the end of the chapter; and unless some people more unwise than the rest of mankind, had gone in for what has been very disrespectfully—I think you will agree with me—called "the hydrogen in the sun business," we should never have had the least possible indication of this quantitative spectrum analysis. I hope you will think that in both cases I have proved my points, that in the connection between photography and spectroscopy we have the greatest possible proof, not only of the extreme benefit which comes from a combination of two different lines of science, or if you will allow me to put it so, two different arts, to two abstract sciences. And I think you will agree with me also that in the case of the application of the abstract ideas of spectrum analysis to the arts, we have not only a promise rich so far as the arts are concerned, but, what is very much more precious to a man of science, a promise of rich results in the science itself. For, depend upon it, that as photography has enriched, to an enormous extent, the field of chemistry, in its artistic development, so will spectroscopy, the moment it becomes the daily work of iron founders, and miners, and the like, be found to be bristling with beautiful scientific truths in every part of the spectrum which is used in these practical applications of the science of optics.

A cordial vote of thanks was awarded to Mr. Lockyer at the conclusion of the lecture, on the motion of the chairman, the **Rev. Arthur Rigg, M.A.**

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

HOCK'S PETROLEUM MOTOR.

The Schottenring Iron and Machine Company (Vienna) exhibit a novelty in prime-motors, namely, the Petroleum Engine, No. 6,038, of Mr. Julius Hock, a Viennese engineer; which is a noteworthy departure from all precedent, inasmuch as the fuel is "combusted" directly within the working or power cylinder, and the power generated is a peculiar and ingenious combination of suction, atmospheric pressure, explosive or expansive force, and *vis viva*, whereby is attained the combination and realisation of two long-sought aims, namely, the utilisation of the force of explosion for the generation of power in a prime-motor, and the utilisation of the liquid hydrocarbons as fuel and power-generators.

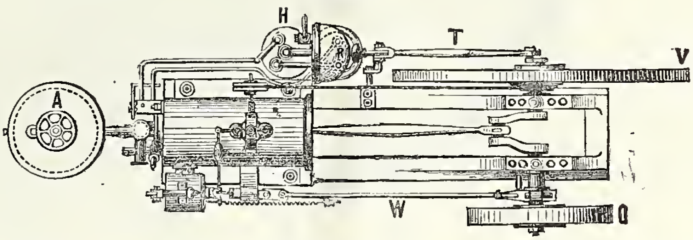
The efforts which have hitherto been made to employ these hydrocarbons, such as petroleum, &c., have taken the direction of its use as an indirect agent, subserving merely the purpose of evaporating water in a boiler into steam, whereof the expansive power supplies the initial force required. In some cases boilers have been fitted with appliances for simply distributing petroleum, in a liquid state, over and among the ordinary fuel used for firing purposes: in a more advanced stage, combustion, having been initiated in the boiler-furnace in the ordinary way, by fuel on the fire-bars, is maintained by supplies of liquid hydrocarbon, forced into the fire-chamber by means of a steam injector, so that it enters

as spray, in a finely subdivided state, favourable for rapid ignition and perfect combustion: in another system, adopting the process of generating an air-gas, by forcing atmospheric air through petroleum or other liquid hydrocarbon in a tank—as commonly practised for illuminating purposes—such air-gas is conveyed to a series of perforated pipes, or burners, placed within the horizontal tubes of a tubular boiler, and by inflaming the issuing gas-jets supplies the heat necessary to evaporate the water in the boiler into steam.

Something of these principles, differently applied, may be seen in Hock's petroleum prime-motor, under consideration, which is thoroughly illustrated "*en gros et en détail*" in the accompanying engravings. Liquid hydrocarbon, in small quantities, is injected by atmospheric pressure, not by steam, not into a fire-box but directly into a cylinder, which becomes the combustion chamber; issuing in the usual form it is at once distributed and divided by an atmospheric jet, serving the double purpose of dispersing and partly vaporising it in the form of spray, and of partially diluting it with a small admixture of air, which is a constant quantity; further atmospheric diluent is supplied through an air-chest, suitably provided with valves, and connected with a variable governor-mechanism, whereby the admission of this portion of the air applied to the work-cylinder may be regulated and varied in an ascending scale, from *nil* to a maximum. But the formation and use of quasi-air-gas does not end here; it is also made independently in a separate apparatus connected with the engine, in order to supply the means of ignition for the gaseous explosive in the cylinder, by means of one permanent flame and one intermittent gas or flame-jet, projected at regular intervals into the cylinder, generating an intermittent series of small explosions, the variable effect and power of which, acting on a suitable piston and rod, connecting-rod, and cranked axle, are absorbed, distributed, equalised, and given out by the ordinary agency of a heavy fly-wheel, belt-pulley, &c.

It will thus be seen that this prime-motor may be regarded as composed of three distinct apparatus, duly and suitably connected and associated together, whereof the engine is the chief, the others being the gas-generator and the receptacle for petroleum. The small plan, shown in Fig. 1, illustrates the general arrangement and relative position of the parts, which are also

Fig. 1.



shown, on a somewhat larger scale, in the side elevation, Fig. 2, and in the end elevation, Fig. 3. The engine is carried on an ordinary cast-iron bed-framing, to which are bolted down the cylinder and the brackets carrying the bearings of the crankshank, fly-wheel V, and driving pully O; upon the shaft is also fitted an eccentric with rod and buffer T, striking upon a hemispherical caoutchouc disc R, acting as an intermittent air-pump, and connected by pipes with the apparatus for generating air-gas, H, which is placed independently on one side of and adjacent to the frame. The engine is also fitted with a governing and regulating mechanism, comprising mainly two parts; the customary governor balls and connections *f f*, driven by belt from a pulley on the crank-shaft adjoining the fly-wheel; and a valve-box X, attached to one side of the cylinder, with spring and rod W W, and actuated by an eccentric on the other end of the crank-shaft, close to the driving pulley; a second eccentric works a cold-water pump U, whereby water is supplied continuously for cooling the cylinder, so that its temperature may not exceed a certain prescribed limit.

The controlling and regulating mechanism of the engine is represented in detail, on an enlarged scale, in Fig. 4. Herein X is the air-chest, or valve-cylinder, fitted with an inlet-valve *b* for air, and an outlet-valve *c* for the exhaust of the combustion products in the work-cylinder, the latter being alternately opened and closed, at suitably regulated intervals, by means of the eccentric-rod W, and the coiled spring W′. The air-induction valve *b* is held in a partially open position, forming a variable opening, which is enlarged or contracted by the action of the governor-balls *f f*. A bent lever R″, pivoting on a bearing affixed on the top of the valve-chest X, is attached at its opposite extremity to the valve *b*; at the intermediate elbow it is connected to the end of an adjustable hollow arm or lever *d′*, the prolongation of which is by a screwed spindle *e*, with nuts, passing through a collar in a sl rt arm *g*, carried on a spindle at the other end whereof is an opposite lever-arm *g′*, attached to the governor axis, and rising and falling with the governors in the usual way. The screwed spindle *e* passes down into the hollow arm *d′*, and terminates in an abutment plate serving to compress the spiral spring *d*; the initial tension of this spring is set and regulated by the screw-nut on *e* against the collar *g*, serving thereby to adjust the valve *b* to its normal position. The products of the combustion and explosion of the petroleum explosive mixture in the work-cylinder, escaping from in front of the piston on its return stroke, are exhausted through the valve *c* into a bent elbow and stove pipe, shown in the side and end elevations, Figs. 2 and 3, and these gaseous products, stated to consist of carbonic acid gas and steam, mingled with certain empyreumatic gases, may thereby be conveyed away to the chimney outlet, or otherwise subsequently utilised for warming purposes, as they escape at a very high temperature.

In Fig. 5 are shown the inflaming and gas-generating apparatus. The object here is to have one continuous current of air-gas, maintaining a permanent flame, and one intermittent current, maintaining a continuous and regular series of puffs or jets of air-gas, which, being inflamed by passing through the permanent flame, form jets of flame injected into the work-cylinder to ignite and explode the petroleum spray therein, and this is attained by the following devices:—A special hydrocarbon fluid I, such as naphtha, with a specific gravity of 0·69, is stored in a receptacle or cistern H, fitted with an air-tight cover, provided with two outlet cocks, and an inlet pipe P dipping down to the bottom, P being in communication with the india-rubber hemisphere R, which is attached to a circular iron disc, fitted with an inlet valve S and a cock Q. By the action of the eccentric rod and buffer-head T striking against the elastic hemisphere this latter is alternately compressed and ex-

panded, drawing in air by suction through the valve S, and forcing it through the pipe P into the gas-generator H, wherein, bubbling up through the liquid hydrocarbon, it volatilises it, and forms an air-gas in the upper part of the receptacle. The inflammable medium so generated passes off by two outlets, whereof one conducts it through a pipe and inlet K into a small telescopic gas-holder M, in a suitable case L, sealed with water, whence through another pipe N it is conxeyed to a burner N′, affixed to the cover at the end of the work-cylinder, and provided with a shield or guard-plate N″ between the cylinder and the flame. This being ignited burns continuously,

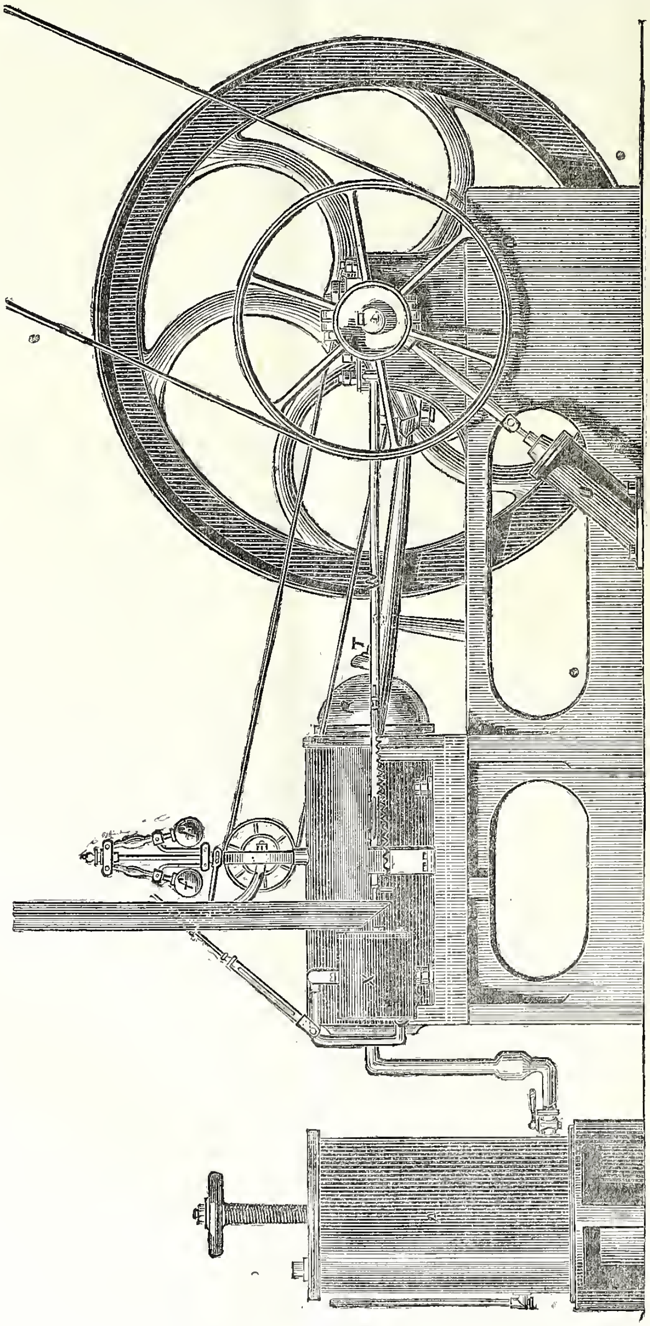
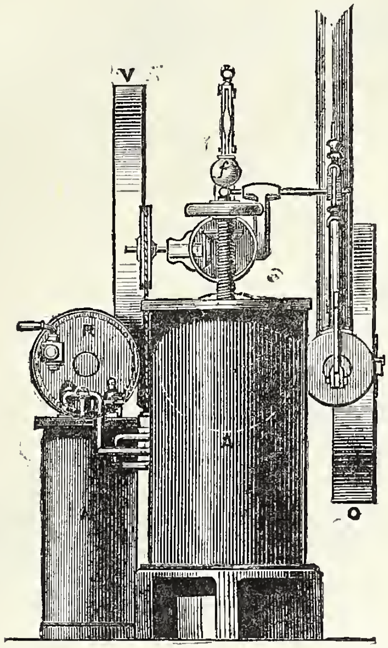


Fig. 2

and inflames the other current of inflammable gas which is throttled and conducted by the pipe J′ from the generator H direct to a burner or injector J, whence, at every impulse communicated by the buffer and air-pump, R, T, it issues in jets, igniting at the flame N′, and thus projecting a succession of flame jets into the work-cylinder through the small inlet valve shown. It will be understood that these impulses will cease the moment the inlet valve Q is opened, rendering the expansion and compression of the elastic medium ineffec-

tive; similarly it may be noted that by means of a variable eccentric (such as Chapman's), the magnitude and power of the puffs or jets of air and flame may be suitably regulated to a nicety. As regards their suitable coincidence or alternations with the strokes of the piston,

Fig. 3.



that is secured at the proper and necessary intervals by means of the relative positions of the crank and eccentric upon the driving shaft.

The third part of this machine is that connected with the supply and automatic feed of the liquid hydrocarbon fuel, petroleum, to the combustion cylinder, where it is exploded, and does its work. This mechanism is shown in enlarged sectional detail at Fig. 6. Placed on a small raised stand is the petroleum recipient A (appearing also in the views Figs. 2 and 3), which is filled with the liquid D, and is provided with a glass indicator-guage A′. Passing downward into the fluid is a metallic plunger B, carried by a screw and handwheel C, passing through the cover of the tank A. The surface of the petroleum within the cistern is open to the pressure of the external atmosphere, and its level may be regulated by the hand-wheel and plunger, the effect whereof is, within certain limits, to influence and vary the power and work of the engine, somewhat similar to the variable expansion gear of an ordinary steam-engine. With a low surface level of petroleum in the recipient the consumption is less, and the power given out and work done are consequently diminished. When the petroleum surface stands high, the greater is the consumption of the fuel, and the power and work are correspondingly increased.

At the bottom of the cistern or receptacle for petroleum, and on the side adjoining the cylinder, is fixed a cock B′, commanding the pipe E, connected with the nozzle or injector E, whereby the petroleum, by the force of atmospheric pressure, is injected into the cylinder. But in the cylinder cover, immediately below the petroleum nozzle E, there is an air-nozzle F, with valve F′, whereby a jet of air enters simultaneously with the petroleum jet, and disperses it in the form of spray D′, in a finely-divided, partly-volatilised condition. The cock B′ must obviously be open for fuel to be consumed and work to be done, and the engine is brought to an immediate stand-still by closing it. A back check-valve E′ is fitted in the rising feed-pipe E, in order to prevent the reflux of the petroleum into the cistern, and keep the pipe constantly full.

The cylinder and cover Z, Z,, as shown in section in connection herewith, form, as will be seen, a double hollow casing, with a space Z, entirely surrounding the piston, so that a continuous supply of cold water from the pump U (Fig. 2) circulates around it, acting as a refrigerating jacket, and lowering the temperature, so as to avoid overheating.

Fig. 4.

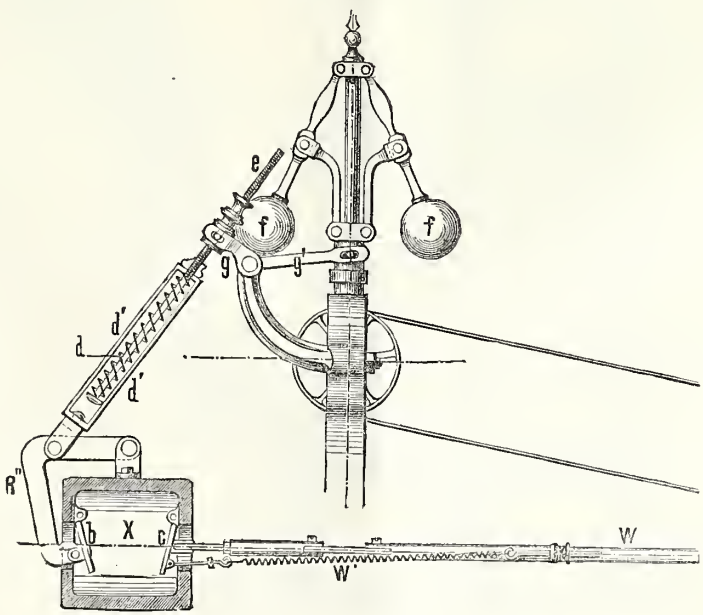
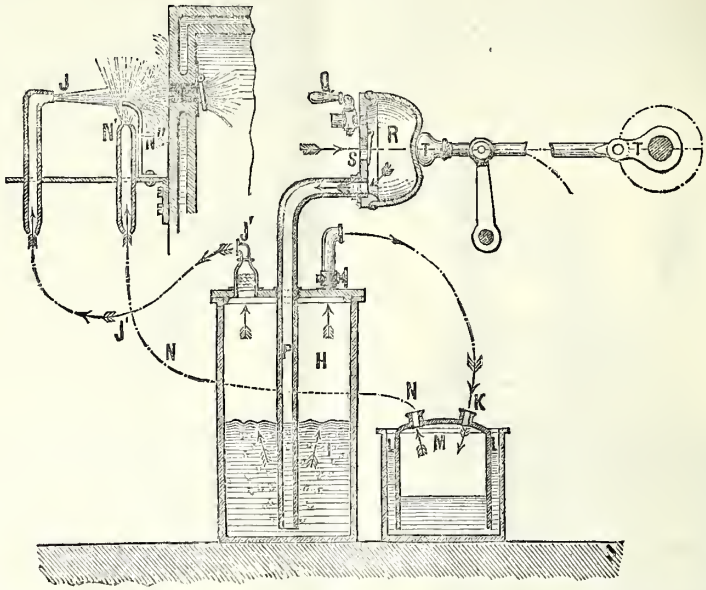
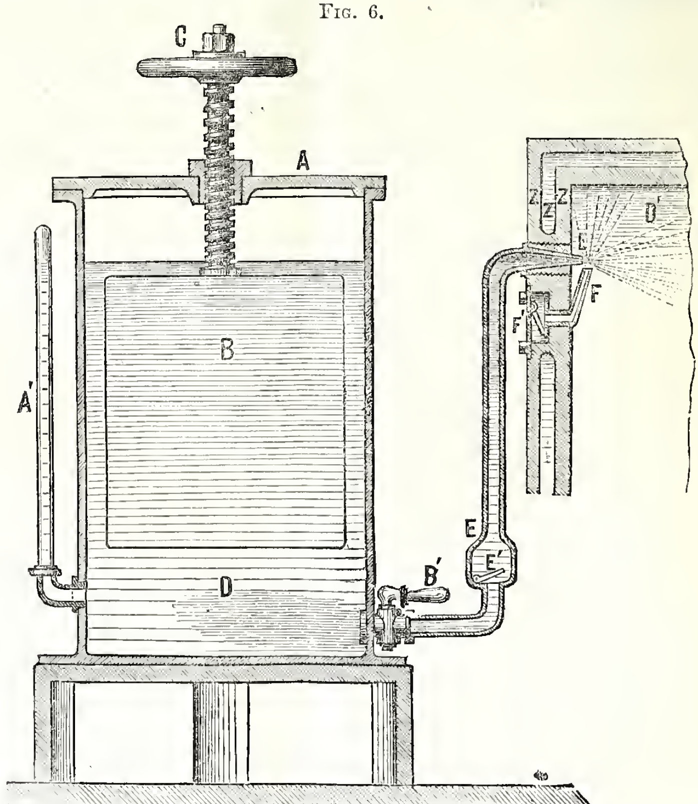


Fig. 5.



The simple preliminaries necessary for setting the engine in motion are then as follows: the closing of the cock Q attached to the india-rubber aspirator, the opening of the cock B′ attached to the petroleum recipient, and of the cocks commanding the gas-pipes of the nozzles J and N′, and the preparatory ignition of the flame N′. Then, as the fly-wheel revolves, causing the piston to leave the end-cover of the cylinder, on its forward stroke, which tends to leave a vacuum behind, but for the effect of the suction in producing an inject of liquid petroleum at E, and of air at F, dispersing the petroleum and mingling it with the air also

Fig. 6.



admitted through valve-box, by V: thus, when the piston has completed about one-fourth of its forward stroke, the cylinder-space behind it is filled with an inflammable and explosive gaseous mixture of air, petroleum spray, and petroleum vapour. At this juncture the buffer-head is made to strike the caoutchouc hemisphere, whereby a jet of air is driven into the gas-generator, communicating the impulse to the air-gas and expelling it forcibly at the nozzle J, so that it is injected into the cylinder, igniting by its passage through the fixed flame. Thereupon the contents of the cylinder are inflamed and exploded, at a high temperature and with great pressure; the shock closes all the inlet valves, and concentrates its effect on the piston, the outlet of least resistance, just as the powder-charge in a gun acts on the projectile, driving it forward to the end of its stroke, coincidently wherewith the exhaust valve is opened by its eccentric, and the contents of the cylinder escape rapidly from in front of the returning piston, brought back by the continued revolution of the flywheel, whereby its return stroke is completed, and the cycle of effects recommences, generating continuous power and motion.

This prime-motor is, therefore, independent of all supplies of ordinary gas—not always available—of ordinary fuel, or water, for evaporating purposes, and the generation of steam; and substitutes therefore, as a motive power, the combustion and explosion within a confined chamber, of comparatively small, well-defined, but variable quantities of petroleum, partly liquid and partly gaseous, finely dispersed and commingled with a definite but variable quantity of atmospheric air; the ignition taking place by means of a temporary current of compressed gas, inflamed, generated, and produced by the engine itself; and the effect being absorbed, and the work developed by the explosion, being taken up by a receptor or piston, which transmits the power through mechanism of a common type. It is, in this case, a horizontal single action engine, but may also be made vertical and double-acting. The engine has been devised and introduced as a moving power suitable for small industries, compact and simple in construction. It consumes a quarter of a gallon of petroleum per horse-power per hour. As an example of its use, it may be noted that the Viennese Imperial Printing Establishment have employed one of them for several months past.

MILITARY AERONAUTICS.

The recent Government experiments in ballooning being the first in which any official recognition has been made of the attempts of aeronauts, considerable interest attaches to them; and though the results are as yet merely negative, yet they serve to confirm what has all along been urged by those who have investigated the subject impartially, and so are of considerable value. The following account is condensed from the *Times*:—

The balloon ascent for experimental purposes from the Royal Arsenal, Woolwich, was made on Saturday afternoon, under very favourable circumstances. The strong westerly winds which prevailed for some days previously, and rendered an ascent for the purposes in view out of the question, had quite abated, and there was almost a dead calm, the best possible condition under which the trial could be made. The apparatus to be tested was the invention of Mr. Bowdler, who hoped by its means to steer the balloon in the air at an angle by deviation more or less deflecting from the direction of the wind. The value of such a discovery in a military point of view may be estimated by the fact that it would enable a general to communicate with his friends in a beleaguered town by a careful calculation of distances, force of wind, and the deflecting power of his machinery. In the late European war any method of ascending in a balloon with a certainty of striking a given town, such as Paris or Metz, would have been invaluable. For this reason Mr. Coxwell, placed his balloon at the service of Mr. Bowdler, and when the Government were applied to for assistance and official recognition of the experiment, permission was readily given to inflate the balloon at the gasworks in the Royal Arsenal, and Major Beaumont, M.P., of the Royal Engineers, the President of the Army Balloon Committee, was appointed to represent the War Office. Major Beaumont has made numerous ascents, several of which have been with Mr. Coxwell, and he has even extended his experience to the use of ballooning in actual warfare, having witnessed from a balloon a battle before Richmond during the Civil War in America. The balloon used on Saturday was a nearly new one, in which Mr. Coxwell has made but three previous ascents. Its height, independent of the car, is 80ft., and it contained, when inflated, 60,000ft. of gas. At 3 o'clock, the hour fixed for the experiments, the balloon was fully inflated. The four passengers in the balloon were Mr. Coxwell, Mr. Bowdler, Major Beaumont, R.E., and Sergeant T. Murray, R.E., to assist in working the steering gear, which was fixed to the car in a few minutes. A tall frame of wood was lashed inside, containing a few small cog wheels and a common crank handle, while outside and above the car were fixed in connection with it two screw propellers, precisely similar to the screws of a ship, and made apparently of tin or zinc. The apparatus was 3 ft. in diameter, and its rate of motion was 12 or 14 revolutions per second. The second screw in Mr. Bowdler's apparatus was fixed vertically just below the other, and with this he designed to raise or depress the balloon, and it was decided to test this first. Major Beaumont, mounted in the rigging, took command; and Mr. Coxwell, by a careful expenditure of ballast, got his balloon, which was held captive by a guy rope, to a nice balance about 20ft. from the ground. The Major gave the order, and the inventor and his soldier-assistant, Sergeant Murray, worked vigorously at the crank, while the vertical fan spun round, but no other effect was produced, the balloon neither rising nor falling, to all appearance, a single inch. Mr. Bowdler, somewhat disappointed, confessed that his contrivance had not shown the power he expected; but it being suggested that possibly he had turned the handle the wrong way, another trial was decided upon. The balloon was brought to a balance again—this time close to the ground; and when the machinery was set to work it slowly but surely began to rise, and rose until it was checked by the rope about 40 ft. from the ground. As soon as the crank ceased to work, the balloon began to descend, which it continued to do till it reached the earth, which was even more convincing. Mr. Coxwell was satisfied that the screw had lifted the balloon, but the Government representative was not so sure, and ordered the experiment to be repeated, which was done several times, and always with the same result. The balloon rose when the fan was at work, sometimes very slowly, but it always came down when the machinery stopped. The order was next given to release the balloon, in order to test the propeller in the higher air. It ascended almost perpendicularly—Major Beaumont in the shrouds, and Mr. Coxwell standing on the edge of the car. The spectators below were unable to ascertain what effect the apparatus had, as the balloon soon attained a considerable altitude and altogether disappeared in the clouds. It appears, however, that after ascending about 1,000ft., the steering apparatus was tried, but no effect on the course of the balloon was apparent. The aeronauts could make the balloon revolve either to the right or to the left, according to the way in which a fan was worked. In the opinion, however, of the Government officer the apparatus quite failed to attain its original object. After a low dip over the Essex marshes by letting out gas, and a repetition of the trial without success, the ballast was discharged, and the balloon ascended an altitude of two miles. They subsequently opened the

valve, and dropped down, alighting safely, at 7 o'clock, on the farm of Mr. Morris, at Cray's-hill, nine miles from Romford.

COAL AT THE VIENNA EXHIBITION.

An interesting report by M. J. Pechar and Dr. Pecz, has recently been published in a series of official reports on the Vienna Exhibition. After pointing out the extensive application of coal by remarking that in the entire exhibition there was scarcely an industrial exhibit in the production of which coal in one form or another has not been employed, for in what business does not heat, light, and machine power hold the first place; and reminding us of the various arts and manufactures in which it is employed, it is observed that the importance of coal, so far as we are concerned, is immeasurable, since it has made modern Europe what it is to-day—the industrial workshop of the world. The coal exhibits of the Prater were but representative specimens of the seams and of the colliery interests of the countries whence they came, yet they form the basis of much useful study. The progress and changes which have taken place in the technology of coal since 1867 is carefully pointed out. Galibert's apparatus for entering mines when filled with foul gases, the various coal-cutting machines of Firth, Brown, Simpson, and others being fully referred to. It appears that the coal production of the whole world in 1872 amounted to 256,275,284 metrical tons (the metrical ton being 366 lbs. lighter than the English, and 4 lbs. heavier than the American ton), nearly half of which was raised in England, one-sixth in Germany, one-sixth in the United States; France, Belgium, Austria, and other countries following for smaller quantities. The subjoined table will prove of general interest:—

	Production in 1872.	Percentage of total Production.	Population of each Country.	Production per head of population.
	Metrical tons.			Metrical lbs.
England............ ..	125,473,273	48·96	31,817,108	7887·15
Germany	42,324,469	16·52	41,058,139	2061·68
United States	41,491,135	16·19	38,650,000	2147·02
France	15,900,000	6·20	36,469,875	871·95
Belgium..............	15,658,948	6·11	5,087,105	6156·33
Austria	10,443,998	4·07	35,904,435	581·76
Russia	1,097,832	0·43	82,172,022	26·72
Australia	942,510	0·37	1,958,650	962·40
Other Countries ...	2,943,659	1·15	260,810,980	22·57

Of the 125,473,273 tons of coal raised in England, this report states that 40,600,000 tons are consumed by the iron trade, 27,400,000 in manufactures, 20,500,000 for domestic purposes, 8,000,000 for gas and water works, 8,000,000 for mining, 3,600,000 for steam navigation, 2,200,000 for railways, 900,000 for copper melting, 900,000 in sundry industries, and 13,200,000 tons (or over $10\frac{1}{2}$ per cent.) are exported. The particulars relative to Germany, France, United States, British Colonies, &c., are equally interesting, and the report is altogether an exceedingly valuable one, and will long be useful to refer to for any fact, whether historical or statistical, connected with the coal industries.

OBITUARY.

Mr. John Grantham.—The death of this well-known engineer took place on the 10th inst. Mr. Grantham commenced his career in an engineering establishment in Liverpool, where he afterwards practised in constructing iron ships, one of them, the *Sarah Sands*, which was designed and carried out under his directions, being then the largest sea-going iron vessel afloat. He was engaged in many large engineering works in the North of England, and was surveyor of steam vessels under the Board of Trade. He subsequently left Liverpool and practised in London, where he was largely engaged in constructing iron vessels, and in references relating to shipbuilding and arbitrations connected with wrecks and shipping accidents. For the last four years he was very much occupied in maturing and perfecting his steam car for tramways, and at the time of his death he was occupied in carrying out a long series of experiments with regard to its working. So far as the invention has been carried out, it offers every prospect of success, and it has obtained the approval of the large number of practical engineers and others who have assisted at the various tests to which it has been put. It must be a source of sincere regret, not only to the friends of Mr. Grantham, but to all who are interested in the promotion of so important a scheme that the inventor should have been taken away just at the period when he might have hoped to have reaped the reward of his labours and anxieties. He was a member of the Council of the Institute of Naval Architects from its commencement, and he contributed several papers to the proceedings of that body, as well as to the Institution of Civil Engineers. He also published a large treatise on iron ship-builing, which is a standard work on that subject. He became a member of the Society of Arts in 1859.

GENERAL NOTES.

Railway Improvements.—The Underground Railway conveys forty-five millions of passengers annually, traversing a line of eleven miles *en route*, and stopping 21 times in the course of 55 minutes. Those who travel by the subterranean road (and their name is legion) have frequently complained of the sulphurous smell, especially between Gower-street and Portland-road. The smell is very offensive, and the directors are ever ready to get rid of it if they can by any means combine economy with safety. The tube of the Pneumatic Despatch Company, which conveys the mails between the Euston Terminus and the General Post-office, runs over the tunnel of the Underground between Tottenham-court-road and Hampstead-road, and it struck Mr. Aird, jun., director of the Pneumatic Company, and Mr. Tomlinsone, jun., resident engineer of the Metropolitan Railway, that some means might be devised by which, without injury to either undertaking, one might be made to subserve the other. Mr. De Wilde, resident engineer of the Pneumatic Company, was taken into the conference, and the result is that self-acting valves have been opened in the tube over the tunnel between Gower-street and Portland-road, by which the foul air collected underneath is sucked upwards and utilised in air as a propelling power of the carrier, which sweeps on with the letter bags from one extremity to tho other. The ventilation in this manner is said to be greatly improved at the point where it needed most improvement. So strong was the current of absorption in the valve in the roof that newspapers let loose were drawn quickly upwards, and so clear comparatively was the atmosphere that one could see to a considerable distance.

Patent Laws.—In the House of Commons, on Tuesday the 21st instant, Mr. Crawley asked the Home Secretary whether her Majesty's Government were prepared to carry out such recommendations of the Committee on the Patent Laws, contained in their Report of 1872, as could be adopted without further legislative powers; and whether he would introduce in the next Session of Parliament a Bill for further amending the Patent Laws in accordance with the recommendations of the Committee. Mr. Cross replied that in the opinion of her Majesty's Government it was better to deal with this matter, not piecemeal, hut altogether; and that it was their intention to consider it fully during the recess, with a view to legislation next year.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,133. Vol. XXII.

FRIDAY, AUGUST 7, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

GENERAL EXAMINATIONS, 1875.

The Programme is now in preparation, and will shortly be published. "English History" and "Logic" will be discontinued; and the general subject of "Gardening" will be substituted for the two subjects of "Floriculture" and "Fruit and Vegetable Culture." A new subject, to be called "Trade History and Geography," will be added to the Programme, which in other respects will be similar to that for the present year.

TECHNOLOGICAL EXAMINATIONS.

The programme for these Examinations is in preparation, and will shortly be issued. It will include the nine subjects of last year, viz., Cotton Manufacture, Silk Manufacture, Paper Manufacture, Steel Manufacture, Carriage Building, Cloth Manufacture, Glass-making, Pottery and Porcelain, and the Manufacture of Gas, with the addition of four new subjects, viz., Agriculture, Silk and Woollen Dyeing, Calico Bleaching, Dyeing, and Printing, and Alkali Manufacture.

IMPROVED RAILWAY LAMP.

The Society's Gold Medal, or Twenty Guineas, is offered for an improved lamp or means of illumination, suitable for railway passenger-carriages, that shall produce a good, clear, steady, durable, and safe light.

It must be simple in construction, and capable of being readily cleaned and repaired.

In judging the merits, cost will be taken into consideration.

Specimens, in a condition suitable for trial, to be sent in to the Society's House not later than the 1st of November, 1874.

The Council reserve to themselves the right of withholding the medal or premium offered, if, in the opinion of the judges, none of the articles sent in competition are deserving of reward.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

PRIME MOTORS AT THE INTERNATIONAL EXHIBITION.

In pursuance of precedent, as established at the previous Annual International Exhibitions since 1871, the Commissioners have had placed at their disposal, by the manufacturers and exhibitors, several steam engines, boilers, &c., as sources of the motive power whereby all the machinery in motion in the Western Galleries is driven. These are five in number, located in separate pavilions or annexes attached to the several rooms; and, as might be expected, are characterised by certain specialities, novel and ingenious features of construction and appliances, which merit particular notice and description.

No. 7,001. Messrs. Barrows and Stewart have a good example of a twelve-horse power double cylinder semi-portable steam-engine, attached to Room I. The characteristic features of this engine are that it has a continuous barrel boiler, and that the cylinders, which are steam-jacketed, are placed over the smoke-box end of the boiler, the crank-shaft and driving-wheel being over the fire-box end, contrary to the usual custom, the positions being reversed in ordinary engines of the portable and semi-portable class (as may be seen at Nos. 7,011 and 7,017, Rooms II. and IV.). This engine is only fitted with the ordinary governors and valve gear, but by way of provision for heating the feed-water for the boiler, the feed-water pump is located underneath one of the steam cylinders and enclosed in the steam-jacket; its piston rod is worked by the same crosshead and slides as the steam piston above it, and it makes therefore exactly the same strokes—a somewhat unusual arrangement. In other respects the mechanical arrangements and construction present nothing remarkable.

No. 7,011. Messrs. Robey and Co. have also an excellent twelve-horse power double cylinder steam-engine, semi-portable; which has the cylinders located over the fire-box end of the boiler, the crank and fly-wheel being at the smoke-box or chimney-end. The speciality of this engine is that it is provided with a fire-box made particularly large and capacious, in order that it may be adapted for burning sawdust and other refuse from wood-working machinery, as fuel; the machinery in Room III., driven by this engine, comprises a complete selection of wood-working machines, to which a prime motor so adapted is specially appropriate. In other respects this engine is of ordinary design and construction.

No. 7,018. Messrs. Tangye Bros. and Holman provide the engine attached to the machinery in Room II. (Fig. 1.) This is a twelve-horse power, fixed, horizontal, high-pressure, expansive steam-engine of a special type, fitted with steam-jacket to the cylinder, patent high-speed governor, and variable expansion gear. The working parts are simple and few in number: the chief casting for the bed-plate comprises also, at tho one end, the crank-shaft plummer-block, and at the other, the front cylinder-cover, with the crosshead guides intermediate, all in one casting, conducing to great rigidity, diminution of strain, freedom from vibration, and special smoothness of working: the cylinder, with its valve-chest and steam-jacket, is bolted on to the cover at the end of the bedplate: special devices for adjustment at the connecting-rod ends and crosshead slippers provide a means of taking up all wear: all the parts are made to Whitworth gauges. The governor i of a special kind, sensitive, simple, and compact, com-

bining in small space a governor, throttle-valve, and stop-valve complete (Fig. 2.) It is driven at a high speed, and is therefore very susceptible, so as to render the working of the engine uniform, under sudden differences of load, or variations of steam pressure: the throttle-valve is nearly steam balanced, having at the bottom an excess area, equivalent only to the small valve-rod, sufficient for the weight of the valve to be balanced by steam-pressure, diminishing wear at the coupling; the steam-port is fully open when the balls are in their lowest position, but as the balls expand or rise with an increase of speed, they depress the throttle-

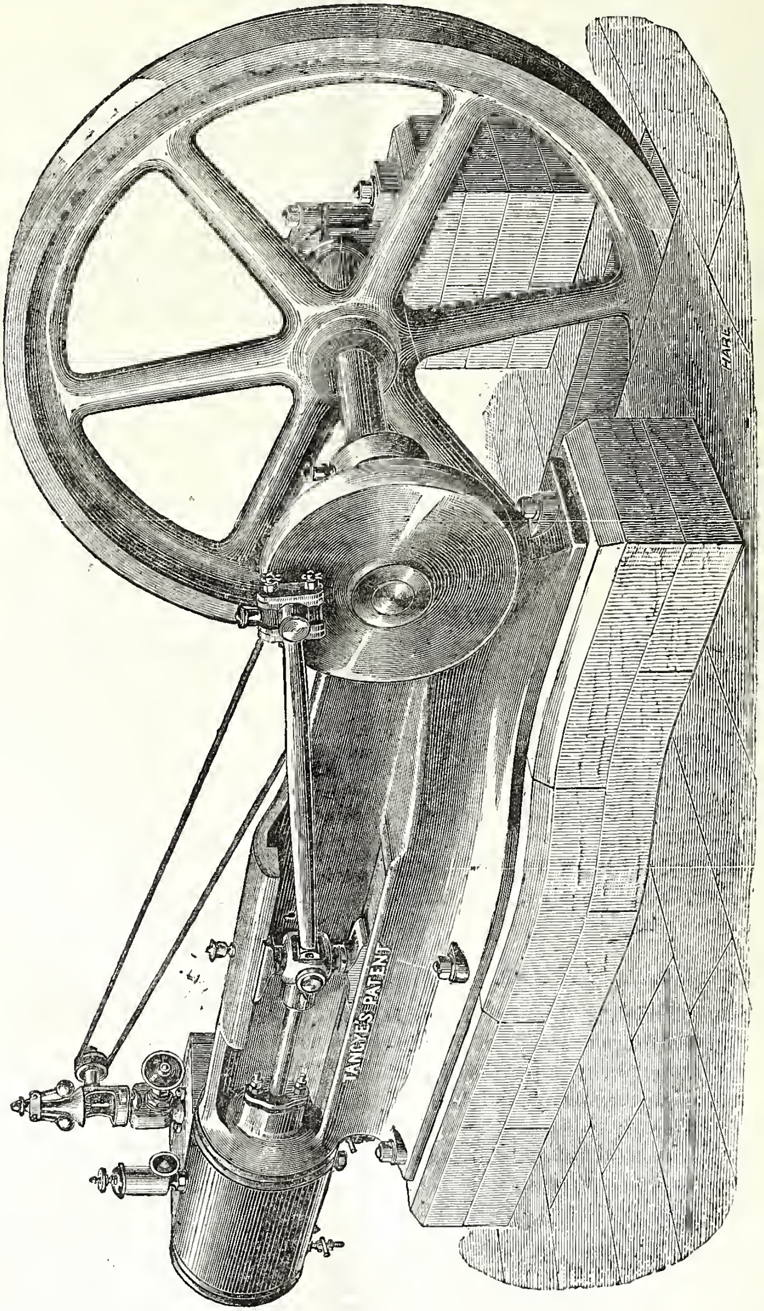


Fig. 1

valve and contract the steam-ports. The engine is speeded by a regulating arrangement, which determines at what speed, or number of revolutions per minute, the controlling action of the governor shall come into operation; for this purpose an internal spiral spring is affixed to the upper part of the governor, so as to press a sliding collar against the internal lever-ends of the arms, and the extent and force of such pressure is regulated and determined by means of a gun-metal stop-nut at the top; by loosening the nut the load on the balls is

diminished, whereby they will begin to control the engine at a lower speed; by tightening the nut the load is increased, and a higher speed must be attained to render the balls operative. The variable expansion is attained by making the eccentric-rod in two parts, with a socket-joint, screw-nut, and index, operating by means of right and left handed screws to open or contract the slide-valve. The dimensions of the engine are 12-in. cylinder and 2-ft. stroke; normal speed 60 revolutions, *i.e.* 240 feet per minute, with cut-off at half-stroke, and boiler-pressure 50 lbs. per square inch, the indicated horse power is 34½. The Grand Medal for progress was awarded to the firm, for this class of engine, at the Vienna Exhibition last year.

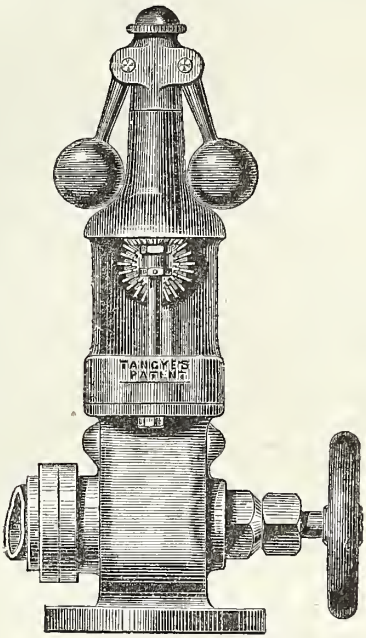
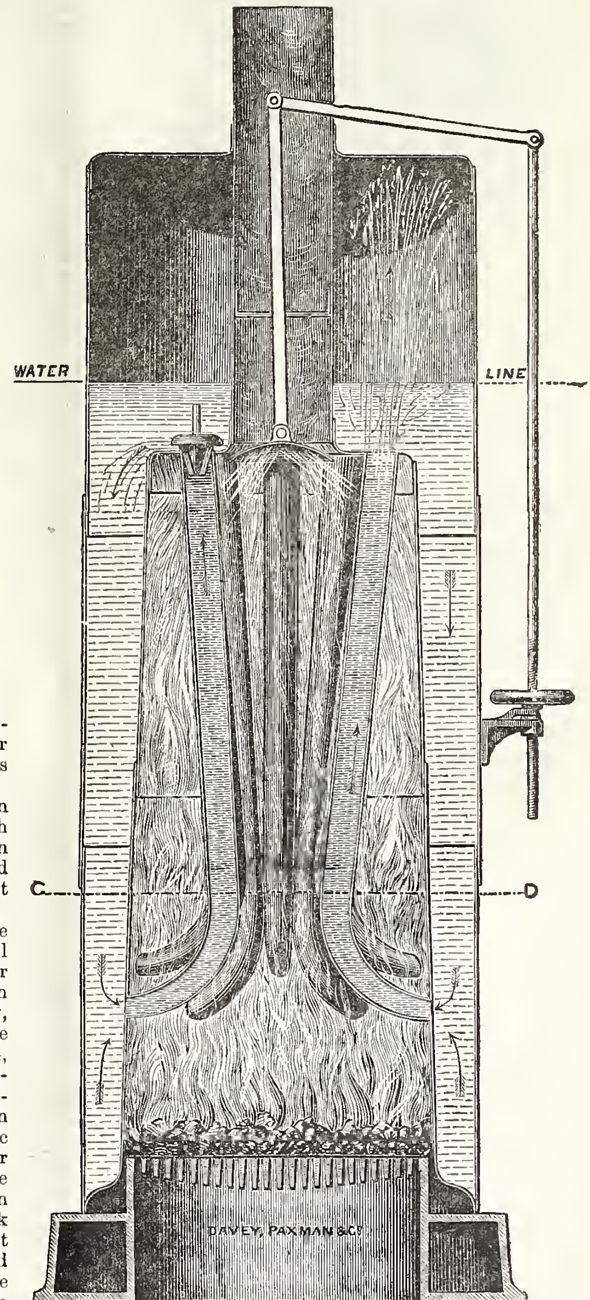


Fig. 2.

Steam is supplied to the Tangye engine by an independent Davey-Paxman vertical boiler, which is also of a special patented construction, as shown in section in the engraving, Fig. 3, and described in the following notice of the vertical engine lent and exhibited by the same firm.

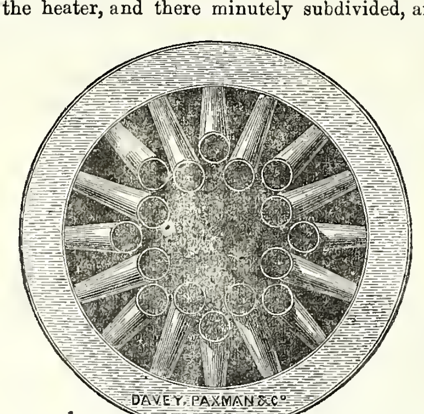
No. 7016. Messrs. Davey, Paxman, and Co. have attached to Room V. a ten-horse-power vertical engine and boiler, fitted with patent feed-water heater. The boiler stands upon a strong cast-iron bed-plate or foundation, forming a feed-water tank, and the engine is bolted on to the outside of the boiler, which is shown in section in Figs. 3 and 4, whereof the chief speciality consists in the Davey-Paxman patent bent taper water tubes and deflectors. As will be seen, this boiler consists of an outer cylindrical shell, and an inner concentric fire-box, wherein are a number of vertical taper tubes, with curved lower ends, opening into the shell of the fire-box below, and into its crown plate above; these water tubes promote a brisk circulation of the water in the boiler, and prevent incrustation; and in order to divert the upward flow at the water surface, and prevent priming, the orifices in the crown plate have deflectors fitted to them, as shown. The flue-opening in the crown plate at the top of the fire-box is also fitted with a baffle-plate or damper, which can be regulated by suitable hand-wheel and levers. The heating surface and brisk circulation obtained by the tubes promote economy of fuel and a high evaporative power, and by increasing the number of tubes additional heating surface may be obtained, if requisite, for rendering the boiler suitable and available for the consumption of wood, sawdust, or similar waste materials for fuel; for the prevention of risk of accident by the water becoming low the boiler is provided with a fusible plug. The engine is fitted with patent governors, apparatus for re-



SECTIONAL ELEVATION
DAVEY PAXMAN BOILER

Fig. 3.

versing the motion, &c. The patent feed-water heater consists of an air-vessel, perforated diaphragm, and receptacle; the feed-water and exhaust steam are injected into the heater, and there minutely subdivided, and so



SECTION . C . D.

Fig. 4.

brought into contact and thoroughly commingled, condensing the steam, and heating the water nearly to boiling point.

No. 7,017. Messrs. Ransomes, Sims, and Head exhibit, at Room IV., a twelve-horse power patent portable steam-engine, fitted with T. C. Brown's patent expansive gear, regulated by the governor, and with Head and Schemioth's patent apparatus, being thus adapted for burning not only coal, wood, and sawdust, but also straw, reeds, the stalks of cotton and maize plants, megass, or sugar-cane refuse, and other the like fibrous material and waste, as fuel. For this purpose the engine is constructed with a large fire-box, and somewhat smaller tubes than similar engines burning coal only; the ordinary fire-bars are made removable, and their place taken by a light grille of wrought iron transverse bars, with 4-inch intervals. The furnace-door is provided with a suitable aperture and cast-iron mouthpiece, to which is attached externally a self-acting feed apparatus, similar to those which feed the hay and straw in chaff-cutting machines; beneath the grille is an ashpan with an opening or mouth at the end towards the smoke-box or forward end of the boiler, and above this mouth is a transverse perforated water-pipe, connected with the feed-pump, whereby minute jets of water are injected into the fire-space. At the mouth in the furnace door is placed a pair of horizontal feed or finger rollers, geared together, and driven by a belt and pulley from the engine crank-shaft itself; a winch handle is also attached to the rollers, whereby, during the essential preliminary operation of firing up and getting up steam, the feed may be effected manually; a horizontal shoot or trough, nearly as wide as the feed-rollers are long, serves for the straw or other fibrous material, &c., to be laid in and arranged for the feed. For commencing operations, the trough or spout having been filled with straw, its contents, being continually renewed, are passed into the fire-box, by means of the rollers and hand-winch, until that is moderately full, and then ignited; the fire and heat being thus maintained, when sufficient steam pressure is generated to supply a steam jet for the blast in the chimney, and subsequently to drive the feed rollers automatically. The combustion of the straw, &c., is almost complete, leaving a loose ash; and, thus burnt, straw is found to be about equivalent, in evaporative power, to its fourth or fifth part (in weight) of ordinary coal; the consumption of ten or a dozen sheaves of straw being sufficient to thresh 100 sheaves of wheat.

The total heating surface of the boiler is 303 square feet, and there are 57 tubes; the double cylinders are steam-jacketed (also at the ends), 8½ inches in diameter and 1 foot stroke. There is a special feed-water heating apparatus, with duplicate feed-pumps, whereof one is a cold-water pump, forcing the feed-water into a receptacle in the smoke-box, where it is heated, and the second or hot-water pump transferring it to the boiler. The self-acting expansion gear consists of an ordinary double slide with a kind of link motion. The ordinary gridiron slide is connected with and worked by a rod and eccentric on the crank-shaft; close adjoining are two smaller eccentrics connected with the back slide or cut-off, the rod of which terminates in a socket or collar, through which passes a circular link, capable of sliding up and down through the same, and connected at its upper and lower extremities with the two eccentric rods. The positions of these eccentrics are so arranged that when the link is so placed that the cut-off slide is actuated by the lower extremity of the link, an early cut-off is effected; and *vice versâ*, when the upper extremity of the link is brought to bear on the slide, a late cut-off is obtained; there are intermediate positions to correspond, and all that is necessary to make the apparatus automatic and self-regulating is to place the link in connection with the governor (Porter's), so that the raising and lowering of the balls should act correspondingly upon the links; and this is effected very simply by supporting rods, arms, and a way-shaft. Thus when the normal speed is exceeded, the governor-balls, in expanding, raise the links and bring the slide-valves simultaneously under the controlling action of the eccentric which gives an early cut-off; similarly a slackening speed depresses the links and prolongs the time of cut-off correspondingly, all within the limits assigned by the angular positions of the eccentrics in relation to the cranks. This apparatus is remarkably sensitive to variations in the load, and delicate in its action in maintaining the normal speed.

The following is the return of admissions for the week ending August 1st—Season tickets, 1,068; payment, 7,842; total, 8,910.

M. Grand, describing the coal fields of Spain to the Paris Society of Civil Engineers, estimated their area at 150,000 hectares (the hectare being about 2·47 acres), from which only 500,000 or 600,000 tons are annually extracted, while Belgium, with the same area, yields ten millions of tons. The Spanish coal fields are situated in Castile, Leon, and Asturias. The processes are described as being very rough and imperfect. M. Delesse stated that the coal of the Asturias was adapted for gas making.

A French paper gives the following *resume* of the degree of activity of the electric correspondence in different nations for 1871:—France, 7,447,000 despatches; England, 12 millions (not including 700,000 telegrams for the exclusive use of the press); United States, 12,404,000; Italy, 2,583,000; Switzerland, 1,517,000, not reckoning 109,000 despatches in transit and 35,000 service despatches; Germany, 7,108,000; Austria, 3,974,000; Belgium, 2,380,000; Holland 2,050,000.

A few years ago the Tasmanian annual Customs receipts ranged from £130,000 to £140,000, but for the first quarter of this year they were upwards of £51,000, against £42,000 for the corresponding period of last year, and £33,000 in 1872. The value of the imports for the three months ending 31st March was £321,000, as against £175,000 for the first three months of 1872; and of the exports, £412,000, against £287,000 for the corresponding period last year.

A company has been formed to work the sulphur deposits at White Island, a marine volcano 140 miles from Auckland. It is estimated that 100,000 tons of sulphur in an almost pure state are lying on the island ready for shipment. Chemical works are likely to be established soon, and the island leased.

EXHIBITIONS.

Philadelphia Centennial Exhibition.—Mr. J. Crump offered to put up the Centennial Exhibition building for 1,500,000 dols.; Messrs. Clark, Reeves, and Co., for 1,397,000 dols.; and Mr. R. J. Dobbins for 1,076,000 dols. Mr. Dobbins got the contract. The building is to cover some 15½ acres of ground, so the builder receives nearly 70,000 dols. per acre, which, considering that the structure is to be constructed of light material, is considered very good.

Collection of American Newspapers at the Vienna Exhibition.—A medal of merit has been awarded to the collection of newspapers published in the United States which was exhibited last year at Vienna. This collection which consists of no fewer than 6,000 numbers of newspapers and other periodicals, is contained in 119 volumes. In the descriptive catalogue which accompanies this article it is stated that 8,081 newspapers and reviews are published in the States, of which 507 are published at New York; 81 at St. Louis; 38 at New Orleans; 93 at St. Francisco; 194 at Boston; 168 at Philadelphia; 41 at Baltimore; 37 at Detroit; 145 at Chicago; 71 at Cincinnati; and 38 at Washington. In the territories it appears that 14 are published in Dakota; Indian territory 2; Montana 8; Wyoming 6; Idaho 5; New Mexico 5; Arizona 4; Colorado 50; and Utah 15.

Two Exhibitions of Art Manufactures in Paris.—It was announced some time since by the Minister of Public Works that an exhibition of the productions of the national factories of Sèvres, the Gobelins, and Beauvais would shortly take place, in order that the public might have the opportunity of judging of the value of these model factories maintained out of the public purse, and the cost of which is £32,397, namely—Sèvres, £19,744; the Gobelins, £8,320; and Beauvais, £4,333. It is now announced that the exhibition will take place at the Palace de l'Industrie, in the Champs Elysées, at the same time as the exhibition of the Union Centrale des Beaux Arts, which opens on the 10th August. The exhibition of the national manufactures will be free, but not so that of the Union Centrale, which is a private society. The three exhibitions of the society which took place before the late war were eminently successful, and the collections of old china, enamels, bronzes, and other objects of art unrivalled. The programme of the coming exhibition differs from those of the former, which also differed amongst themselves; it includes modern art, manufactures, and models, and designs for the same, and a retrospective exhibition, forming a history of costume by means of productions in all the graphic and plastic arts of ancient and modern times to the end of the 18th century, with, as on former occasions, the prize drawings and models of all the schools of design in France. It is an admirable idea thus to bring the productions of the State factories into juxtaposition with those of private art manufactures, and the fact will certainly cause the porcelain manufacturers, and the carpet and tapestry weavers to exhibit their choicest works. The products of Sèvres, the Gobelins, and Beauvais have not been exhibited since 1867, and it is five years since the Union Centrale held its last exhibition, so that the coming shows will illustrate the progress made in France in art manufactures during a considerable period, which naturally will give importance to the whole. It is not out of place to remark, however, that the former exhibitions of the Union Centrale, although only two years apart from each other, from the excellence of the collections, and the admirable arrangement which characterised them, were thoroughly successful, but that now announced will certainly exceed them in attraction.

Permanent Exhibition of Machinery, &c., at St. Petersburg.—The Russian authorities announce that the Polytechnic Society of Russia has been authorised to hold an exhibition of machinery, apparatus, and tools, with the exception of locomotives and portable engines, invented or improved in construction since the year 1872, whether of Russian or foreign origin. Application for admission to be addressed to the Société Imperiale Polytechnique de Russie, at St. Petersburg, with complete descriptions and drawings, with prices; and objects admitted will be received till the end of September. The exhibition is to open on the 1st of October and to close on the 1st of April in each year. Medals and honourable mentions will be awarded, and the Society will recommend such machines, &c., as it thinks of special importance, to the attention of the Russian Government. No charge is made for space, and the society will supply the requisite motive power, but not pulleys or driving-bands, take general charge of all the machinery when once in proper order, insure the contents of the exhibition, take charge of packing cases, re-pack, conduct experimental trials and make the results public, and manage sales without any fees. Exhibitors are bound, however, to remain, or cause their engineers to remain, ten days at the exhibition, if required in order to instruct the officials in the working of the machines. All the reports on the objects in the exhibition to be made within the first two months of the doors being open. Provision is made for placards, announcements, and hand-bills of all kinds of a commercial character. Wall space for this purpose will be charged at the rate of twenty shillings per square metre monthly; and announcements will be translated into Russian, if desired, and 1,200 copies printed at a fixed charge of twenty shillings per page of any size. Books of patterns, with prices, will be admitted gratis with such announcements, or may be exhibited on the wall at the same rate. All machines, &c., will be admitted duty free, except when sold.

THE PROJECTED CENTRAL ASIA RAILWAY.

M. Ferdinand de Lesseps, at a recent meeting of the Geographical Society of Paris, gave some information with regard to the projected Central Asiatic railway, and the encouragement which he has received from the Czar and his ministers, and from influential persons in this country. M. Charles de Lesseps, after meeting with a favourable reception from the authorities in India, has visited Cashmere, and has proved the impracticability of the route originally proposed from Orenburg through Samarcand, the Hindoo Koosh, and the Cabool valley to Peshawur, chiefly due to the barbarous condition of the population of Afghanistan. M. Charles de Lesseps proposes, therefore, to adopt an easterly route, in connection with the line in course of construction between Moscow and Siberia, through the Sir-Daria valley to Tashkend (which has flourished under the Russian *régime*, and now has a population of 200,000), skirting the lofty table-lands of Pamir, and passing thence to Kashgar, Yarkand, and Cashmere. The engineers considered this the safest route, especially as the new government at Cashmere seems determined to tread in the paths of civilisation, and has given great facilities for trade, of which the English in India have not been slow to avail themselves. The route now proposed seems to lose in topographical advantages what it gains in safety of communication. It has to cross several lofty mountain-chains—the Mons-Dagh, the western spurs of the Kuen-Lun and Karakorum ranges, and the Himalayas. But the difficulties do not seem insuperable; and, if successful, this line will give fresh life to once powerful countries, and possibly change the face of the world.

A fifteen-year contract has been definitely closed at Milan, for putting Pullman palace cars on all trains and lines in Upper Italy.

SOME NATURAL EFFECTS OF RADIATED HEAT.

By Thomas A. Wise, M.D.,

There are two explanations given of the manner in which artificial ice is produced by the natives in Bengal when the temperature of the surrounding atmosphere is considerably above the freezing point. The late Sir John Leslie supposed the ice was formed by the cold produced by the evaporation of the water from the shallow porous vessels used in the process, while Dr. Wells believed it was by the radiation of heat under favourable circumstances. By weighing the dishes in the evening and morning, and by a series of thermometric observations, made by myself, the latter explanation was found to be the correct one, as detailed in a periodical in India,* and lately in one in this country.†

The second object of my experiments was to prove the possibility of keeping the ice through the year in the moist and high temperature of Bengal. For this purpose I built an ice-house above the ground, of a cylindrical shape, some twenty feet high, with a pear-shaped interior. This was well defended both inside and out with non-conductors; a double door, made of the same material, led to the top of the building, in which the ice was placed, rammed down into a solid mass, and kept dry by careful drainage. By these means I was able to keep the ice, and supplied the Governor-General (Lord William Bentinck) with it at Barrackpore, in the middle of the hot month of May, 1834. But the quantity required for supplying the wants of the public in Calcutta was too large, and I was gratified to find that an enterprising American firm soon after carried out my idea, by freighting their ships with ice that they sent to India for indigo, &c., and kept it in such an ice-house as the one above described. A large and lucrative trade has since been carried on, which ensures a regular supply there and elsewhere of this most important commodity at as cheap a rate as in London and Paris.

The observations into which I was led during my experiments on the production of ice, caused me to notice some more general effects resulting from the radiation of heat from the ground, as evidenced by the changes undergone by vegetable life during periods of sudden transitions from heat to cold. As the results of these observations appear to have some practical value, I am induced to submit them for the consideration of those interested in such questions.

The influence of cold has often a most pernicious effect on our fruit-trees and vegetable productions when exposed in blossom to it, they are by a sudden reduction of the temperature to an extent of 10°, 15°, or 20° below the surrounding air. The effects of such a change upon the foliage and blossom of our trees and cereal crops is not so generally known and guarded against as it ought to be.

The early period at which the winter cold commences in this variable climate, often produces a peculiar and strikingly beautiful effect on the foliage of trees. Some of the tender leaves, when they are affected by the early cold, partially change their green tint to a yellowish or deep brownish copper colour. This gives a varied richness and beauty to the mountains and rocky cliffs so characteristic of Scotland, and when the setting sun pours his red rays upon the varied tinted foliage, it produces a most gorgeous appearance, only to be seen in such northern latitudes.

In these more northern latitudes the late period at which the winter cold ceases, is often anticipated by some days of mild weather and sunshine, which, on account of the sudden transition from cold, advances vegetation rapidly. This is often checked by a return of cold weather, when the fruit trees in our gardens are putting forth their blossoms, and the cereal crops are in flower, which with their tender stems are easily affected by changes in temperature, and are often destroyed by exposure to a cold below the freezing point.

This is explained by the herbage on the surface of the ground radiating the heat, and producing a deposit of dew upon the plant, which, as the cooling process advances, becomes hoar-frost.

A downward current is likewise produced by the warmer and dryer air below being displaced by the colder and moister air from above. This current towards morning is very cold, and sometimes with wind from the east, is very pernicious to the fruit of exposed trees; as it destroys the blossom and young fruit, particularly of wall trees, when not protected by woollen nets or an overlapping coping, to intercept the descending cold air. On this account peach trees often have a good crop of peaches near the top of the wall, and are stripped below where the bevelling of the wall exposes the blossoms to the cold descending currents of air. On such occasions I found the stamen and pistils of the flower changed to a dark brown colour, brittle and dead. Should the fruit be formed before being exposed to the cold air, they are arrested in their growth, and become brown before they fall off.

In low, damp situations, during calm, clear, and sultry weather after rain, another class of effects is produced on our corn crops. A low, white, creeping fog may be observed after sunset over deep pools of water, or hanging over low-lying damp situations, which gradually spreads over the neighbouring fields, and continues during the night. Should the sun rise clear and bright the fog "is eaten up," and the rapidly absorbed vapour round the tender plants increases the cold, already many degrees under the temperature of the air, and the herbage from the cold state is suddenly heated by the dispersion of the fog and the influence of the rising sun; so that the same effect is produced as when a frost-bitten part of the human body is suddenly heated, followed by gangrene. But if the heat be imparted to it slowly, this effect is prevented, and the part is restored to health. In like manner a cloudy morning, or the shelter of trees and rain prevents the sudden transition from cold to heat, and the injurious effects of radiation are avoided.

It is consequently in low, damp situations that the crops are subject to such changes, and are liable to be injured by the radiation of heat. On examining a field which had been so exposed, I found the young shoots of an oak tree, the stems of the potato plant, and the leaves of the clover stiffened and crisp; they soon became black in colour, and dead, while the tubers and roots were unaffected. On another occasion I found a bed of mint had its leaves dry and shrivelled, dark-coloured, and dead, with many of the leaves fallen off. In a like position the leaves and pods of peas had white spots upon the surface, and the peas, as they were younger, had a brownish dark colour, and were soft and watery. They had lost their natural smell, and had acquired a disagreeable sweetish taste. A bed of strawberries after such an exposure had the centre of their fructifications reduced to a brown or black colour, while the plants under the shade of trees were uninjured, the former being exposed to the chilling influence of radiation, while the latter were protected by the trees from the sudden change of temperature.

A friend stated to me the following particulars. In the progress of improvement a Loch in Scotland was drained; but its bed remained in some places wet and swampy. A potato field bordered the old lake, and included the drier portion of its bed. The potatoes grew well, and after a period of uncommon heat in July, there was a very severe and biting frost, a dense fog rested over the field during the night and disappeared with the morning, which was bright and clear.

* "Experimental Inquiry into the Means Employed by the Natives of Bengal for Making Ice." By T. A. Wise, M.D. *Journal of the Asiatic Society of Bengal* (vol. 2, p. 80-1) for 1833.

† *Nature*, for 1872. No. 114, for 4th July.

"When I looked out," he says, "I perceived that the moist portion of the potato field, which formed a part of the old bed of the lake, was blighted; while the dry portion of the lake's margin and sloping bank was comparatively uninjured." On another occasion I examined a field of barley and oats which had been exposed for a few hours to a considerable degree of cold from radiation. The corn of both fields had a blueish shade, or a reddish brown colour, and the grain was shrivelled, soft, and watery. I examined another large field of spring wheat, which had been sown after potatoes, in a rich, moist valley near the river Suir in Ireland, and the field was lower than the surrounding land. The seed came up well, and the crop became marked for its luxuriant appearance. Soon after, on the 11th of July, a severe thunderstorm, accompanied with heavy rain, occurred, when the wheat was in flower; and on the 18th, it was observed to acquire a yellowish tinge before the usual time. From this date the wheat lost its luxuriant appearance, and this was supposed to have been caused by the lightning. Had this been so, it would have been injured in patches and tracts, which was not the case; and what satisfied me on this point was the general change that had taken place over the field, excepting under the shelter of the trees, where the wheat continued healthy and the yield excellent. This proved that the wheat had been injured by the dispersion of the pollen during the high wind, which weakened the plant, and the radiation of heat in the clear still nights which followed the storm. The cold injured the weakened plant at the critical time of flowering. On examining the ears few were filled, and even the best had but only a few grains near the stem, which had been protected. In general the grains were small, deformed, and withered; and the intelligent proprietor informed me he calculated that his loss would be £80 by the blight in this field.

Another consequence generally follows from the weakening of the wheat and other cereals by exposure to cold, viz., its being affected by mildew, caused by the minute fungus (*Puccinea graminea*) which so frequently infests and injures the crop of corn in moist and warm seasons.

Mr. Mechi, the distinguished agriculturist, in a letter to the *Echo* newspaper, dated July 8, 1874, writes as follows:—"I fear that we must moderate considerably our expectations of a great wheat crop. On Sunday and Monday (4th and 5th July), from some unknown cause, there was a dropping down of many stems, and many ears appeared suddenly ripe and were dead and shrivelled. Yesterday, a visitor to my farm reported having seen similar effects in other districts; and this morning, in a letter from a friend 14 miles from him, dated the 6th, he says, 'My crop looks very well, but my bailiff tells me this morning that ho yesterday found all the wheat blighted, the same as last year. I hope he is wrong.' It is not possible at present to estimate the percentage of mischief done, but let us hope it will not extend."

This blight appears to have been produced by the exposure of the wheat to the sudden transition of temperature; and if we know the cause and extent of such injuries to our crops, our next object is to endeavour to prevent them. It will be sufficient to indicate some of the means.

1. As we find cloudy weather, or the shelter of trees, prevents the bad effects of radiation, a net or covering over the plants before sunrise would be equally efficacious where it could be done.

2. As wheat sown in October is stronger, it should be preferred to spring wheat, as it is not so readily affected by cold.

3. The pollen may be more equally diffused over the ears of corn, by agitating the plant in calm weather, by means of strings across the fields, which can be moved backwards and forwards in different directions. This is done in France with advantage, and it strengthens the plant, developes the ear, and renders it less liable to be injured by cold.

3. The most important remedy against cold and blight, and the best means of ensuring a good crop, is by a proper working and a thorough draining of the land, so as to diminish the surface water, and prevent the accumulation of cold or diminution of heat, by which many healthier plants are produced, a fuller crop ensured, and the injurious effects of cold and mildew prevented, a result which soon repays the enterprising farmer for his trouble and for the expense he has been at.

NEW MATERIAL FOR PAPER.

The *Gardeners' Chronicle* gives the following account of a plant suitable for paper-making, the Zizania of North America:—Before proceeding to particulars of the discovery lately made in regard to the fitness of the Zizania as a material for paper, it may be well to give a short account of the plant considered as an object of botany, few people in this country being acquainted with more than the appellation. It is a grass of the tribe Oryzeæ, thus having a degree of affinity with the rice plant of oriental Asia, from which, however, it is well distinguished at the same time by the structure of the flowers. In the rice plant, *Oryza sativa*, the flowers are bisexual, or provided individually with both stamens and pistils, whereas those of the genus Zizania are monœcious. The stamens in both plants, as in most or all the rest of the tribe Oryzeæ, are six in number. Five species in all have been discriminated of the genus; *Z. aquatica*, however, is the only one of importance, and it so happens that the structural characters of the flowers are sufficiently like those of the others to have led some of our botanists to distinguish it under the name of *Hydropyrum esculentum*. For convenience sake, at all events in relation to paper-making, it is better to let the Linnean name remain, and to call the plant, as it were, emphatically Zizania. Like the beautiful silky-plumed reed grass, or phragmites of our own country, to the bent and crossing stems of which, secure from capture, the sedge warbler attaches its nest, the Zizania is a thorough water plant, having its habitat in swamps, ponds, and shallow streams, which it fills during the summer and autumn with a mass of herbage almost incredible, and which even the forest-like phragmites represents but imperfectly. The density and luxuriance are so much the more remarkable since the plant is only an annual, though in truth, if we want to learn what an annual grass can accomplish in six months, we have only to look at our fields of waving wheat, to say nothing of what is achieved by Indian corn. The constant and abundant supply of moisture of course goes a long way towards promoting the immense development. Rising to an average height above the surface of the water of fully seven or eight feet—the maximum having been observed, not uncommonly, to be twelve to fourteen—the density of a Zizania grove, as met with in the remote wilds of North America, and the ease with which the light canoe of the Indian can brush its way among the reedy and flexible stems, combine to render it an admirable place of concealment. The natives are prone to seek its shelter, especially in times of peril, or at all events they were accustomed so to do in days gone by, as many a time pictured graphically by the American novelists. Occasionally, however, the growth is so dense that even to paddle a canoe among the myriads of slim green shafts is no longer possible. The culms and foliage of this remarkable plant present no features materially different from those of the other large aquatic grasses, nor is there anything very striking in the inflorescence, which is quite devoid of the rich colour and the velvet touch of the Phragmites, approaching more nearly to the plain fashion of the *Poa aquatica*. As in the last-named, it is terminal and erect, and of great size. The seeds are so large, and in substance (when quite ripe) so bland and

farinaceous, that they furnish nourishment to countless flocks of water-fowl, especially geese and wild swans, both of which, at the brooding season, resort to the Zizania groves as if by instinct. Because of these excellent qualities, and their really nutritious value, the seeds are employed as food by the human aborigines Many of the wandering tribes of native Indians depend on the Zizania harvest, called by them Tuscarora, as their principal source of food during the winter. They suffer seriously, if by any mishap the supply runs short, looking to it in much the same manner that the Arabs do to their Palm-trees and their dates. The gathering of the grain generally falls to the lot of the squaws, or native Indian women, who collect it in their canoes by bending sheaves of the great panicles towards their bodies, and then threshing them with the paddles employed for the propulsion of their simple vessels. Subsequently it is dried in the sunshine and winnowed, the grain being enveloped, when it drops from the stem, in plaited and cucullate glumes, such as in other plants would constitute a husk.

Now as to the employment of Zizania straw as a paper material. That other grasses have been utilised for this purpose needs no saying. Many people, however, have no idea of the extent to which grass is employed in paper-making. Sufficient is it to say here that in 1873 there was imported into England for the exclusive use of the paper-makers no less a quantity of Esparto-grass than 100,000 tons—London, Liverpool, Newcastle, and Hull being the chief receiving ports. It is for the same general descriptions of paper for which Esparto has proved so serviceable that Zizania is adapted—the descriptions, that is to say, which are in demand for newspapers, books, and magazines. Zizania yields fully as much of the raw material, so to speak, as Esparto, and has the great and peculiar merit of being comparatively free from silicates. Paper made from it is quite as strong and quite as flexible as that which is made from rags; it is easily bleached, economical in respect of chemicals, pure in colour, and remarkably free from specks and blemishes. Samples in our own hands at this moment present a surface of perfect evenness, and in general appearance conform exactly with the best papers of the same class we have ever seen, no matter what made from. Zizania paper has the further merit of receiving a very clear impression from the types employed by the printer; it is also remarkably well adapted for the reception of woodcuts.

New discoveries usually have some hindrance to contend with. In the present instance there is a check, only temporary it is to be hoped, to the extensive use of Zizania in England, in the enormous cost of the conveyance of the rough straw across the Atlantic. The freight is charged, it would appear, not upon the weight but upon the space occupied, and as the bulk is very considerable this becomes prohibitive. Five tons of Zizania that were recently imported for first experiments occupied a space equivalent to 30 tons. The bulk might, of course, be reduced by hydraulic pressure, but the cost of this in turn would be too serious to justify resort to it. Commercially regarded, Zizania, in a word, is too bulky to be imported for manufacturing purposes, unless it is converted near where it grows into "half-stuff." By no means restricted to British America, the Zizania is nevertheless most particularly a plant of our own territories, a circumstance which with Englishmen should again count in its favour. The Zizania districts occupy a large extent of territory on the shores of Lakes Erie, St Clair, Ontario, &c., and there is abundant means of transport both by water and rail to Montreal, from which port it can be shipped to England. An annual supply of at least 100,000,000 tons appears assured. It is not as if the growth of the plant depended on human agency, nor yet as if it were exposed to the possibilities of human destruction, or (being a water-plant) to the casualties of weather. In these respects it is like the Zostera of our shores. The cutting is said to cause the plant to thrive and multiply even more than before, operating as a kind of tillage. The ground it occupies is not available for other purposes, so that no landowner will ever desire to interfere with it for the sake of introducing a different plant.

THE FIJI ISLANDS.

Looking at the interest these islands are now exciting in consequence of their proposed annexation to the British Crown, it may not be without use to give a brief account of some of their most important characteristics, as described by the most recent authorities on the subject. Lying between 15° 40′ and 20° south latitude, they are entirely within the tropics, and are characterised by the richness and profusion of the vegetation peculiar to these regions. They number about 255, of which about 80 are inhabited, varying in size from Viti-Leon, the largest, which is about 220 miles in circumference, down, through all the intermediate sizes, to the insignificant coral islet with its clump of cocoa-nut trees. The more important islands of the group are mostly mountainous, rising more or less abruptly from the shore to a height in many parts of 2,000 or 3,000 feet, and in a few even to over 4,000 feet. These hills and mountains are generally of a grand and picturesque outline, being composed for the most part of old volcanic lavas, conglomerates, basalt, and trap, clothed from base to summit with a dense vegetation, which, on the easterly or windward sides, is generally developed into thick forests, containing numerous varieties of large and valuable trees, while on the opposite sides the vegetation is mostly confined to rich grasses and a few thinly scattered trees of the casuavina and pandanus classes. Skirting the foot of the mountains, and forming the numerous bays which indent the coast, and stretching in many places far into the interior between the ranges, are plains of the richest alluvial soil, extending in some parts of the larger islands over many square miles, watered, and not unfrequently, inundated, by the rivers and numerous streams which carry off the superfluous rainfall of the mountains, and kept perennially green with a rank and profuse vegetation. The rivers are unusually large in proportion to the size of the islands, and being subject to frequent and sudden heavy floods and corresponding subsidences, carry down to the sea immense quantities of mud, sand, and gravel, which are deposited at their mouths in deltas, low swampy banks, or extensive mud-flats, more or less covered by the tide, or overgrown with mangrove and other ill-omened plants. Many of the beautiful bays on the coast are free from the mud and the mangroves, and, instead, are fringed with groves of cocoa-nut, breadfruit, and banana trees, the beach bordered by pure coral sand, and the sea deep and transparent, receiving but little pollution from the clear streams, which fall in numerous cascades from the neighbouring hills, while a group of white houses, half hidden among the trees, together form frequent pictures of the most charming quiet and loveliness.

The present white population is estimated at 2,000, of whom 1,700 are British, 70 American, 100 Germans, and the remainder of other nationalities. The British subjects are mostly either of Australian birth, or have been long resident there or in New Zealand, or other foreign countries, comparatively few having come direct from England. The settler on his plantation leads an isolated and a lonely life, in many cases separated by miles of river or trackless mountains from any other white man, or cut off by the sea from the next island, he spends his days surrounded by his black labourers, who are generally but little above the brutes in intelligence, and are only interesting so far as that they do work for him. The houses of the planters are in many cases built for them by the Fijians of reeds, cocoa-nut leaves, &c.; they are low in the roof, and have small windows and doors,

and rarely any flooring beyond the hardened soil. Nevertheless, they are very cool and comfortable, and some of the better ones are really more adapted to the climate than the more pretentious wood and iron erections which are now becoming common. Owing to the wetness of the climate it is almost impossible to keep a house moderately free from damp without a wooden floor raised some distance from the ground, which not only improves the general comfort and appearance, but also adds most materially to the healthiness of the house and its freedom from mosquitos. Nearly all the planters now of any importance have good wooden houses, generally roofed with corrugated iron, surrounded by a wide verandah, under which a great part of his domestic life is passed. When the settler is a married man there are generally to be found many comforts, and not a few luxuries. Cows and a good dairy, goats, fowls of all sorts, a good garden with abundance of fruit and vegetables, while here and there, where the natives of the country will allow it, fair saddle-horses are kept. During the greater part of the year the planter has plenty of occupation out of doors, either in managing the crops already in the ground, or preparing fresh land in extending his plantation. His life, therefore, while on the plantation, although too often very lonely, is yet most healthful; and as long as he abstains from the abuse of stimulants and other vices, and avoids unnecessary exposure to wet and cold chills, he remains in perfect health, as far as the climate is concerned. The natives are a virtuous race, who, aided by the good teaching of the missionaries, have managed to keep themselves wonderfully free from the contamination of the vices of civilisation.

Under the management of the British Government there seems every possibility that Fiji could become a prosperous settlement. In addition to the great natural advantages of soil and climate, the geographical position has caused it to be chosen as a place of rendezvous for the steamers performing the mail service from California to New Zealand and New South Wales. With the single exception of the beautiful and fertile island of Tavinin, the coasts abound in secure and admirable harbours well known to the residents, and only requiring the completion of an accurate survey to make them accessible to strangers.

AMERICAN PATENT LAW.

The new law relating to patents, trade marks, and copyrights in the United States, which takes effect on and after the 1st of August, provides that no person shall maintain an action for the infringement of his copyright unless he shall give notice thereof by inserting in the several copies of every edition published, in the title-page immediately following if it be a book, or if a map, chart, musical composition, print, cut, engraving, photograph, painting, drawing, chromo, statue, statuary, or model, or design intended to be perfected and completed as a work of fine art, by inscribing upon some visible portion thereof, or of the substance on which the same shall be mounted, the following words :—" Entered according to Act of Congress, in the year —— by A B in the office of the Librarian of Congress at Washington," or at his option the word "copyright," together with the year the copyright was entered, and the name of the party by whom it was taken out—thus, "Copyright, 18—, by A B." For according and certifying any instrument of writing for the assignment of a copyright the librarian shall receive from the persons to whom the service is rendered one dollar, the said fee to cover in either case a certificate of the record under seal of the Librarian of Congress, and all fees so received shall be paid into the Treasury of the United States. In the construction of this Act the words "engraving," "cut," and "print," shall be applied only to pictorial illustrations, or works connected with the fine arts, and no prints or labels designed to be used for any other articles of manufacture shall be entered under the copyright law, but may be registered in the Patent-office. The Commissioner of Patents is charged with the supervision and control of the entry or registry of such prints or labels, in conformity with the regulations provided by law as to copyright of prints, except there shall be paid for recording the title of any print or label not a trade mark six dollars, which shall cover the expense of furnishing a copy of the record under the seal of the Commissioner of Patents to the party entering the same.

GROWTH OF THE AMERICAN PAPER TRADE

In 1810 there were 185 mills in the United States, which were located as follows:—

New England States	75
Middle States	76
Southern States	16

Their product of paper was divided as follows :—

Reams.		Value in dols.	
50,000		averaging 3·00	per ream.
70.000 cheap book,	„	3·50	„
111,000 writing ..	„	3·00	„
100,000 wrapping..	„	·83	„
336,000	Total value ..	741,000	

This was exclusive of paper-hangings. The 28 mills in New York made that year 77,756 reams, worth 3 dols. This year rags were first imported from Europe to any extent. In 1814, there were 187 mills, making 340,000 reams annually, worth 820,000 dols. In 1818, the value of rags gathered in the United States was estimated at 900,000 dols. per year. In 1820, the product of paper was estimated at 3,000,000 dols., and the cost of materials and labour at 2,000,000 dols. The manufacture employed 5,000 person, of whom one-third were males over sixteen years of age. The 70 mills of Pennsylvania alone consumed 2,600 tons of rags, and produced 800,000 dols. worth of paper. In 1828, the newspapers of the United States required 104,400 reams of paper, worth 500,000 dols., and those of New York consumed 15,000 reams, an amount only about equal to the weekly supply at present of the metropolitan journals. In 1829, the 60 mills of Massachusetts consumed 1,700 tons of rags, making 700,000 dols. worth of paper. The total product of the Union was valued at 7,000,000 dols. In 1832, the manufacture of paper had not increased, but the outlay for rags was estimated at 3,500,000 dols. The paper made in Connecticut was valued at 564,000 dols. In 1842, the capital invested in paper-making was 16,000,000 dols., and the product valued at 15,000,000 dols. Stock consumed was 87,500 tons, and there were 600 mills. (These figures are evidently very vague.) In 1845, there were 88 mills in Massachusetts, using 15,886 tons of stock in making 607,175 reams of paper, worth 1,750,200 dols., and employing 1,369 hands. In 1850, there were 443 mills, with a capital of 7,000,000 dols., producing 10,000,000 dols. worth of paper according to the United States census. In 1854 there were 450 mills, having 3,000 engines, and producing 125,000 tons, using 201,500 tons of rags. In 1860 the number of mills had advanced to 550, with an invested capital of 14,000,000 dols., and a total product valued at 21,000,000 dols. The number of hands employed was 11,000. In 1872, "Lockwood's Directory" states the number of mills to be 812, valued at 34,564,700 dols., employing 22,000 hands, with an annual product valued at 66,500,000 dols.

Connecticut has 5,128 manufactories, employing as labourers 61,684 men, 20,810 women, and 7,029 boys and girls. The capital is 95,281,278 dols., wages 38,978,187 dols., the materials worked up being worth 86,419,579 dols., and the products turned out 116,065,474 dols.

BRITISH OCEAN TELEGRAPH LINES.

Mr. E. J. Reed, C.B., M.P., Member of the Council of the Society, has upon request, given notice of his intention next session, "to call attention to the desirability of bringing British ocean telegraph lines under united and responsible public management, and in closer co-operation with the telegraph systems of the chief commercial states of the Continent, and to move that a select committee be appointed to inquire and report on the subject." From his position with shipbuilding works going on, requiring constant communication with foreign states, Mr. Reed has had experience of the expense and inconvenience of ocean telegraphy in its present condition, and can appreciate the special importance of cheaper and more complete telegraphic communication to our commercial marine of 23,000 sailing vessels and 3,000 steamers. The appointment of a special committee would give an opportunity to merchants, shipowners, and others, with whom the special committee of the Society has been in communication, to be heard on the subject, as also to the officers of the Treasury and of the Postal Department, to explain the delays in carrying out the economic and administrative principles of the system. Under increasing necessities, commerce is being more and more conducted by telegrams, and less and less by letter; and while inland telegraphs save days, it is to be borne in mind that ocean telegraphs speed transactions by weeks and months, and the stimulus that telegraphy gives is especially important during periods of depression like the present. It can be shown that the present high charges continues to be almost prohibitory of social messages; that the social messages from India do not amount to much more than 1 per cent. of the whole; that it is almost prohibitory of important communications from emigrants, of their arrivals, movements, and wants to their families. It may be shown that the total number of the ocean telegrams, excluding those from our Continental neighbours, do not exceed some two thousand messages a-day, a number, having regard to the affairs of all our shipping and commerce, and all our colonies and relations, that is utterly incommensurate. Its increasing necessity for our public administration, especially with India, is also apparent, and the increasing necessities may be shown of extended branch lines for the prevention of wars and the repression of insurrections.

The trading companies, for telegraph risks, can only obtain dear capital by financing at some ten per cent., and upon that dear capital must charge a high profit, as also for comparatively dear separate establishments. The Government may work with comparatively cheap capital on the ordinary price of the public securities, and may, with much advantage, utilise its existing postal and other establishments, and may render a responsible service at little above its cost.

Mr. William Abbot, in his last monthly circular, gives facts of importance as illustrative of the extreme and grievous differences of the service of ocean telegraphy, under the trading telegraph companies. As to one of them, however, it is a matter of justice to admit, and to state, that its service is so far advanced as to be satisfactory, at least in respect to rapidity and accuracy, and to serve as a contrast in those respects.

"The revenue of the Anglo-American Company continues to augment on a large scale, and it is extremely satisfactory to learn that the average time occupied in the transit of all messages between London and New York, during the month of May, did not exceed 17 minutes and and 50 seconds. This rapid working becomes startling by contrast with that nearer home; thus a message from London to Paris occupies about one hour, and it is quite a matter of congratulation if, during the hours of business, the reply to a message to Paris can be received in London in less than two hours and a half; in fact, so perfect has become the organisation of the Anglo-American Company that messages can be forwarded from London to California and a reply received thereto in the same space of time as is at present occupied for a similar service between London and Paris. In the former case 11,000 miles have been traversed, whereas in the latter, the distance to and fro does not exceed 500 miles."

Mr. Reed has also given notice that he will next session call attention to the successful working of the half-franc message systems of Belgium and Switzerland, and move that it is desirable to reduce the cost of inland telegraph messages in this country.

It is extremely important that the attention of Parliament should be directed to the causes of the delay of the reduction of the inland postal telegrams to 6d., and to the injurious consequences to commerce and to social progress as well as to the revenue. At the time private telegraph companies' works were taken by the Post-office, the annual number of telegrams transmitted was about six millions annually. At the beginning of this year the number transmitted was eighteen millions, and the present rate is about twenty millions. But what is that amongst a population of thirty-two millions? Only two telegrams in the year to every three of the population, of a population which writes every year nine hundred and fifteen millions of letters, and sends besides upwards of one hundred millions of post cards and book packages. In Switzerland and in Belgium the half-franc messages yield an important surplus revenue. In this country the surplus would be much greater. The heads of large business houses state that where one shilling message is now sent four sixpenny messages would be sent.

In 1856, when Mr. Baines, of the Post-office, with the support of Mr. Rowland Hill, sent into the Treasury a plan for sixpenny telegrams, the companies' works might have been purchased and extensions made for less than two millions. Eight millions of extra cost, immense loss to commerce and the arts, and the delay of a surplus revenue, is then due to administrative default, to ignorance of economical and administrative science, and to apathy. For it is impossible that, with economic progress, commerce and the transmission of intelligence could be allowed to go on for ever burthened as it was with the extra charge of duplicate and dear establishments.

The late delays will, it is confidently stated, be found to be due to obstructive forms of the sanction of necessary payments—delays which would be ruinous between one branch of a commercial house and another. It appears that works of extension, which in commercial business are charged to capital, have actually been charged by the Treasury to revenue, with the effect of making the present return of profit for the service to be two-thirds less than it really is. It is considered that this should be matter of grave inquiry. This misrepresentation—for it is held to be no less—has occasioned the loss of surplus to be pointed at by the opponents of reform as a warning disaster, as if a surplus revenue were the only profit to the public. Whereas the gain by the saving of time by the business telegrams, amounting to two-thirds of the whole, the saving of stocks by sending for goods fresh and fresh as they are wanted, the saving of capital and the interest on capital, and speeding the "turn overs" which are now often doubled and trebled within the same time, is estimated as being already upwards of five or six millions annually of contribution to the public prosperity, and in the quickened "turn over" of duty-paying commodities, being one great cause of the rebound of the revenue which has of late been so remarkable, so that there is ground for the belief that if the telegraphic service were rendered gratis it would yet be publicly remunerative.

The mining of iron ore in Ohio employed, in 1872, 2,238 men, who raised 336,758 tons of native ore in that year, against 251,229 tons in 1870. The receipts of iron ore at Cleveland during 1873, from all ports outside the State, including Canadian ores, was 689,440 tons.

SWEDISH STOVES.

With regard to the present stove competition of the Society, the following may be interesting. The account is given by a correspondent of an American paper, writing from Gottenberg, Sweden:—

The amount of fuel consumed warming houses is generally inverse to the amount of cold to be combatted. The truth of the proposition has been strangely and fully confirmed by a more extended and careful examination into the plans of warming adopted in North Europe, and it is with some fear that the facts may seem incredible that this is written for Americans. To begin with facts, I will mention that we are now living in two rooms of a hotel, one 20 by 20 feet, the other 20 by 15 feet, the ceiling being 12 feet high. Opening into these rooms is one common entrance-door and a pair of huge folding doors. The weather during March was cold, even colder than in Philadelphia or New York, and through the month the number of fires used were about four in a week, each fire consisting of from eight to ten billets of wood 12 inches long, or about enough to start two coal fires in America. The rooms were thoroughly warmed, and the temperature, night or day, never varied five degrees. The quantity of fuel consumed was about one-twentieth part of what would, under similar circumstances, have been required to warm the same room in America, and yet Americans pride themselves on what they know about house-warming.

The writer's son had been living in Gottenberg during eight months past, occupying two rooms even larger than those of which the dimensions are given. He purchased last fall one "fam," of about 200 cubic feet of wood, of which on the 1st of March one-fourth was left, after "firing" all the winter. The warming is done with a kind of stove called a "kakelung," and seemingly on principles that are more scientific than those of the many patent contrivances of the Americans, whose double function seems to be to consume fuel and stifle the inmates of the dwellings. This is based upon personal experience, at the end of three months spent in a first-class dwelling (with modern improvements) in Philadelphia last fall. A sense of relief was felt when we escaped again to old foggy England, where patent heaters are unknown. The fact is, that the American people are oblivious to the frightful effects that come from their system of heating, and only become aware of its discomforts and dangers after passing a winter with English grates or the kakelung.

To return to the last-named system, a kakelung is simply a great stove of masonry covered with porcelain plates, having usually five flues, through which the gases of combustion must pass up and down, a distance of 30 to 50, or even 60 feet, before escaping into the air. The general principle of their operation is to provide enough material to absorb all the heat from the fire; to conduct the gases through these long flues until their temperature has fallen to a point that no longer gives off heat. The quantity of the material in the kakelung is so great that the temperature from one firing (which is always enough) will not raise the temperature of any part so much that the hands cannot be held upon the outside. Two hours after a fire is made, and after the wood has burned up and the flue been closed, the kakelung begins to get warm on the outside, the light porcelain plates give off their moderate warmth to the atmosphere in the room, and ten hours later there will not be much difference in the temperature of the stove or of the room. A kakelung, instead of being an unsightly obstruction, is so constructed as to constitute an ornamental piece of furniture. Doors open into them in front, where in a kind of closet, with iron shelves, food can be kept warm or warmed. Baking can be done in the furnace for hours after the fire has been burned out. In the Grand Hotel, Rydberg, at Stockholm, the writer created some merriment by inquiring whether the kakelungs were simply erections to support the mirrors and flowers with which they were adorned.

Now this result in heating, which has been described, is in a great measure due to double windows. The conducting power of a thin pane of glass interposed between the external air and that of a warm room, is never imagined until an experiment is tried. Such cooling does no good, it simply costs money, and answers no purpose of ventilation, and, speaking from actual experience, I would rather live in a room hermetically sealed and warmed by a "kakelung," than in any room into which burned air is conducted from one of our American furnaces. I am well aware of the scientific arguments and explanations that have been put forth in reference to American house-heating. They are good on paper. The practice is what I refer to; and it is without fear of making a mistake that I assert that any house in Philadelphia can be warmed with one-fourth the amount of fuel, and with twice the comfort, by means of kakelungs, as with furnaces, if other conditions, peculiar to heating here, are at the same time observed.

AMERICAN BESSEMER WORKS.

The following facts concerning the present condition of the American Bessemer Works were communicated to the *Journal of the Franklin Institute* by Mr. A. L. Holley:—The product has been increasing from various causes—better organisation, better refractory materials, and chiefly numerous large and small improvements in mechanical details. In 1868 an output of 500 tons of ingots per month was barely reached in the best works; in 1870, the production at Troy and Harrisburg had risen to about 1,700 tons per month, maximum. Early in 1872 the Harrisburg Works turned out above 2,000 tons per month, and for a year or more these and the Cambria Works took the lead in this direction, the latter plant having run as high as 640 tons in one week. During 1873 the Cambria, Harrisburg, North Chicago, and Joliet Works averaged 25 to 30 heats of 5 tons each per 24 hours. During the week ending July 12, 1873, the Harrisburg Works made 180 heats, yielding 890 tons of ingots. The product of the Cambria Works, the week ending Janurry 17, 1874, was 189 heats, giving 956 tons of ingots. During one 24 hours (Friday, January 16), 46 blows were made. On Friday, February 13, 1874, tho Troy Works made 50 heats in 24 hours, yielding 267 tons of ingots. This is the most remarkable run on record. During the week ending April 4, the Troy Works made 195 heats, yielding 972 tons of ingot, which is the largest week's work. In January, 1874, the Troy Works made 2,899 tons of ingots, and in April the North Chicago Works made 3,526 tons, which is the largest month's work. These are all 5-ton plants, consisting of two 5-ton vessels and accessories, and they work only eleven turns, or five and a half days per week. The blooming trains employed at Troy, Cambria, North Chicago, Joliet, and Bethlehem, are capable of rolling more than the average product of the Bessemer works. The first of these was erected at Troy in 1870; the feeding tables was first applied by Mr. Fritz to the Cambria mill, and have since been applied to all the mills, with some modifications. The Troy and Bethlehem mills roll ingots fourteen inches square, weighing over a ton, to make three rails each. The other mills at present roll twelve inch two-rail ingots. The production of rails from blooms has been more uniform, because the rail train was a highly perfected machine long before the Bessemer process was introduced. The Cambria mill has often produced over 1,000 tons of rails per week, from a twenty-one inch train. Probably tho best week's running on record, all things considered, was the Troy, ending April 25, 1874, viz., 1,012 tons of sixty-two pound rails, in eleven turns, from nine furnaces and a twenty one-inch mill; of these there was not one second quality rail, and there were but $3\frac{1}{2}$ per cent. of short rails.

TELEGRAPHY IN THE UNITED STATES.

At the Broadway office of the Western Union Telegraph Company, a test was recently made of an invention which promises to be of almost more importance to the present age than were Morse's first achievements to the people of his own time. The test resulted successfully, and it proved that four messages can be simultaneously sent on a single wire in opposite directions, and with no more liability to mistake than if an equal number of wires were used. To make the matter clear it will be necessary to look a little backward. Morse took the first step in telegraphy—and the first is always the greatest —by the invention of a system by which messages could be sent between any two terminal points, and dropped at any way station on the circuit. The objection to his system was that the transmission of a single message occupied a wire entirely. And though electricians were convinced that a different result could be attained, no one showed how it could be done until so recently as three years ago, when Mr. J. B. Stearns invented the duplex apparatus. That was the second great step, and it instantly doubled the capacity of every wire which had been erected. By the Stearns process two messages can be sent simultaneously on a single wire in opposite directions between any two terminal points. But this system, like the Morse, had its objection—the message could not be dropped in any way station except by the use of a repeater. Nevertheless the invention was recognised as of immense practical importance throughout the world. A few days ago was taken a third great step, and one not inferior to either of the others. It needs only to be said of it to recommend it to the least scientific, that in one instant it will quadruple the usefulness of the 175,000 miles of wire owned by the Western Union Telegraph Company. It is a new process, a multiple transmission by which two messages can be sent simultaneously in the same direction over the same wire, and either message can be dropped at any way station on the circuit. Nor is this all. The old duplex system can be applied to the new invention, and by the combination four messages can be sent simultaneously over the same wire in opposite directions between any two terminal points. And not the least recommendation of the discovery is that it calls for no changes; the old Morse key is used, without the need of any new class of operators—as in the automatic telegraph—and with no duplication except as to parts of machinery. The invention is the result of the joint labours of Messrs. George B. Prescott and Thomas A. Edison. And if not scientifically, at least practically, a great deal of credit is also due to the enterprising policy of Mr. Wm. Orton, the president of the company. Of course, it is needless to add that the new system will be speedily put in practice by the Western Union Company, by whom the patent is controlled. It will make itself felt in more ways than one. For instance, the Western Union Telegraph Company have been forced to erect 60,000 miles of wire during the last three years, and, of course, at an immense expense. An indefinite future like that could not be very satisfactory to stockholders. But this year scarcely 2,000 miles need be erected, and every wire is practically four. But without further enlargement, and almost in the words of Mr. Orton, the discovery may be called the solution of all difficulties in the future of telegraphic science.—*New York Semi-Weekly Times.*

An inquiry has recently taken place under the direction of the Austrian Minister of Commerce as to the construction of a proposed canal between the Danube and the Oder. No decision has yet been arrived at upon the subject, but it is believed that although the plan is rather influentially supported, the chances of obtaining a state guarantee of interest upon the capital required for the execution of the work are very small.

PEAT AS A SOURCE OF FOOD.

In a recent article in the *Times*, on the mining and other undertakings carried on by the Duke of Sutherland, on his Highland estates, the following somewhat novel suggestion is put forward :—" The peat industry has not at present past beyond the experimental stage; but when we consider the state of the coal supply, the possible existence in Scotland and Ireland of an inexhaustible source of fuel becomes a matter of natural importance. The peat, dried in blocks in the ordinary way, forms an efficient household of furnace fuel, but its usefulness is limited by its bulk. At Forsinard, on the new railway, the Duke of Sutherland has set up a factory for the preparation of peat, and has placed it in the charge of Mr. Kidd, who has brought much thought to the subject. He has constructed a furnace of a novel character, which burns peat in a half-dry condition, and which, though of very small size, affords heat enough to carbonise large quantities of the same peat in an ordinary chamber, and to convert it into charcoal of very fine quality, said to be worth £4 per ton. Mr. Kidd does not rest satisfied with this result, but expresses a conviction, difficult at first to hear without a smile, that peat may be rendered highly valuable as an article of food. Dr. B. W. Richardson, in his recent address to the International Conference for the prevention of cruelty to animals, told his hearers that a time would come when all things necessary for the sustenance of the body would be prepared artificially by chemical processes, and when the slaughter of animals for food would entirely cease in civilised communities. However distant this time may be, and however much opposed to the real interests of the lower animals, which mankind would no longer have any interest in maintaining, Mr. Kidd is certainly labouring to promote its arrival, for he asserts, with unquestionable truth, that peat contains all the elements from which the body is built up, and with much confidence, that these elements can be separated from what is worthless, and presented in palatable and nutritious forms. He offers to visitors a preparation which is certainly not nasty, and which may possibly, although this remains to be proved, possess all the nutritive value which he claims for it. It would, indeed, be curious if a remote Highland district were to make the first step towards the practical fulfilment of Dr. Richardson's prediction, and if the new Sutherland and Caithness Railway were hereafter to render us a self-sustaining people, careless about free trade, and indifferent to bad harvests or to cattle diseases."

M. Ernest Stamm, an Alsatian engineer, has recently devoted his attention to the study of the question of a connection between France and Italy independently of Swiss territory. With this object the idea of tunnelling Mont Blanc is advocated by him in a paper read before the Société Industrielle de Mulhouse. A survey proves that while Chamounix is 3,445 ft. above the sea level, and Entrèves, on the south, 4,216 ft., a tunnel between the two points would not be longer, nor its gradients more difficult than the Mont Cenis tunnel.

It appears from a parliamentary paper that the total amount of capital proposed to be raised by the 281 railway and other private bills brought before Parliament this session was £63,363,240, of which it was proposed to raise £43,763,000 by shares and £19,602,240 by loans. Last year the amount of capital proposed to be raised was £86,893,943; in 1872, £86,444,834; in 1871, £29,719,190; in 1870, £23,670,299; in 1869, £29,221,706; in 1868, £25,207,356; in 1867, £42,638,775; and in 1866, £175,490,646.

During the year 1873 there were exported from Boston nearly 2,000,000 dols. worth of sewing machines, 350,000 dols. of agricultural implements, 106,000 dols. worth of carriages and parts, and 1,274,800 dols. worth of metal manufactures, machinery, hardware, &c., of the value of nearly 2,000,000 dols.

THE VIENNA TRAMWAYS.

The Austrians commenced tramways in their capital in 1868, and they have been rapidly developed and worked. A report recently published affords a good deal of general information on the subject.

Six months since the Vienna tramways extended in double line over twenty-five miles. The number of passengers has gone on increasing from six millions in 1868 to thirty-four millions in 1873, the exhibition year. In the last-named year the number of carriages on the line was 280, and the number of passengers per carriage, daily, was 338, each vehicle carrying sixty to seventy at a time. The average payment per passenger is less than 2½d., the receipts in 1873 amounting to £297,214, a large amount for a city with a population of only 825,000. Everything was favourable to the adoption of the growth of tramways in Vienna—an antiquated system of omnibuses, dear cabs, broad boulevards, populous outskirts recently added to the city, and railway stations a considerable distance from the centre of the city. Much experience has been gained respecting the best form of tramway carriages; at first they were built with *imperiales*, or seats on the roof, but these have been entirely abandoned.

The whole of the lines are in the hands of a single company. The lines are all double, and the steel rails lie on sleepers of oak with transverse sleepers of the same wood. The paving is excellent, and carefully kept. The construction of the lines cost £239,854.

At the commencement of the present year the company had 1,864 horses and 554 carriages, vehicles drawn by two horses, assisted where requisite by another horse ridden by a lad. The horses are from Hungary; they are smaller than the *percherons* used by the Paris Omnibus Company, and worth about £18 each. They are too hard-worked, and wear out rapidly; they are expected to run more than eighteen miles per diem. The company had to purchase 1,100 last year. The rations of the horses are abundant, and cost in 1873 about 1s. 10d. a day.

The company has not half its carriages at work; at first it had winter and summer vehicles, but afterwards the *saloon carriage* was adopted. This vehicle has eighteen places only, and the smokers and non-smokers are separated. The seats are transverse, with a passage through the middle as in American ca s, and only two persons on each seat. Stoves are used in the winter. The cost of a new carriage is £180, and although they are solidly built the repairs were found to amount to about 4s. 9d. per vehicle per day. This expense has, however, been reduced by one-half since the company established its own workshops.

The capital of the company is £500,000 in shares and £140,000 in obligations, total £640,000. The dividend and interest amounted in 1873 to ten per cent.; but it must be remembered that that was exhibition year, and if the receipts were large the expenses for extra horses and carriages were also large. The daily receipts per carriage average £3 less a few pence, and the expenses £2 8s. 6d., giving a profit for the year of £54,942, to which were added the receipts for dung, &c. It may be stated that previous years do not exhibit a result very much inferior to that of 1873, the number of passengers per carriage daily having been 317 in 1871, 331 in 1872, and 338 in 1873.

Continental statisticians have arrived at the conclusion that the right principle for tramway carriages is to have them small and running constantly; one of these Austrian saloon carriages has therefore been taken to Paris, and will most probably be the type of those to be used on the new tramways.

In the discussions respecting the proper kind of carriages and modes of working railways and tramways respectively the following conclusion has been drawn, namely, that the object of a railway is to collect as large a number of passengers as possible in a few trains, while the object of a tramway is to convert every yard of ground into a station and to pick up passengers so fast as not to allow them to accumulate.

CORRESPONDENCE.

FALL OF A CONCRETE BUILDING IN ISLINGTON.

Sir,—Referring to the article on concrete buildings, written by me, and published in your issue of the 4th ult., and to the fatal accident which occured on the 6th by the fall of a so-called concrete building while in the progress of erection near Islington-green, by the Monolithic Fireproof and Sanitary Construction Company, of 49, Cornhill, allow me to call the attention of your readers to two all-important facts that came out at the inquest. The first, which was elicited by the foreman of the jury, is, that it had not been deemed necessary to engage the services of an architect, and the second is that the clerk of the works, who was killed, had attained the age of 64, and had been a farmer all his life up to within two or three years of the time of his death. After leaving the country, till the time of his appointment as clerk of the works, the deceased had been in the office of a financial agent.

I examined the ruins the day after the accident, and perfectly agree with the editor of the *Building News*, who says in the number of that journal for last week, "After a careful personal inspection of the ruins we can only express our opinion that the greatest carelessness has been shown in the composition of the concrete. The manner in which the concrete was prepared and laid inevitably caused the result which has befallen it."

What practical person would have expected a concrete roof of 50 feet and 34 feet 6 inches in dimensions, even though it had two pillars of concrete each 1 foot 9 inches square towards the centre to support it, to stand, when it had been formed without the supervision of either architect or competent clerk of the works?

No competent clerk of the works, not to say architect, would have permitted the concrete for such a roof to be formed of a compound of selenitic lime and Portland cement, mixed with clean silicious sand.

The coroner, in his summing up, said no good would be gained by returning a verdict of manslaughter against a public company, so the jury returned a verdict of "Accidental Death," but added, as a rider, "and such death was due to the default of Noble (the deceased), and in the opinion of the jury the deceased was not competent to take charge of the building as clerk of the works."—I am, &c.,

Wm. Collett Homersham, C.E.

59, Caversham-road, N.W.

The committee appointed by the French Minister of Public Works to investigate the scheme for a submarine tunnel between England and France, has recommended that, on certain formalities being complied with, it should be taken into consideration. The experiments described in its report would occupy about a year, and if they were successful a concession would be granted.

The French Association for the Advancement of Science is to hold its third annual meeting at Lille, from the 20th to the 27th August of this year. The President of the Association for 1874 is M. Ad. Wurtz. Communications should be addressed to the Secretary of the Association, 76, Rue de Rennes.

The statue of Dr. Priestley, the discoverer of oxygen, was unveiled at Birmingham on Saturday, August 1st (the centenary of the discovery). The statue was presented to the town by Professor Huxley, who afterwards delivered an address in the Town-hall.

GENERAL NOTES.

Music by Telegraph.—At the last meeting of the California Academy of Sciences, the president, Professor George Davidson, said that Mr. Mumford, of the Telegraph Company, had shown him an instrument for the transmission of musical sounds along a telegraph wire. He himself heard distinct musical sounds sent 800 miles. He had asked Mr. Mumford to extend a wire to the Academy's building, so as to show the members this remarkable invention, but a detailed description of the instrument could not be given until patents were obtained.

Egyptian Railways.—It appears that the State railways of Egypt were worked in 1872-3 at $40\frac{1}{2}$ per cent. of the gross receipts, the gross receipts of the financial year having been £1,478,395, while the working charges were £598,825. The low ratio of the working expenses to the traffic receipts is accounted for by the cheapness of labour in Egypt, and the practice of employing soldiers on the lines. The locomotive expenses of the lines for the past financial year were £285,545, that sum included £188,440 for coal and coke.

New Steel Yacht.—A steel yacht has been built in Philadelphia, with expectations of going 26 miles per hour. The result at the first trial was 21 miles. Her plates are one-sixteenth of an inch thick, with a bow little less than razor sharpness. The frames are steel, the angles being only $1\frac{1}{4}$ inch thick and 14 inches apart. All the seams are double rivetted. Her locomotive boiler has been tested to a pressure of 200lbs. to the square inch. Her cylinders are 10 inches in diameter and 10 inches in stroke. The screw is four feet in diameter with seven feet pitch. This little craft is termed the *Aerolite*, and is destined for Egypt.

The St. Gothard Tunnel.—The works of the St. Gothard Tunnel were advanced during the month of June 134 metres, of which 71 on the Goeschenen side, and 63 on the Ariolo side. At the 30th June, 1,031·50 had been driven at the north end, whilst the total advancement at the south end was 925·90, making a total length of tunnel driven of 1,957·50, so that by the present time more than two kilometres of tunnel have been pierced. During the first three quarters of the second year of working, viz., from 1st October, 1873, to 1st July, 1874, 1,165 metres of tunnel has been driven, of which 655 on the north side and 510 on the south. The progress at the Goeschenen side has been very successful considering the continuing hardness of the rock. On the Ariolo side the works are much hindered by the great influx of water. But there is every reason to anticipate that better progress will be obtained each successive month, as was the case at the Mont Cenis Tunnel, and that this gigantic undertaking will be completed considerably within the specified time.

Forest Clearing by Steam.—Some experiments in the clearing of wooded lands took place recently at Bonerbo, near Anstruther, Fifeshire. The experiments were carried out under the auspices of the Canadian Land Reclamation Company, and were intended to demonstrate the ease with which the forests of Canada could be cleared by means of a new patented process. This process owes its origin to Mr. A. Gilchrist, manager in the east of Fife for the Scottish Steam Cultivation Company, who some two or three years ago suddenly conceived the idea of attempting to pull out the roots of trees by means of the traction engines used in steam ploughing. A traction engine, of twelve horse-power, is stationed some distance off from the wood, and a wire chain is fastened to the tree. Steam is then put on, and the tree is pulled forcibly out by the roots. An objection to the adoption of the process was that it would injure the wood by splitting the tree, but the experiments showed that, with proper precautions, there was no fear of such a result. In the course of five hours upwards of 300 trees in a plantation nearly 100 years old were pulled out. Of that number, not above six were broken, and in these cases the result was wholly due to the inexperience of the ploughmen engaged in the work, who placed the chain too high up the tree. It is hoped that the method may prove applicable to the clearing of new tracts of forest land.

Railway Statistics.—A Parliamentary return just published states that in 1873 there were in all 1,682 miles of railway in the United Kingdom. The total authorised capital amounted to £676,686,586, of which £588,320,308 was paid up. The number of passengers, exclusive of season-ticket holders, was 455.320,188. The total receipts from all sources amounted to £57,742,000, of which 55 per cent. was from goods traffic, and 41 per cent. from passenger traffic; 53 per cent. of the gross receipts was consumed in the working expenditure, leaving £26,989,152 for net receipts. This was 4·59 per cent. on the total paid-up capital.

Sub-Wealden Exploration.—The Sub-Wealden Exploration, which has hitherto been conducted almost solely by private enterprise, is now to be assisted by a Government grant. A short time ago Professor Ramsay and Mr. Henry Willett waited upon the Chancellor of the Exchequer, and pointed out the precise object of the exploration, with the view of seeking aid from the Government. The application has resulted in the recommendation of a grant of £1,000, to be paid at the rate of £100 for every hundred feet pierced in excess of 1,000 feet. For example, if the boring should be continued to 1,500 feet, the committee would be entitled to £500.

Iron in Greece.—According to an official report from Syra, a considerable quantity of iron ore has been shipped from the Island of Seriphos for England by the Hellenic Metallurgic Mining Company. The first shipment was made in 1872, and up to the end of October last seven steamers had traded about 8,000 tons of this ore for Newcastle, where it is said to have been successfully smelted at the Royal Greek Ironworks, erected near that town, and to have given 64 per cent. of excellent metal. The quality of the Seriphos iron ore is said to be equal, if not superior, to the best Swedish or Spanish ores. A consignment of about 500 or 600 tons has been shipped from Seriphos for Koumi, in order to make the experiment of smelting it with the coal found at that place.

Steel Rails.—It is said in *Les Mondes* that several of the French railway companies are adopting steel rails. The Eastern Company has laid on a portion of its system rails of the Vignoles type, of Bessemer steel, weighing 36 kilogrammes per metre. The Northern Company has adopted a rail weighing 30 kilogrammes, 300 per metre, for its entire system. The Southern Company is being supplied with rails of 38 kilogrammes per metre. The lines of the Western Company are also largely laid with steel. Two principal advantages, it is stated, result from the substitution of steel for iron. The steel rails are worn away gradually and evenly, whereas the iron are often rendered useless before having lost any considerable portion of their weight. The best iron rails cannot resist a traffic greater than 20 millions of tons (in some cases not more than 14 millions). The steel rails may last a time corresponding to a traffic of 200 millions of tons.

The Influence of Soil on Cholera and other Diseases.—The influence of different kinds of soil in assisting or retarding the progress of cholera has been discussed at a recent meeting of the Académie des Sciences. M. Decaisne, following in the steps of Herr Pettenkofer, of Munich, has been engaged in making researches on the subject, and the results of his investigations show at any rate a curious coincidence between certain kinds of soil and the spread of the disease. For the purpose of proving the correctness of his theory, M. Decaisne has applied himself to the examination of the sanitary conditions of three large towns of France—Lyons, Versailles, and Paris. It is well known that the two first-named cities have always resisted the attacks of cholera. The disease has never laid strong hold upon them, and M. Decaisne not unnaturally seeks for some explanation of this comparative immunity which these towns have enjoyed. On the other hand, Paris yields itself an easy prey to the ravages of the epidemic, and seems rather to attract than repel its visitations. Accepting these well-established facts, M. Decaisne finds what he conceives to be their explanation in the different character of the soil underlying the three towns. Versailles is built on a bed of clay, impervious to water; Lyons stands upon granite; while Paris is constructed upon a porous foundation. Of course M. Decaisne does not attribute the presence of cholera to this fact alone, but his arguments are directed to show that it may act as a powerful influence.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

GENERAL EXAMINATIONS, 1875.

The Programme is now in preparation, and will shortly be published. "English History" and "Logic" will be discontinued; and the general subject of "Gardening" will be substituted for the two subjects of "Floriculture" and "Fruit and Vegetable Culture." A new subject, to be called "Commercial History and Geography," will be added to the Programme, which in other respects will be similar to that for the present year.

TECHNOLOGICAL EXAMINATIONS.

The programme for these Examinations is in preparation, and will shortly be issued. It will include the nine subjects of last year, viz., Cotton Manufacture, Silk Manufacture, Paper Manufacture, Steel Manufacture, Carriage Building, Cloth Manufacture, Glass-making, Pottery and Porcelain, and the Manufacture of Gas, with the addition of four new subjects, viz., Agriculture, Silk and Woollen Dyeing, Calico Bleaching, Dyeing, and Printing, and Alkali Manufacture.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

MACHINERY, ENGINEERING, AND CONSTRUCTION.

(*Continued from page* 762.)

In the preceding section the exhibits of machinery relating specially to the treatment and manipulation of iron having been treated of, those connected with the working of stone come next in order of classification. Of this class it may be generally remarked that they are of quite recent origin and introduction, in comparison with those relating to iron; and indeed this is almost an obvious corollary from the difference in character between the two materials, iron being, so far as regards its treatment and working by manual labour, comparatively an intractable and refractory material, seeing that it is impossible, without the aid of machine-tools, to work it into any desired shape and condition, as to surface and dimensions; whereas there is scarcely any stone, even the hardest marble, granite, and the like, which cannot be cut, tooled, and worked by hand to any desired mould or form, plane, angular, or curvilinear. The invention and application of machinery for the treatment of stone not having been a matter of necessity, it has therefore remained longer in the dormant and inchoate state, so to await, as it were, for the uprising of a stimulus of purely industrial origin, due, as in many other cases, to the modern antagonism between capital and labour, master and man, and culminating in the arbitrary dictation of trades unions. The desire, as far as possible, to attain independence of skilled labour in masonry, has been the prominent cause, within the last few years, in the development of machines for dressing and moulding stone, purposes previously deemed beyond their scope.

II.—Stone Machinery.

In this department there is, unfortunately, but one large and important exhibit directly affecting the working of stone:—

No. 6,051. The Patent Machine Stone Dressing Company, in Room II. of the Western Galleries (Machinery in Motion), display their Machine for the dressing of stone by power (Holmes and Payton's Patents).

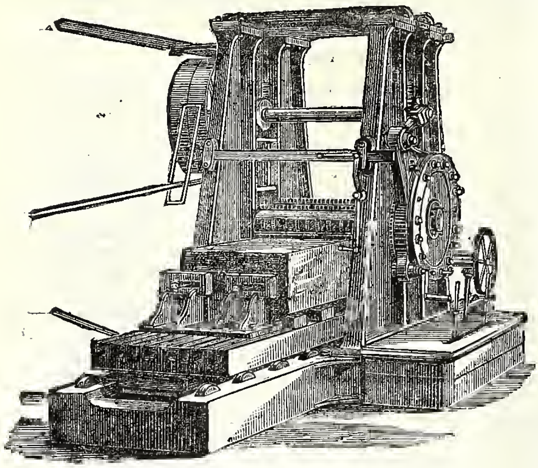
The machines used by this company are mainly of two kinds, not differing materially in construction and operation, but only in power; the heaviest and most powerful machine being intended and adapted for the dressing and working of the hardest stone, granite; a lighter and less powerful machine being employed for stone of an inferior degree of hardness, such as Red Mansfield, Yorkshire Grit, Bath, Portland, and the other varieties of limestones and sandstones. The machine exhibited, whereof a general view is given in the annexed engraving, is of the second, or lighter class, suitable for the dressing of any stone short of granite, a standard of which the Red Mansfield stone, above enumerated, may be regarded as the representative in the superior limit.

As will be seen, the general form of this stone-dressing machine is not dissimilar to the class of planing-machines familiar to the frequenters of the workshops of mechanical engineers, whereby iron is brought to a perfectly smooth plane surface, with such modifications as are dictated by the different nature of the material to be operated upon in this case. There is a stout, strong, and heavy foundation framing or bed-plate, whereon are firmly bolted down two suitable strong vertical side-frames, braced across and stayed at the top by means of a top-framing, the whole being of iron. The working parts of the machine proper are two, namely, the horizontal travelling-bed or table, and the dressing or tooling apparatus. In the upper part of the vertical framing is carried the transverse shaft, with fast and loose pulleys, whereby the cutting tool is actuated from any suitable prime-motor, fixed or portable engine or other. There is also a first-motion shaft, whereby through suitable gearing on countershafts the other requisite motions of the machine are obtained, and this is driven by another set of fast and loose pulleys.

The description in detail of the parts of the machine will be elucidated and simplified by a consideration of the objects sought to be attained, and a comparison with similar work done by hand. In manual work a rough surface is reduced by continued strokes of a hammer on a tool with a cutting edge, whereby the projections and roughnesses are gradually chipped off in fragments, leaving a ribbed or tooled surface. In the operation the block of stone is a fixture by its own weight, and the hand-tool passes over its entire surface, from end to end and from side to side. This machine for dressing stone has been devised to imitate, as nearly as practicable, the action of the tool in the masons' hands; but it is found most practicable and convenient to invert the motion and to make the tool stationary, at least in

the horizontal plane, and to cause the block of stone which is to be dressed to travel beneath it. Moreover, inasmuch as some blocks are thicker than others, and as the cutting operation proceeds the thickness of the stone diminishes, it is necessary that the cutting tool should be moveable in a vertical direction to correspond. This being understood, there are two traversing motions requisite; one of horizontal traverse, to and fro, beneath the cutters, for the stone; and another of vertical traverse, up and down, for the tool. These are therefore attained and communicated as follows:—

Upon the first-motion shaft a bevel wheel gears into a similar wheel on the second-motion shaft, which runs longitudinally alongside the bed-plate, and carries two



Holmes and Payton's Stone-Dressing Machine.

pairs of double geared bevel-wheels and clutches, for the reversal of motion; one of these duplicate reversing gears engages in a bevel-wheel fixed on a short vertical spindle, carrying a worm which gears into a spur or worm wheel on a transverse shaft, whereon also is a spur pinion engaging in a rack attached to the underside of a solid moveable bed-plate which runs upon rollers in the foundation-frame and forms the travelling table; by this rack and pinion motion the table is made to travel from end to end of the bed, and back again by reversal of the gear. The table is slotted on its upper surface with suitable T-grooves, for the attachment, by means of bolts and nuts, of cast iron blocks or bracket frames, provided with screw bolts and nuts, for the purpose of firmly holding the block of stone.

The other pair of duplicate reversing gear, by means of suitable intermediate gear and shafting, actuate two vertical screw shafts, passing up in recesses in the vertical side-frames, and working in two sliding blocks therein, so that the latter, which carry the cutter-crosshead, are elevated or lowered as may be requisite by the screw motion in alternate directions. Lever-handles are provided, by which the clutches are thrown in gear on either side, or out of gear entirely, as is necessary at every change of cut and motion.

The vertical side-frames are practically in duplicate, each consisting of two parts, joined at top by a casting, and having their internal faces planed, to act as slides for the blocks, which carry two transverse shafts, that of the cutter-crosshead below, and the driving shaft above. Thus at whatever height above the table the cutters may be set, and throughout their continuous traverse downwards, the driving-shaft, when in gear, imparts to the cutters the peculiar action which constitutes the speciality and distinguishing characteristic of the machine, viz., a continual jigging motion of oscillation or rotary reciprocation; this motion is generated by means of an eccentric and short arm on the driving shaft, connected by a pin to an arm or disc on the axis of the cutter-crosshead. This crosshead is provided with duplicate sets of cutting tools, set face to face at a certain interval of its periphery, and intended to do the work of cutting in opposite directions: of these one pair are plain steel knife-edges, extending the whole length of the shaft, from side to side of the machine, and the other pair are series of steel chisels or cutting tools set side by side like the teeth of a comb. The action of these tools depends in great degree upon the angle at which they are brought in contact with the stone, at the successive strokes; and this is adjusted by an ingenious device, which is the invention and patent of Messrs. Ellington and Johnson, the engineers by whom this machine was made, and applied by them thereto; consisting of a double regulating disc.

The object of this duplicate-disc regulator is to obtain the power of adjusting the angle or set of the cutters by means of a differential motion of the discs. The jigger-arm of the driving shaft is attached to a disc which is carried loose on the shaft of the cutter-crosshead, in close proximity to a similar disc which is also carried on that shaft, but firmly keyed thereto. In a projection on the periphery of the latter of the discs is carried the shaft of a spur-pinion, gearing into a spur-wheel or rack on the circumference of the other disc; so that by means of a winch-handle the cutter-crosshead can be made to rotate through the entire circumference.

The fixed or outer disc, or face-plate, is divided round its outer edge into 16 equal intervals, corresponding to angles of $22\frac{1}{2}$ degrees, by as many circular orifices; and the back-plate is similarly divided into 14 intervals, which are therefore larger than those in the face-plate. The arrangement is such that in the normal position of the discs, *i.e.*, when the cutters are exactly vertical, or perpendicular to the face of the work, the two holes which are uppermost in each disc coincide, and form a zero-point, the others in their relative positions constituting a species of circular vernier-scale; a loose moveable plug or pin completes the connection or attachment between the two discs. Any one orifice in the face-plate being brought into coincidence (by the handle and pinion) with any other orifice in the back-plate, the discs are fixed in that position by inserting the plug, and thereby the cutting tools are set at a corresponding angle, to work in one direction only, according to the work to be done. By bringing the corresponding pair of orifices, on the other side of the zero or index, into coincidence, the cutters are set at the same angle, but in the opposite direction, for the return motion of the travelling table and block. By making a half-revolution of the disc, the opposite pair of tools are brought into action, with corresponding adjustments.

The cutting tool having been thus duly set and adjusted, as desired, according to the nature of the work to be done, its level in relation to the surface of the block is adjusted by means of the vertical screw motion: This having been effected, the driving shaft and jigger-motion are set in action, and the clutch thrown in gear for the forward traverse of the table and block, until the whole surface has been dressed over, when the travel is stopped; the cutters are then set at the opposite angle, the cutter-stock lowered by the screw motion the depth of one cut, and the clutch reversed for the return journey of the block. The speed of travel of the block is about 4 ft. per minute, higher or lower as the quality of the stone may vary. A depth of one quarter of an inch can thus be taken off at one cut, so that three or four traverses in general suffice for the production of a perfectly true and well tooled surface on an ordinary scappled block. If a plane untooled surface is required, the driving shaft and jigger-motion are thrown out of gear, and the surface is finally finished off by the knife-edges, whereby it is planed down.

In this manner plane surfaces, and blocks for ashlar

work, can be dressed, or faced and jointed, at an average rate of one minute per square foot, which may be estimated at from six to fifteen times as much as can be effected manually. All kinds of straight mouldings, steps, &c., can be dressed by this machine with speed and facility. The cost per superficial foot of stone surfaces thus prepared may be stated approximately to average from 1d. to 1½d.

For the purpose of reducing wear and tear, the wearing surfaces are throughout made large, and all the parts of the machine of ample size and strength; for the cutting tools, cast-iron, chilled in a peculiar way, is employed, and found very durable, and capable of executing a large amount of work. The machines vary in size from a 2-horse power machine, weighing six tons, suitable for blocks 18 inches square by 8 feet long, up to one of 4½-horse power for blocks 15 feet long by 5 feet square, and 16 tons in weight. Machines for dressing granite are made somewhat stronger and heavier at all points, and may be taken to weigh about 33 per cent. heavier (for the same sizes) than those above quoted.

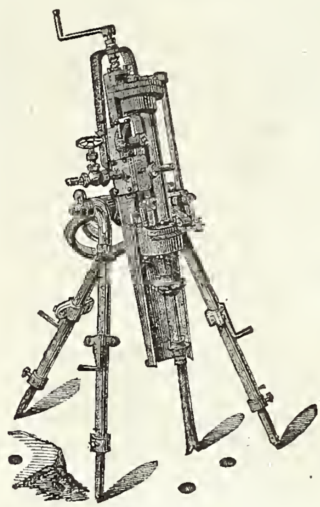
In the Universal Exhibition at Vienna last year, the Medal of Progress was awarded to this company for their stone-dressing machinery; and at Vienna, as well as on many large works in this country, the machine has been adopted; such as, *e. g.*, the new buildings of St. Stephen's-chambers, Westminster, on the Thames Embankment, and of Queen's-buildings, Queen Victoria-street, City. It is also used by Messrs. G. Trollope and Sons, and other large contracting building firms. Specimens of surface dressing, on blocks of stone and marble, are on view at the Exhibition alongside the machine itself, showing the regularity and accuracy of work thus effected.

In Room V. are exhibited two machines of a class, such that, though not strictly appertaining to the working and dressing of stone, yet as being adapted for use in the quarrying and "getting" of stone in blocks from the primeval, stratified, and other rocks, they demand notice in this article—these are machines for drilling and boring holes in rock. They are percussive rock-drills, and, like all machines of their class, resemble a steam-hammer, consisting mainly of a steam cylinder with a double acting reciprocating piston, whereof the piston-rod terminates, at its lowest extremity, in a cutting or drilling tool. The steam pressure, when admitted at the lower end of the cylinder, raises the piston, rod, and drill-bar; and when admitted to the upper end, above the piston, assists their downward fall by its impulse. The blows thus given are effective from their force and rapidity, whereby the beds of rock and stone are penetrated at a rate proportioned to their nature and quality of resistance. It may be noted that the change of steam by the alternate opening of the induction and eduction ports at either end by the valves, is effected by the reciprocal motion of the piston itself, and without the aid of the ordinary appliances of a steam-engine for this purpose, viz., cranks and eccentrics. It is obvious that for continuous boring the whole machine must, by some mechanical device or other, be made to progress forward at a rate corresponding to the penetration of the rock, and this is effected by a feed motion. In another respect also it is necessary, for good and effective work, that the piston and boring-bar should have a step-by-step rotary motion imparted to them, in order that the drilled hole may be truly circular and straight. This general description applies to all percussive rock-drills, which differ only in the special construction and devices whereby the chief movements above referred to are effected. They may be worked by compressed air as well as by steam.

No. 6,039. Messrs. Le Gros and Silva exhibit the Ingersoll Rock-drill, as represented in the accompanying engraving.

The characteristic feature of the Ingersoll Rock-drill is that its feed-mechanism is automatic. To obtain the power of self-acting motion in the feed is not easy of attainment; and, if the forward motion is not proportioned to the degree of penetration at each stroke, there is risk of the piston striking the cylinder cover; but this difficulty is effectively overcome by the device adopted.

As will be seen, in its ordinary form the whole machine is carried by trunnions on a tripod stand, whereof the legs are telescopic and may be lengthened or shortened, being fixed by screws; their relative positions can also be altered so as to effect any desired change in the position of the machine. Upon the trunnions the frame rests, and can be oscillated in any desired direction. The frame consists of a semi-cylindrical shell, having on each side V-shaped pieces, corresponding and fitting into similar grooves in the side of the cylinder, and forming slides and guides for the cylinder when fed down by the feed-ratch, or raised by hand by the feed-screw. The cylinder is provided with a steam-chest and ordinary D slide-valve, abutting against two short valve stems, which in their turn abut against and are acted upon by two tappets, one at the top and the other at the bottom of the cylinder; these tappets have a rounded shoulder, projecting slightly into the cylinder, so as to come in contact with the piston at each end of its stroke. When the piston reaches the top of its up-stroke, it strikes the upper tappet, forcing it back, and thereby changing over the valve so as to admit steam above the piston, and exhaust the steam from below the piston, and at the same time, by the lower valve stem, pushing the lower tappet shoulder forward into the cylinder; this being struck on the descent of the piston, at the bottom of the down-stroke, changes over the steam, and again puts the upper tappet in position, and so forth in alternate and contrary action.

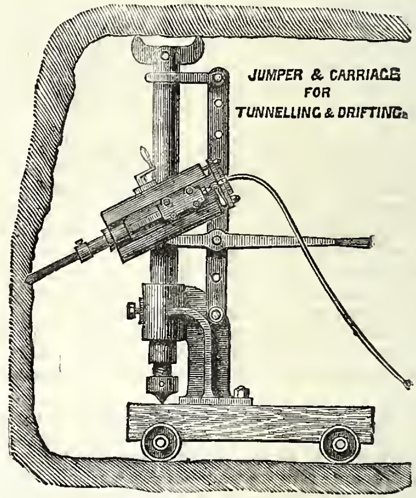

The Ingersoll Rock-drill.

The necessary rotation of the piston is guaranteed by a species of rifling in its upper part. A hole is bored in the top of the piston to a suitable depth, into which fits (so as to move easily without binding) a round steel bar, which passes through the top cylinder cover, and is fitted with a ratchet wheel provided with two pawls. The steel bar is rifled with eight grooves, having pitch of one revolution in about 7 feet; and in the head of the piston a brag-nut is fitted, threaded to correspond with the rifling. The stroke and pitch are so regulated as to give the piston and drill-bar about twelve strokes in each revolution. At the up-stroke the piston makes one-twelfth of a turn with the rifling,

ascending the rifled bar; at the down-stroke, the piston descends in a right line, carrying the spiral forwards, or rather causing the rifled bar to make one-twelfth of a turn; thus operating alternately to generate a perfect and efficient intermittent rotary motion in the piston and drill-bar.

The cylinder is made somewhat longer than the stroke or distance between the slide-valve tappets, so as to permit of a space for cushioning the piston at each end of the stroke with steam (or compressed air). In the lower clearance at the side of the cylinder opposite to the valve-tappet, but a little lower down, is placed a corresponding tappet, which acts upon a spindle placed outside the cylinder, and carrying at its upper end a pawl engaging in a ratchet wheel at the top of the cylinder working on the feed-screw, which passes through a collar in the frame. This tappet motion, with its pawl and ratchet, whenever struck by the piston, operates the downward feed of the cylinder on the slides in the frame in proportion as the drill-hole is deepened; but if from the hardness of the rock, or any other cause, the stroke is ineffective, and insufficient penetration ensues, the piston stops in its descent short of the feed-tappet, and consequently the downward feed is arrested. So soon as, in the progress of the work, the cylinder has descended to the bottom of the guides and frame, it is raised to the top of the frame again, by turning the feed-screw in the reverse direction with a handle; another length of drill-bar is then attached to the piston, and the operations are resumed. By the relation above described between the positions of the lower valve-tappet and the feed-tappet (there being a difference of about $\frac{3}{16}$ths of an inch), the steam is always admitted to the bottom of the cylinder before the piston completes its stroke and sets the feed-motion in action, thus efficiently cushioning the piston, and preventing its striking the cylinder cover. All the working parts of the machine are therefore at rest when the blow is struck, and the effects of the concussion is entirely borne by the drill-bar, piston-rod, and piston, which form, as it were, one solid rod, independent of the rest of the parts, so that it can be easily withdrawn from the cylinder. These arrangements conduce to diminution of wear and tear, and consequent expenses of repairs and maintenance. The parts of this rock-drill are few, and its arrangement simple and easy. For the purpose of preventing vibration and displacement when the drill is running, a heavy weight is fitted and carried on a lug on each leg of the tripod. This kind of frame is most suitable for vertical boring, and in places where access is not free; but the machine itself may be fitted and used with various kinds of carriages, either singly on a tunnelling column, which, by means of a screw, can be clamped in any position across a driftway or heading, horizontally or vertically; or singly or several machines on a suitable gadding car or frame. The machines are made in various sizes, the largest having a 5-inch cylinder, being 700 lbs. in weight, and being adapted for boring holes for heavy excavations in rock, from two to five inches in diameter, and to a depth of 40 feet. The blows are delivered at the rate of 400 per minute, with a stroke of $5\frac{1}{2}$ inches in hard rock, or 8 inches in soft rock. The next size has a 4-inch cylinder, weighs 500 lbs., and is intended for medium use, for holes up to 3 inches diameter and 15 feet depth, blows 400 to 500 per minute with a 7-inch stroke. The smallest size, $2\frac{1}{2}$-inch cylinder, weighs 130 lbs.; its stroke is $3\frac{1}{2}$ inches, delivery 800 blows per minute, and will bore holes to a depth of 6 or 8 feet, and from 1 to $1\frac{3}{4}$ inches in diameter: this is a suitable size for block holes, mining and sinking shafts, and gadding in quarry work. The judges of the American Institute have for three successive years, 1871-73, awarded a medal for superiority to this rock-drill, which is an American invention, much used in the United States.

No. 6,044. Mr. J. A. Warrington exhibits the Kainotomon Rock-drill, an English invention, the patent of Messrs. Brydon and Davidson. This machine has not a self-acting feed-motion, but requires to be fed down by hand, by screw motion, *pari passu* with the execution of the work of penetration in drilling the hole, and can thus be fed down rapidly if needed, in case of a seam unexpectedly occurring in the rock. It may be fed three inches out of stroke, without stopping the working of the drill. As exhibited, this machine is mounted on a tripod stand, but may also be fitted to and worked on a clamping column and carriage, for use in tunnelling and drifting. The machine is attached to the stand by a peculiar clamp, which acts like an universal joint. This clamp has a cylindrical bar passing through it, provided with two gripping



The Warrington Rock-drill.

plates at the top and bottom, or on opposite sides, so contrived and arranged, that by a single set-screw the machine can be adjusted and secured at any angle, or readily released and altered to a fresh position. For this purpose the clamp is formed with a projecting boss, with an external screw-thread, which enters into the shell of the jacket on the cylinder and is therein secured by a screw-collar; this being made a working fit so as to admit of the machine being turned freely into any position when the set-screw is loose; the machine turning on the cylindrical bar, and the screwed boss, in two planes at right angles to one another, thus commanding the whole circuit. On tightening the set-screw, the cylindrical bar will be gripped firmly between the two gripping-plates, whereby the clamp will be secured on the bar, while the opposite or internal gripping-plate will be pressed up against the surface of the jacket, so as to tighten the clamp against the jacket, and prevent motion on the screwed boss; thus a double grip is obtained by one set-screw, and simultaneously released by the same.

The jacket is of cast steel, or other suitable metal, and forms the slides and guides, wherein the cylinder is fed forwards or downward by screw motion, through a screw, with pair of bevelled wheels, and suitable handle.

The cylinder is of uniform diameter, and the piston-rod carries two pistons. The induction ports from the two ends of the cylinder are brought to the steam chest in the centre, within which works the valve, which is the peculiar speciality of this invention. It is an oscillating tappet-valve, vibrating on a pivot, the head being pierced for the valve-orifice, and the opposite arm projecting into the cylinder, and being provided with a projection or stud at its extremity, which, when struck alternately by the internal faces of the double piston,

effects the requisite reciprocating movement of the valve. The exhaust orifice is formed in the face of the valve, which works in contact with a port-face in the valve-casing, and all the ports are formed with sides radiating from the pivot, in lieu of being straight.

Another speciality of the Kainotomon rock-drill consists in the method of rifling, whereby the continuous partial rotation of the cutting or boring tool or drill is effected; a device which consists of a special attachment to, and downward prolongation of, the cylinder-neck through which the piston-rod, which carries the drill, passes. Within the cylinder-neck a tube is loosely fitted upon the piston-rod, being held in position by a screwed cap: the piston-rod is fitted with a projection, stud, or feather, which works in a spiral groove, having the desired pitch, cut in the internal periphery of the tube or sleeve, thereby rotating the piston-rod and drill on the back or up-stroke. A catch, held in position by a cap and two screws, and pressed by a suitable spring, engages in a ring of ratchet teeth cut in the upper end of the sleeve; and the arrangement is such that the sleeve is free to rotate on the forward or down stroke of the piston, but held stationary on the return stroke; thus the effect of the rifling communicates a partial movement of rotation alternately to the sleeve and the piston-rod. Washers are fitted at the cylinder-neck around the piston-rod to act as buffers to the piston, and absorb and prevent injury by concussion. A method of making the feed-motion automatic by suitable gearing and devices connecting the feed-screw with the rifled sleeve, so as to communicate to the former the intermittent partial rotary motion of the latter, is provided for by the inventors, and presents obviously no practical or mechanical difficulty; but they accord preference to the hand-feed, as in the machine exhibited, for which they claim advantages.

This rock-drill may of course be worked by steam or compressed air; indeed, in the selection of a motive power, it is obvious that, in mining operations especially, the latter affords many advantages, the exhaust air conducing to ventilation. Three sizes are made, viz., for 1 to 1½ inch holes, for mining purposes, weight 249 lbs.; medium for 1¼ to 2 inch holes, in quarrying and open cuttings, and sinking large shafts; and a large size for 2½ to 3½ inch holes, and the heaviest class of work in tunnelling, &c. The rate of progress varies from 3 inches to 1 foot per minute, according to the nature and quality of the rock which has to be penetrated, and the size of the machine employed. The largest sized machine will drill and clear itself effectually down to a depth of 20 feet. The Kainotomon rock-drill will penetrate the hardest rock, such as granite, quartz, gneiss, ironstone, whinstone, &c., and it may be used at any angle and in any position and direction, being of course suitably mounted.

As intimately connected with the subject of rock-drills, it may not be out of place to note that the Diamond Rock-Drilling Machine Company, although they do not exhibit their machine this year (as it formed a prominent and important exhibit last year in this same room of the Western Annexe of machinery in motion), nevertheless show in the Southern Galleries, Room XXII., in the class of Architectural and Building Appliances, some excellent and instructive specimens of the cores which are brought up by their "Diamond" rock-drill, forming complete and useful practical records of the precise nature and thickness of the different strata penetrated; a classification and index which possesses undoubted value in all prospecting operations, undertaken with the view of determining the exact nature of the mineral treasures of the earth's crust, which lie buried beneath any particular locality.

The foregoing exhibits are all that may be regarded as representative of the class of machinery for the working of stone, and the next to be treated of will be those connected with timber.

(To be continued.)

THE ETHNOLOGICAL COLLECTION AT THE INTERNATIONAL EXHIBITION.

By P. L. Simmonds.

The attempt which has been made by the Commissioners of the Exhibition to form a collection illustrative of aboriginal manners and customs is highly praiseworthy, calculated to be of high interest and instruction. The collection, although at present small, forms the nucleus round which might be drawn a large number of existing public and private collections, and from it might well spring a permanent museum. If the ethnological collection of the British Museum, the Christy collection, the fine collection of Col. Lane Fox, now on view at the Bethnal-green Museum, and those of other private collectors, could be brought together and geographically arranged, very much might be done to form a museum highly creditable to the nation, for be it remembered we have more native tribes under our jurisdiction than any other State. Look, for instance, at all the eastern races and tribes in our possessions in India and the Straits Settlements, Labuan and Hong-Kong, Ceylon and Mauritius; in Australia, New Zealand, and the Fiji Islands; in South Africa and the Cape Colony, Natal, and the settlements of Western Africa; in North America, British Guiana, and Honduras. But there are other aboriginal races of great interest in various quarters in the Arctic regions, in the Central American States and Brazil, in French and Dutch Guiana, Chili and Patagonia, and the vast islands of the Eastern Archipelago and Pacific.

Many of these natives are, from the contact of civilisation, the experience gained by travel, and the inroads of commerce, adopting European habits, dress, and manners, as in several of the Pacific Islands, in Japan, China, and parts of India. The native peculiarities of dress, utensils, weapons, and rude manufactures will soon become obsolete, but by patient assiduity, and at a comparatively small outlay, most instructive groups and collections might be formed, with all the accompaniments of descriptive labels, drawings, prints, photographs, &c., likely to interest the eye and inform the mind. If "the proper study of mankind is man," what can be more instructive for the information of both young and old than to place prominently forward all that can educate and inform them respecting the numerous races and tribes of mankind? Even the objects already shown in the Albert Hall gallery form a most interesting series for examination and description, and I propose furnishing some details thereon, commencing, however, in this section, with a few introductory remarks, taking up first the Australasian tribes.

With the changes which the inroads of civilisation are making, and the gradual decrease, and, in some instances, annihilation, of the native tribes, it becomes increasingly interesting to study the rude tools, weapons, clothing, and other articles which they employed or manufactured in bygone days. The arts and manufactures of a people are the most valuable records of its history. What important ethnological facts have been ascertained and established by means of broken pottery or rusted metal! For many reasons it is desirable that collections of aboriginal implements and productions should be preserved.

The very small amount of authentic information which the literary and scientific men of Europe have been able to obtain about the state of man in his natural condition surprises us. In the untutored savage of the woods we have before us what our own forefathers were, what nearly every race has been at some period of his existence. No work would present such food for calm reflection as an unvarnished picture of the phases through which the most polished and learned nations have passed. We have the savage roaming the woods in quest of food, followed by his obsequious wife and children. In all savage countries woman is inferior to man and turned

into a domestic drudge. We have next a semi-barbarous people, rearing a few domesticated animals, and partially depending upon the chase for support. The race now fairly emerges from the dark regions of barbarism into the light of civilisation. We have a polite and literary nation living in proud cities, and attired in their gayest and most fashionable habiliments. The female sex now holds undisputed sway in its own proper sphere of action in domestic and social life. Science is called in to aid human exertion, the liberal arts are cultivated, and man is as perfect as he appears capable of becoming in this world.

We may observe humanity under singular aspects, but all races have many peculiarities of one common nature. The transition from rude barbarism to moral civilisation is the least seldom accomplished; when knowledge illuminates the mind, high civilisation is sure to follow. We suppose here, however, that a nation effects this vast revolution for itself in consequence of intercourse with more civilised states. In the colonies of great nations a far different result follows upon the occupation by the superior race. The highly civilised have intruded upon the savage tribes, and as they have multiplied, the aborigines have slowly been exterminated by war, hunger, and disease. The moral right of civilised nations to occupy lands that only bear a scattered and scanty race of aborigines appears undeniable. Political economists have drawn a line of demarcation between land unoccupied, and land actually in cultivation. The right of property in the soil is the capacity to turn it to proper advantage. Thus a nation may be barbarous and, yet be able to to cultivate agriculture and commerce, and to turn the soil to every advantage, and no nation ought to dispossess it. On the other hand, a fine continent capable of maintaining myriads of human beings in comfort, may be occupied only by a few nomadic tribes, without a foot of land in cultivation, and without a human habitation, or property from labour of any kind. It would be hard to say that the waves of civilisation should not fertilise such wastes. The nation which discovered has never scrupled to occupy. The erratic habits of the indigenous tribes, as well as their unmitigated ignorance, has prevented them from being able to turn the great elements of production around them to ordinary advantages. The British nation has been thus justified in occupying the vast continents of America and Australia as fields for colonisation; they were only maintaining a few scattered tribes, when capable of supporting countless myriads.

In every colony indigenous races have been found which would not amalgamate kindly with the superior race. In some respects they resemble the gipsies, who used to wander about the different countries of Europe; they will not abandon their erratic habits, and are fast disappearing, till their fate seems to be utter annihilation. The more striking the success of colonisation, the more certainly will the unoffending aborigines be doomed to destruction. The warlike tribes will require much time, trouble, and bloodshed to exterminate, but they will ultimately be subdued by the knowledge and moral courage of their civilised foes. The fate of the more inoffensive tribes will be similar; they will fall victims to the vices of the civilised race, and to the progress of civilisation. Every effort to ameliorate their social condition, to bring them within the pale of civilisation and amalgamate them with the whites, will be fruitless. The indigenous tribes will not exist except as separate and distinct races.

Sixty years ago the aboriginal tribes of Van Diemen's Land, or Tasmania, are said to have numbered over 7,000; now there is not a single native left.

The early history of Tasmania was a continued struggle between the natives and the colonists; and the former set the superior science of their foes at defiance. In 1830, Governor Arthur attempted to take them prisoners, and with that view ordered a general muster of the colonists, but the effort proved unsuccessful. In the year 1835, Mr. Robertson, afterwards chief protector of aborigines in Port Philip, was able to bring them together, and removed them to Flinder's Island in Bass's Straits. A gentleman connected with the Port Philip press, who made a tour of that island in 1844, described the aboriginal population of Tasmania as having dwindled to about fifty. They were under the charge of Dr. Milligan, and were well cared for. The aborigines of Australia are also fast disappearing. It is generally acknowledged that the right of property in the soil is based on certain natural laws. The aborigines of the countries we have colonised had no laws, and they had no property in the soil in the shape of improvements, the result of labour. Priority of possession gave the indigenous races a moral right to the game on the land, but it conferred—according to the universal recognised opinion of modern nations—no privilege of holding, or transferring it, against the right of a civilised nation.

Discovery is held to give a title to regions which are inhabited only by indigenous tribes, and since the times of Columbus and Cabot this rule has been acted upon. It may have been remarked that many confound occupation with discovery, but it appears to require both to constitute a good title. We find instances of one European nation surrendering by treaty territories which it had discovered but not occupied, and the validity of titles granted by the aborigines has never been acknowledged. They are in no more favourable position than the wild animals of the woods, their land being transferred from nation to nation without reference to their wishes. Colonisation is undertaken for the advantage of the emigrating people, and the aboriginal races stand in the way of the immigrants. If able to contend with the invaders of their territory, they give them much trouble and annoyance, but, if not, total neglect, alternating with some ill-constructed attempt to ameliorate their condition, is the line of conduct which has been pursued towards them; and the annihilation of the aborigines of the colonies will be a stain upon the fair fame of our nation. Every portion of land, with scarcely an exception, when discovered by navigators, has been found to support a certain number of human beings.

The vast continents of America and Australia, and the chain of islands known collectively as Polynesia, contained indigenous races. They differed materially in the degree of barbarism in which they were plunged. The aborigines of New Holland were at the lowest point of human degradation. The tribes of North America were superior, but still far sunk in barbarism, while the Aztecs were little inferior to the civilised nations of Europe in knowledge of architecture and acquaintance with many other useful arts. The history of these indigenous tribes is unknown, and hardly one of them possesses oral traditions bearing the stamp of genuine authenticity. The rise, progress, and migrations of these rude societies must ever continue to be buried in the darkest oblivion.

To the philosophic traveller who beholds the aboriginal native in his yet uninvaded haunts, and marks his health, his cheerfulness, his content, his freedom from anxieties and cares, few spectacles can be more gratifying; and he readily admits that the broad and beaten track of civilisation is by no means the only road which has been left open to man for the attainment of happiness.

The aborigines have followed their simple avocations for ages, engaged in hunting and fishing, with perhaps occasional predatory incursions into the hunting ground of some other tribe. What was it to them that the nations of the old world pursued their murderous science of war, that revolutions convulsed the political world, that pestilence and famine stalked abroad sweeping away myriads of human beings? The knowledge of a savage was confined to what passed in his own tribe, or at most among those tribes which were located in the immediate neighbourhood of his own. They could have

no direct communication with any person beyond. They were necessarily shut out from communication with the world of learning, politics, and civilisation. Yet even the most savage races have a certain culture of their own. An inartificial and rude kind of music seems to be familiar to the whole of the aborigines of the great continents which have been colonised by the Anglo-Saxon. The islanders of Polynesia especially are possessed of quickness of discrimination and sensibility. Their feelings are poetical, and not seldom heroic. It is to be hoped that these islanders will be more fortunate than the races who were found in Van Diemen's Land and New Holland. New Guinea and several of the larger islands in the South Seas will soon be required for the purposes of colonisation, and the same fatality will most probably attend the advent of colonisation there as elsewhere.

The Government has declared the aborigines to be British subjects, and they form a remarkable portion of the rapidly-progressing colonial empire of Britain. It is impossible to predict either the future progress of our colonising system, or what may be the history of that gigantic empire comprehended in the word "Colonies." But in that history the fate of the indigenous races must be a striking chapter on which the learned and great of mankind will ponder with no ordinary interest, and such a nation ought not to put it in the power of the future historian to charge it with cruelty against an unoffending aboriginal race. The country colonised with the Anglo-Saxon race must inherit all the high and honourable principles of the parent, for the child is father to the man; and indeed a colony can hardly be viewed in any other light than an extension of the mother country. A few adventurers from it arrive in an unoccupied country, and go forth into the wilderness as the pioneers of civilisation; the numbers gradually increase; the settlers, as a matter of course, require towns and villages to supply them with necessaries, and the shipping and mercantile interests increase; agriculture is deemed profitable and followed by numbers, and the country is rapidly developed. By and bye we have population increasing, the country lined with railroads, and the streams and rivers ploughed with steamboats, until the *terra incognita* of Australia is changed into a great and populous state, with all the aids and appliances of civilisation distributed far and wide over the country.

A very important question here arises—What is to become of the aborigines, and where are they to go to live? When the forests and plains of Australia are densely settled, and the soil maintains its myriads of human beings, how is the black man to exist? Where is he to rest his weary foot? Is he to be provided for at the expense of the Government? or is he to be starved out and exterminated before the new comers? The annihilation of the entire aboriginal population will not conduce very much to the credit of the British race.

The influence of the aborigines upon the progress of a colony, particularly in its early stages, is far greater than has been generally conceived. The great progress of Victoria and South Australia has mainly to be attributed to the ease with which the colonists dispersed over the fine tracts of land which these colonies contain. Had the colonists been under the necessity of fighting against powerful tribes of aborigines, their energies would have been confined within a very narrow space; their ranks would have been thinned, and their spirits broken. The reverses which the New Zealand colonists have met with may be chiefly attributed to the disaffection of the natives. It has been stated in England, and even asserted in that colony, that the late war in New Zealand and the decadence of the native population were the result of the extension of the white occupation of territory, since the natives were engaged in a war for the preservation of their land, and with it for their existence. But this is by no means true. The area of the northern island, the seat of three-fourths of the total Maori population, is about $29\frac{1}{2}$ million acres; of this area about seven million acres are in the hands of the British, while $22\frac{1}{2}$ million acres remain to the natives; the latter then have an extent of land equal in area to three times that which they have alienated. The relative numbers of each race are—of Maoris, 53,000, and of Europeans, 63,000.

The Maoris have most deservedly been considered one of the finest and most intelligent of the aboriginal races. Compared with the inhabitants of Australia, and of many of the uncivilised islands in the South Pacific, the Maoris stand out as their superiors in every respect. Their extreme aptitude has enabled them to adopt easily many of the habits and customs of European civilisation, and to throw off a good deal of the barbarism of their forefathers. Excepting in a few special articles, their traditionary manufactures and weapons have become almost obsolete amongst the Maoris, and it is acknowledged by themselves that some of their most cherished arts are being rapidly forgotten.

"The New Zealander," says the Rev. Richard Taylor in his work on New Zealand, "is acquainted with every department of knowledge common to his race. He can build his house, he can make his canoe, his nets, his hooks, his lines; he can manufacture snares to suit every bird; he can fabricate his garments and every tool and implement he requires, whether for agriculture or war; he can make ornaments of ivory or of the hardest stone, and these two with the most simple and apparently unsuitable instruments, sawing his ivory with a mussel shell, and his hard green jade-stone one piece with another, with only the addition of a little sand and water; and all these works, it must be remembered, he could accomplish without the aid of iron, which was unknown before Cook's time."

The aborigines of Australia occupy perhaps the lowest place in the graduated scale of the human species. They have neither houses nor clothing. The are entirely unacquainted with the arts of agriculture, and even the arms which the several tribes have to protect themselves from the aggressions of their neighbours, and the hunting and fishing implements with which they administer to their support, are of the rudest contrivance and workmanship. Fifty or sixty years' intercourse with Europeans has not effected the slightest change in their habits, and those even who have the most intermixed with the colonists have never been prevailed upon to practice any of the arts of civilised life. Disdaining all restraint, their happiness is still centred in their original pursuits, and they seem to consider the superior enjoyments to be derived from civilisation (for they are very far from being insensible to them) but a poor compensation for the sacrifice of any portion of their natural liberty. Frequent attempts have been made to divert them from their vagrant propensities, and to prevail upon them to adopt some of the fixed occupations of social man; but, except in one or two instances, these attempts have been utterly unsuccessful. In the year 1815, Governor Macquarrie tried an experiment of this sort on rather a large scale. He caused allotments of land, for the purposes of cultivation, to be given to sixteen native families at George's Head— a situation which, as they were coast natives, and therefore fishermen as it were by birth, was extremely well chosen, from its immediate contiguity to the entrance of Port Jackson, near to which is some of the best fishing ground yet discovered. A native, named Boongarie, who was the hereditary chief of the district where this endeavour to form a native settlement was made, and who had always been distinguished for the docility of his temper, his inoffensive manners, and his friendly demeanour towards the colonists, was placed at their head, the governor having given him a brass medal, on which was engraved "Boongarie, Chief of the Broken Bay Tribe." A boat, named after him, was presented to this little colony, as were also the necessary implements and seeds for culti-

vating their allotments, but it was found, I believe, that no inducements were sufficiently powerful to wean them from their original habits; and no rational hope can be entertained that any future endeavours which may be made to civilise the adult portion of the aboriginal population will have more satisfactory issue. Reserves of land have been appropriated for their service in most of the colonies, and occasional donations of provisions are served out to supply their most pressing emergencies in some of the British colonies; but, after all, they are unwelcome guests upon the charity and hospitality of the white population who have succeeded them. In Imperial legislation they are either completely overlooked as regards questions where their interests are at stake, or some boon is obtained for them by the aid of philanthropists, which is calculated to injure their ultimate prospects. The false sympathy which occasionally is excited on behalf of the aborigines is not calculated to be of very material benefit to them. It interferes on their behalf without either sense or discrimination, and speedily tires and abandons them to their fate.

It is impossible to form any correct estimate of the actual number of aborigines in Australia. Attempts have been made to form a presumptive enumeration in each of the different colonies of the great island continent, but with very little approximation to truth, owing to their wandering habits, the immense extent of territory they have at command, and the impossibility of meeting any collective tribes, or any native of sufficient intelligence to give accurate information.

When Port Philip was first settled, it is believed that the aborigines of that district numbered about 5,000. According to official returns made in the year of separation from New South Wales (1851), this number had been reduced to 2,693. An attempt was made to take an account of their numbers at the census of 1857, and subsequently at that of 1861. The result was 1,768 at the former, and 1,694 at the latter date. It is not pretended, however, that all were enumerated on either occasion. The returns from the Central Board for the Protection of the aborigines testified to the ascertained existence of 1,860 in different parts of the colony in August, 1861, and that number was believed by the members of the Board to be rather under than over the mark. By a still later return, made by the same Board, the aborigines in the colony amounted on the 25th September, 1863, to 1,908. At the date of the last census taken in April, 1871, the aboriginal population of Victoria was returned at 1,330, of whom 546 were females.

The following is the return of admissions for the week ending August 8th—Season tickets, 1,900; payment, 15,131; total, 17,031.

Flax has been grown in India chiefly for its seed for some years, but of late the Bengal Government has endeavoured to encourage its production as a fibre. Ireland is the great country for flax-spinning, and raises a good portion of the fibre used, but Russia has more acres under flax than all the rest of the world. The total area for all countries is 3,000,000 acres, of which Russia has 1,600,000, Ireland 129,432, and the United States 61,204 acres. Prussia, Austria, and France are the greatest flax raisers, with the exception of Russia.

The annual railway returns of the Board of Trade just published for 1873 brings out the fact that the traffic of the railways of the United Kingdom has exactly doubled itself in thirteen years. Exclusive of rents and tolls, &c., and taking the receipts from goods and passengers only, the gross income of the railways in 1873 was £55,675,000; in 1860 it was £27,767,000, increase 27,908,000—the increase being thus fractionally more than the whole income of 1860.

The construction of a line of railway from Salt Lake to Coalville is in contemplation; the new line will connect the Union Pacific with sundry coal-fields.

EXHIBITIONS.

INTERNATIONAL EXHIBITION OF CHILI, 1875.

The Chilian Government has fixed the 16th of September, 1875, for the opening of an exhibition at Santiago, to which, in addition to native products—raw and manufactured—those of all other American and European countries will be admitted. This exhibition has the two-fold object of demonstrating the actual progress made by the Republic since the Agricultural Exhibition of 1869, and of further stimulating the development of the resources and general trade of the country, by bringing into notice new branches of industry, and improved methods of working those already known.

The classification of the exhibition is as follows:—

First Section—Raw Material.—Group 1, raw products used for food. Group 2, animal and vegetable products used in manufactures. Group 3, mineral products used in manufactures.

Second Seetion—Machinery.—Group 4, steam and other engines, weighing and hoisting machines; railways. Group 5, manufacturing machinery. Group 6, mining and metallurgy. Group 7, civil engineering and public works. Group 8, naval and military engineering and material. Group 9, agricultural machinery and tools. Group 10, philosophical instruments, &c.

Third Section—Industry and Manufactures.—Group 11, manufactured articles used for food. Group 12, fabrics of all kinds, embroidery, lacework, &c. Group 13, dressed furs and skins; tannery and saddlery. Group 14, paper, stationery, and printing, lithography, and bookbinding materials. Group 15, clothing and other articles of domestic use. Group 16, furniture, upholstery and decorative work. Group 17, gold and silver plate and imitations of same; jewellery and fancy articles. Group 18, iron, ironmongery and general hardware, brass work, cutlery, and metal work. Group 19, glass ware; porcelain, earthenware, and fancy pottery. Group 20, building materials. Group 21, products of mining industry.

Fourth Section—Fine Arts.—Group 22, architectural designs, models, plans, &c. Group 23, painting. Group 24, sculpture, bas-reliefs, &c. Group 25, engravings, lithographs, &c.

Special Section—Public Instruction.—Group 26, public instruction.

There will also be a special section devoted to the exhibition of the material used and the methods followed in primary schools for children and adults, and in secondary and universitary instruction.

During the course of the exhibition there will be an exhibition of animals, horticultural products, &c., of which the rules and special programme will be published in due season.

All letters relating to the exhibition to be be addressed —"To the President of the Chilian International Exhibition, 1875, Santiago (Chili)."

Foreign commissions, or exhibitors, preferring to communicate directly with the President of the Exhibition, must forward their applications for space in time to reach Santiago before the 1st of January, 1875.

Applications for space must be made on a form provided for the purpose, and addressed to the President of the Exhibition, or to the foreign commission appointed in the country of the intended exhibitor. The Directing Commission in Santiago reserve to themselves the right of limiting the space demanded, when in their opinion it is more than is required for the exhibition of the goods. Exhibitors will have the preference according to the date of their application. Packages containing goods intended for the exhibition must be marked

Esposicion de Chile, besides the exhibitor's private marks and numbers. The exhibition is constituted a bonded warehouse, in order that all packages may be forwarded to Santiago immediately after their landing in Valparaiso. Custom-house officers appointed for the purpose will receive and examine the goods on their arrival. In order to expedite the examination of the contents of the packages, exhibitors must produce a list of the contents of each passage.

Goods belonging to Sections I., II., and III., will be received on deposit in the exhibition stores, from the 1st of March to the 15th August, 1875; after that date no articles belonging to the above sections will be received. Articles belonging to Section IV., and to the Special Group of Public Instruction, will be received up to the 25th of August, 1875.

The expense of arranging the exhibit will be borne by the exhibitors, who will likewise provide glass cases and similar fittings for the display of goods, if they require them. The arrangement of the stalls must be in conformity with the general plan laid down by the Directing Commission. No charge will be made for the space in the exhibition building or its annexes. The Directing Commission will take every precaution to preserve the articles exhibited from damage, but will not hold itself in any way responsible for loss, accident, or injury, which may occur. Persons intending to exhibit machinery in motion are requested to state in their applications for admission the machines they propose to work and the power they require.

No article can be removed from the exhibition before its closing, unless by special permission of the Director General.

Two months after the date of closing the exhibition, the owners or their agents must remove their goods, as well as every article that they have had in use; after which time, if not removed, the directors will not be responsible for any loss, and any articles remaining unclaimed six months after the closing of the exhibition will be sold at public auction.

The following special prizes are offered:—

1. A prize of 1,000 dols. (£200) in money, for the best Rolling Stock and Permanent Way of a Narrow Gauge Railway (3 feet or less), with Tank Locomotives, to haul from 60 to 100 tons on gradients of 1 in 50, and curves of 160 feet radius.

2. A prize of 1,000 dols. (£200) in money, for the best system of Measuring and Distributing Water for Irrigation, both in fixed and proportional quantities, to be accompanied by the apparatus and practical demonstrations necessary for applying it to the requirements of the country.

3. A prize of 500 dols. (£100) in money, for the best complete set of Boring Apparatus for Surveying Mineral Lands, Coal Fields, &c.

4. A prize of 500 dols. (£100) in money, for the best treatise on the Social Condition and Requirements of the Agricultural Classes of Chili, to include Suggestions as to the Best Means of Regenerating them.

Exhibition of the Franklin Institution.—The exhibition intended to celebrate the fiftieth year of the Franklin Institute is to be held in Philadelphia from Oct. 6 to Oct. 31. All products of national industry may be sent for exhibition. In addition to three classes of premiums—a silver medal of the Franklin Institute, a bronze medal, and a diploma of honourable mention—cases of special merit may be referred to the Committee on Science and Arts, with a recommendation for the award of the Scott legacy premium of the Elliot Cresson gold medal. The Scott legacy premium—a bronze medal and 20 dols.—is vested in the city of Philadelphia by the provisions of the will of John Scott, of Edinburgh, made in 1816, and the city has confided the trust to the Franklin Institute. The Elliot Cresson gold medal is an honour which has rarely been awarded.

New York Industrial Exhibition.—According to accounts from America, active preparations are about to be set on foot by the Industrial Exhibition Company of New York for the purpose of raising funds to erect building and carry out the enterprises of the company. The company was chartered April 21st, 1870, with permission to purchase real estate, erect a building or buildings for an industrial exhibition, and issue bonds. The charter has since been amended by an extension of the time and the grant of additional rights. It is the plan of the company to raise a loan secured by a first mortgage on its property at a low rate of interest. This it proposes to effect by placing the loan in small amounts without recourse to the ordinary methods of raising money by appeal to capitalists. The principal advantage granted to it under the acts emendatory of its charter is conferred by an amendment passed April 29th, 1874, enabling it to issue what are called "premium bonds" to the amount of 20,000,000 dols., with such rights and privileges as may be determined on by the company. Under the original charter, land has been secured occupying a square of eight city blocks, from Ninety Eight to One Hundred and Second Streets, between Third and Fourth Avenues, making a plot of 1,000 feet square. A clause in the charter virtually gives the company, without compensation, all the streets and avenues included within this property, by permitting the company to build over them. On this land it is proposed to erect the largest building ever used for monster fairs and expositions. It is to occupy the whole block, and will have a front on each face of 1,000 feet, and will be seven stories high, in all 150 feet in elevation, with a tower at each corner 200 feet high. The building will be in the form of a hollow square, each side of the square being 250 feet deep, leaving an open space in the centre, in which an iron tower 700 feet high is to be erected, at a cost of 750,000 dols. The tower is to be connected by iron bridges with the hollow square around it, and the whole will thus form one building. The internal arrangements of the building are not yet planned, nor are the details of its front and general appearance, but the main outlines of the plan are enough to show its magnitude, and it is considered that a building with nearly 4,500,000 square feet of flooring will afford room enough for all the halls and exhibition-rooms which the most extensive display or meeting would tequire. The building is to be fireproof, and the materials will accordingly be brick and iron. The buildings are to be finished by January 1, 1879.

Exhibition of Specimens and Apparatus at British Association Meetings.—Mr. Ray Lankester writes to *Nature* to draw attention to the arrangements to be made this year at the British Association meeting (for the first time) for the reception of specimens and apparatus illustrating papers or short communications made to the sections. The provision of a room for this purpose—a kind of temporary museum—has during the last four years been recommended by the committees of Sections C and D, several times, and this year the experiment is to be made. Those who have promoted this plan are naturally anxious that it should be a success, and it is therefore hoped that the secretaries of the various sections will assist in initiating this new feature of the meeting, by endeavouring, as far as possible, to secure from the authors of papers objects which illustrate their communications; such objects to be deposited during the week of meeting in the room provided by the Council. This room will be open to inspection under the same regulations as the sectional meeting rooms, and the objects deposited will be carefully ticketed and arranged, and, where necessary, placed under glass cases. From Section A, physical and astronomical apparatus and models may be expected; from B, new chemical products and specimens of apparatus illustrating new processes; from C, geological specimens of rarity or new to science; from D, zoological and botanical specimens, anatomical preparations, for the exhibition of which microscopes

will be provided, and also ethnological specimens; from E, maps and geographical models; from F and G, models or machinery not to large for a room. Objects exhibited must be in illustration of some communication (however short) to one of the sections, in order that they may thus be sanctioned by the committee of such section. By the co-operation of the sectional secretaries with the members of the committee appointed to superintend the arrangements of this room or repository, it is hoped that an important and valuable feature may be added to the scientific interest of the meetings of the Association.

PUBLIC MUSEUMS AND LIBRARIES.

The following returns of the numbers of visitors for July have been received up to the present date:—

	Number of Visitors.
British Museum	(no return)
National Gallery (Trafalgar-square)	86,891
Kew Gardens and Museum	104,527
South Kensington Museum	70,470
Bethnal-green Museum	40,449
Geological Museum, Jermyn-street	2,453
Patent-office Museum	19,513
Edinburgh National Gallery	18,203
Edinburgh Museum of Antiquities	19,222
Edinburgh Museum of Science and Art	35,340
Royal Dublin Society:—	
Natural History Museum	4,271
Botanic Gardens, Glasnevin	26,354
Dublin National Gallery	
Zoological Society, Dublin	12,590
Museum of Irish Society, Dublin	
Tower of London	18,791
Royal Naval College, including Greenwich Painted Hall	

PRIZES FOR HAND TURNING IN METAL.

The Company of Turners of London, in continuation of their action in former years, propose to give, in 1874, their silver medal and the freedom of the company and of the City of London to any one workman or apprentice in England who may send in the best specimens of hand turning for the year. Last year the prizes were awarded for turning in ivory and stone; this year one of the materials to be used will be brass or gun-metal. The chief medal and freedom will be adjudged to that object which the judges may decide to possess paramount merit as a specimen of pure turning, and the qualities which will be chiefly considered in awarding the prizes in metal are shown under the following heads:—(1) Truth and nicety of fitting. In optical, surveying, horological, and other instruments, perfection of turning and accuracy of finish in cylinders, adjustable tubes, screws, milled heads, &c., will be required, any part of an instrument illustrative of the merit of the turner being alone required. (2) Beauty of original design. In vases, tazzas, and similar examples special regard should be given to beauty of form, by causing the lines to run freely into each other, so that where they meet there shall be no abruptness. (3) Accuracy of copying. The specimens may be copies of any known work, and may be either of the same size or reduced. The merit will consist in the most perfect reproduction of the character of the original. This quality may also be shown by pairs of specimens, which shall be facsimiles in every respect. Where duplicates are exhibited as specimens of accuracy in turning, a templet should be furnished as a test of the same. (4) Originality, novelty, or special skill in any other particular, as applied to this class of work. The specimens must be of moderate size; and it is recommended they should not exceed 3 ft. in any dimension. They should be very carefully packed in boxes, and accompanied by a list stating the contents of each box. If there is more than one box belonging to one competitor, his several boxes must be numbered consecutively. Each specimen must be marked with a mark or motto, and accompanied by a written memorandum stating (1) whether the design is original; (2) if a copy, where the original is, and what is its size as compared with the specimen; (3) the grounds on which merit is claimed for the specimen; (4) whether it is purely hand work, or whether any mechanical aids have been used; and also a verification may be required that it is the genuine work of the exhibitor. The use of the slide-rest will not be prohibited; but in any case, where used, it must be so stated, and preference will be given to purely hand-turning. There must also be a sealed envelope marked outside with the same mark or motto, containing the name and address of the competitor, and his age, if an apprentice, together with a certificate of good character. These will not be opened till the judges have made their report. In addition to the prizes above named, a bronze medal of the company will be given to the competitor second in merit, and the company's certificate of merit to the three next best exhibits. The Baroness Burdett-Coutts, a member of the Turners' Company, having placed £25 at its disposal, the court of assistants have decided to offer, in addition, three money prizes of £2 15s. each for this class. The different objects must be delivered free at the Mansion House, London, during the portion of the week beginning Monday, October 12th, and ending Wednesday, October 14th, and will be on view from Monday, October 19th, to Saturday, October 24th. The judges will be authorised to make such allowance as they may think fit in regard to the expense of carriage. The specimens sent will remain the property of the competitor; care will be taken of them, but the company will not hold themselves responsible for their safety. The candidates must remove the specimens at their own cost within a week of the decision being communicated to them. The judges of this year in metal will be the following citizens and turners:—Mr. S. Jackson, 66, Red Lion-street, E.C.; Mr. J. H. Evans, 104, Wardour-street, Soho; Mr. H. Porter, of Cary's, 181, Strand.

EAST INDIAN COLONISATION SOCIETY.

An association under this title has been set on foot in Edinburgh, of which the objects are:—

To obtain full and accurate information as to the soil, climate, and products of India, that are best suited for industrial settlements of Europeans.

To diffuse a knowledge of the same by occasional papers, circulating them among our skilled artisans of all crafts, and among our merchants, intelligent agriculturists, and gardeners generally.

To convey information regarding the culture of the products in India, such as the cottons, silks, dyes, tanning substances, lacs, india-rubber, teas, coffees, sugars, minerals, &c.; and to show how these may be improved by European machinery, skill, and enterprise.

To point out localities where manufactories may be established with advantage, such as for piece goods on the banks of the Narbada, for jute on the Hooghly, and mills in many other localities, for tweeds in the Valley of Khooloo, through which all the fine Tibetian wools for Cashmere pass. To suggest how woollen manufactures may be advantageously mixed up with other materials, such as with cottons, the Rheea, Tussah, and other silks abundant in, and peculiar to, India, and thus turn to better account the resources of her Majesty's empire in the East, and extend the commerce of Great Britain on towards Central Asia, and by the Brahmaputra River, through Assam, on to China, as well as increase the traffic by the Suez Canal and the proposed railway through the valley of the Euphrates.

To send petitions to the House of Parliament on important subjects connected with India.

To show that as limited companies cannot well work so distant a field as colonies in India, from want of interest in the *employés*, and the indirectness of the management, a scheme of assisted emigration, similar to that of New Zealand and Australia, is absolutely required.

It is submitted that, as an experiment, her Majesty's Government may be pleased to permit two or three hundred settlers of different crafts, with a due proportion of agriculturists and gardeners—all fit men—to be sent out to India to each of the climates mentioned in the pamphlet by Dr. Graham, or any other suitable locality; that townships with allotments of lands be laid out, settlers with a small capital being permitted to select their own farms from the waste lands within five miles of these townships, the emigrants being allowed to take their wives and families from this country, and permitted to build their churches and schools in their different townships.

The selection of these emigrants, and providing them with ships, &c., might be vested in the Government Commissioner, and a sub-agent appointed in Bombay to watch over them on their arrival, and forward them to their destinations. The Government Commissioner of the province wherever they might be sent, might select the sites for the townships, guide the colony during its infancy, until it can adopt its own municipal laws and government, and manage for itself.

In six or eight years, it is expected these settlers will be in such a thriving condition, as not only to defray the advances granted, but to promote greatly the stability and revenue of the British Empire.

PUBLIC ANALYSTS AND THE ADULTERATION OF FOOD ACT, 1872.

The following letter is now circulating extensively amongst public analysts and the chief scientific authorities of this country. Members of the Society and others interested in the question may obtain all particulars by addressing Mr. Wentworth Scott:—

"Dear Sir,—The time is now rapidly approaching when the position and functions of public analysts must be placed upon a more definite and satisfactory basis than at present obtains, if the connection existing between such scientific officers and the vendors and consumers of 'articles of food, drink, and drugs,' is to be of lasting benefit to the inhabitants of the British Isles.

"In my opinion it is exceedingly desirable that a society or association of analysts should be formed before the close of the present year, having the following amongst its more prominent objects:—

"1. The combined action of fellows or members of the society upon all questions affecting the profession, of public importance or scientific interest.

"2. The inauguration of a definite qualification for public analysts, which shall be satisfactory to the public and recognised by Government.

"3. The due amendment and consolidation of the several enactments for the suppression of adulteration.

"4. The appointment of specially qualified referees for the better and more equitable adjustment of disputed cases.

"5. The frequent meeting of the members of the society for the purpose of reading and discussing papers on appropriate subjects, and of increasing their private and professional good feeling towards each other.

"I feel convinced that you will agree with me in believing, that no chemist, worthy of his cloth, would submit to 'examination' by any authority at present in existence at Somerset House, or South Kensington, and that it is essential that all diplomas or certificates of qualification shall emanate from the Council of the 'Society of British Analysts,' or in other words from those of our own body, who have—what neither of the above departments do possess—the requisite knowledge and experience.

"At this stage I do not seek to commit you to details, but if you can accord your general approval to my proposal, kindly fill in the annexed form, and return the same to me at your earliest convenience.—I am, &c.,

"Wentworth Lascelles Scott.

"County Analyst's Laboratories,
"Wolverhampton, July 16th, 1874."

ELECTRO-CAPILLARY MOTOR.

A curious capillary experiment was devised by M. Lippmann some months since, which the author has recently utilised in a very ingenious way. The original experiment is thus described in the *Journal of the Franklin Institute*:—Place in a saucer or in a large watch-glass a globule of mercury an inch or two in diameter, and pour upon it a little water acidulated with sulphuric acid and slightly coloured with potassium bichromate. If now the mercury be touched laterally with the point of a needle, the globule will be observed to contract and withdraw itself from the needle, then to extend again to its primitive position. This brings it again into contact with the needle, the contraction is renewed, and so on indefinitely. When the globule is quite large it executes contorted and grotesque movements, which are surprising to those who are not in the secret. The explanation of this phenomenon is found in the fact that under the joint influence of the iron and the bichromate, the mercury is successively oxidised and deoxidised, thereby producing an alteration in its capillary condition, and causing the swelling and flattening. This oxidation and deoxidation may also be effected by an electric current. The globule is seen to swell up or to flatten, according as it is connected with the negative and deoxidising or with the positive and oxidising electrode. It is this oscillating motion of the globule of mercury that M. Lippmann has utilised in his motor. It is constructed as follows:—In a trough of glass two small cups are placed, full of mercury; in each of these moves a piston formed of a bundle of glass tubes. The trough is filled with acidulated water, and the two masses of mercury are in communication with the electrodes of a battery in such a way that when the one contracts the other flattens. Consequently, when one of the pistons rises the other falls; and by simply transforming this reciprocating motion of the pistons into a rotary one, an electro-capillary engine of some hundredths of a kilogrammetre of power is readily obtained. In the machine actually constructed by M. Lippmann the fly-wheel made a hundred revolutions per minute. The extremely feeble current needed to set this engine in action suggests its use as an indicator of currents too feeble to be detected by the ordinary instruments. Used in this way it would constitute an extremely sensitive electrometer. Indeed, it might come in use for the reception of cable dispatches, which, as is well known, are sent by means of very feeble currents. Certain movements of the machine might correspond to certain predetermined characters or sentences, and in this way the dispatch might be easly deciphered.

A brown aniline dye, known in the trade as *Cannell*, is now prepared by Knosp, of Stuttgart. It is obtained from a by-product in the manufacture of fuchsine, and is said to be essentially the by-acid salt of chrysotoluidine. Cannell may be used for dyeing silk and woollen goods without the aid of any mordant, whilst with cotton the best mordant is tannic acid.

Under the name of "Dingler's Green," a new green colour has been introduced. Samples of this material were exhibited at the Vienna Exhibition by Julius Dingler, of Augsburg. It consists of a mixture of phosphate of chromium and phosphate of lime.

THE PRODUCTS OF THE BALEARIC ISLANDS.

The Vienna Exhibition attracted the attention of agriculturists and others to an extent that no previous International Exhibition had done towards these islands, and great exertions were made by local committees to collect specimens and samples of the most noteworthy of the island products. Consul Bidwell thinks it may not therefore be uninteresting to enumerate the articles which were exhibited as helping to show the nature and kind of the best products of the Belearic, in a way that would not otherwise appear, for it is worthy of remark that many of the inhabitants possess but slight knowledge of their products and resources. It has been confessed indeed by old residents that they have seen articles in such exhibitions for the first time, the existence of which in their native country they were ignorant of.

The exhibitors from the islands numbered 76, the articles exhibited were 212 in number. It must be mentioned, however, that the native manufacturers and industries were not so well represented as they might have been, or as were the agricultural products. The articles exhibited may thus be grouped together :—

Twenty kinds of wine under the names of Tinto, Albaflor, Molla, Giro, Pampolrodat, Manuel, Narauja, Malvasia, Moscatel blanco, Virgeu, Cereza, Viageso, and Gorgollosa; 5 of spirit, 2 of almond oil, 14 of olive oil, 3 of honey, 18 of wheat, 47 of peas and beans, 1 of millet, 1 of wheat flour, 1 of saffron, 4 of Indian corn, 2 of oats, 1 of barley, 1 of hemp, 2 of cotton, 14 of almonds, 5 of carob beans, 3 of dried figs, 2 of capers, 1 of Esparto grass, 2 of lignite, 2 of starch, 1 of vegetable hair, 2 of wool, 1 of silk, 4 of olives, 2 of palm work, 1 of ashes from almond shells, 36 specimens of Majorca marble, 1 of coralline, 4 of cement, 1 of hard soap, 1 of soft soap, 1 of cheese, 4 of salt, 16 of paste for soup, 1 of rope made from hide, 1 of glue, 1 of calf skin leather, 4 of chocolate, 1 of preserved meat, 1 of hair bristle, 1 of preserved thrushes, 1 of preserved fish, 3 of jelly, 5 of preserved milk and milk preserved with coffee, 3 silver purses, 17 specimens of manufactured linen, cotton, and woollen cloths, 12 pairs of boots and shoes, 1 ornament of sea shell flowers, 1 specimen of ornamented pottery of Felanitz, 1 water cooler, 4 specimens of painting, 4 brass rollers for pulleys, 1 balance, several books and publications, including a treatise upon reform in the writing of the blind, with a model of a machine for writing the new character proposed, and several specimens of printing.

Forty-nine prizes and diplomas of merit were granted for the above, viz., for cereals, carob beans, vegetables, preserves, silk, honey, soap, wine, oil, soup paste, dried figs, capers, preserved milk and coffee, chocolate, olives, hemp, boots and shoes, ship models, shell work, and painting, among which was a prize for landscape painting by Don Antonio Ribas, a young Majorca artist of much promise. The wine called "Albaflor," made from the Malvasia grapes in the vineyard of Don Fernando Coloner, Marques de la Cenia, gained a first prize for progress. This wine is said to have been favourably known in England in the time of the British possession of Minorca, but it had subsequently been deteriorated by the sulphur employed to check the oidium disease which attacked the vines. A considerable improvement has, however, taken place in the flavour of the wine.

A peculiar action of alkalies and oxidising agents upon cotton fibre has been examined by M. Jeanmaire, and published by him in the *Revue Hebdomadaire de Chimie Scientifique et Industrielle*, No. 47. If cotton is saturated with chromic acid, or chromate of potash and sulphuric acid, or with permanganate of potash, and subsequently washed, although the fibre presents no apparent change, it is found to be seriously weakened when treated with any alkali.

THE MINERAL RESOURCES OF TURKEY.

Turkey, or the "sick man of Europe," is now occupying a most anomalous and pitiable position amongst the other European powers. One of the chief riches of nations consists in the possession of deposits of natural ores and minerals, provided these deposits are worked and made commercially valuable. It is an odd thing that although Turkey is in such financial straits at present, she makes no endeavour to develop her mineral possessions. These latter seem, from many accounts and reports of travellers and engineers, to exist in the soil of Turkey in almost incalculable quantities, but to be very slightly worked indeed. At the time of the Exhibition of 1867, Turkey sent but a very small number of samples very indifferently worked. The various technical publications that were issued on, and after this exhibition, mentioned but a very small number of worked mines, and we do not believe that since then affairs have much altered with them.

According to official documents there have been identified in Turkey lead, iron, copper, silver, mercury, arsenic, and coal. The rivers of Valachia carry down auriferous sand, and washings are carried on at many of its water-courses. The mountains of Thessaly and of Epirus show abundant deposits of argentiferous lead, notably on Mount Ergenik to the south of Tebelen, and also on the slopes of Mount Pelion, where mines of argentiferous galena have been discovered containing from one to four parts to 1,000 of lead. Carbonate of copper has also been found there in large quantities.

The foundries of Clissoura, of Palanko, and of Ricka, are supplied from the mines of oxide of iron situated between the valley of Novada and that of Clissoura. Important furnace-works have been established at Samakow in the Balkans; they have twelve cupola blast-furnaces, and supply annually 12,000 tons of iron of good quality. At Karatova argentiferous galena is worked, mixed with pyrites and hydrated ores of iron. Near to Okrida there are silver mines, also at Kastendil, and at Kalkandil, at which latter there are, in addition, copper mines. In Bosnia and in Serbia iron mines are worked at Vichgrad, at Voïkilya, at Bounovatz, and at Vissok; there are also deposits of this metal at Maïdam, at Novi-Maïdam, and at Sari-Maïdam. Copper ores, both as pyrites, as carbonate, and as grey argentiferous, as well as iron oxide, abound in the north-east of Serbia, particularly at Meïdunpek, and at Bodja. There exist, also, mines of cupriferous oxide of iron at Terchenaïka, and at Boudna, and mines of galena and of copper have from old times been worked at Bejadefier, and at Beja d'Aranca in Valachia. The ore of this last locality contains twenty-five per cent. of copper. The Government works some mines of iron in Crete, in Scyros, and at Trebizonde; but they produce but a very small quantity of ore.

The presence of coal has been determined at a great number of points, but it is worked at very few places, and in a manner extremely vicious, as has been ably set forth in a series of articles in the journal *La Turkie.* Coal is to be found in the province of Trebizonde, district of Sefranbolo, in the provinces of Smyrna and d'Adavendegnia, as well as around Kars, near to Karaisa, and in the province of Salonica. The coal strata known on the borders of the Black Sea are distributed over a space of about 300 kilometres as far as the Archipelago. At Heraclea, upon the Black Sea, several seams are worked from five to twelve feet in thickness, lying in a true coal stratum. In 1854 these mines supplied the allied fleets, and produced 20,000 tons of coal annually; they might be managed so as to supply 100,000 tons annually.

From the foregoing, it is evident that mineral riches of all sorts abound in Turkey, and it is a matter of surprise that now-a-days, when mineral riches are so much appreciated, that they should not have been developed in a manner worthy of their great extent and value. In looking for the causes of this deplorable

neglect, we easily find one great drawback to the development of trade and of mineral production, and that is the want of good communications by rail, or even by road, so that any quantity of mineral produced would be useless, from the high cost and difficulty of carriage, except for local demands. In the second place, the exaggerated rate of interest upon gold causes an undue amount of stock-jobbing among capitalists in that country, since the simple placing of their money at interest in the frequent loans is so much simpler than engaging in large commercial enterprises, where the profits may be for some time deferred. Some great capitalists, however, are showing themselves disposed to make serious efforts to develop the mineral resources of Turkey, but, unfortunately, find themselves met by the absurd dislike of the Ottoman Government to allow concessions to companies at all, especially to foreign ones. However, seeing that railway communication is fast spreading, and that the Eastern mind is becoming disabused of its ancient prejudices, it may be that a time is not far distant when Turkey will realise and utilise its true riches, and no longer be an eyesore and the only laggard in flourishing and commercial Europe.—*Iron.*

THE AR-MEN LIGHTHOUSE.

The *Bulletin Français* gives an account of what must be considered a very remarkable engineering exploit, one at all events which has been considered worthy of a special medal at the Vienna Exhibition—the building of the Ar-men Lighthouse. The mountain system of Brittany has a sort of continuation in a series of reefs and igneous rocks which jut out in a broken line westward of Finisterre. On one of these rocks, called l'Isle de Sein, there stands a lighthouse, but the real danger lies to the westward, and the rocks there have literally bristled with wrecks of vessels making for Brest. In 1860 the committee for lighting the coast of France decided to erect a lighthouse on the extreme end of the danger, and after a careful examination, M. Ploix, the consulting engineer, decided on the Ar-men rock as the best site. At the same time he did not attempt to depreciate the prodigious difficulty of the task, and characterised it as "nearly impracticable." The currents are so strong, and the seas run so high, that neither M. Ploix nor the other engineers, nor the director of lighthouses, were able to approach nearer than fifty feet. All they were able to ascertain was that the rock was gneiss, about eight yards across and twelve in length, and that it was just visible at low water. After settling their plan of operations, they applied to the fishermen of the neighbouring island of Sein, as most familiar with the locality and the danger, to commence the necessary work. These men undertook the task, and provided with life belts began to watch regularly for the best opportunity of landing on the rock. As soon as they got their chance, they crouched down on the rock, and clinging on with one hand, with the other worked away with a cold chisel so as to sink a sufficient number of sockets for the insertion of the iron clamps. Every now and then a wave would break over the rock, drenching them with foam and spray, and not unfrequently one of the party would be carried off by the heavy sea, but would soon be picked up by a vessel kept purposely on the watch. At the end of the first season (1867) seven landings had been effected and eight hours work done, which sufficed for the sinking of fifteen sockets, while the following year the weather was more favourable, and forty new holes were pierced, some of which were below water. In 1869 the blocks of stone were first placed in iron clamps about a yard long, rivetted into the sockets. The blocks were all hewn according to pattern and joined together with Parker-Medina cement. The work of dropping them into position was exceedingly laborious, owing to the violence of the sea; but two of the officials were constantly in attendance, urging on the workmen, and at the end of the season twenty-five blocks, each about a yard cube, had been successfully laid. In 1870 eight landings took place and eleven cubes were laid, and in 1871 as many as twenty-three, the work by this time becoming easier as further progress was made. A steam launch is now used for the conveyance of material, and a sort of masonry scaffolding having been built, the builders have succeeded, during the first half of this year's season, in placing in position no less than eighty-seven blocks. The expense, however (as may be imagined), has hitherto proved considerable. Each of the forty-five holes pierced during the first two years cost upwards of 2,000 francs, and on December 31 last the charges had amounted to more than 189,000 francs. The light is to be a revolving one of the first order, and 97 feet above high-water mark; there are to be seven stories in the house, and there will also be a steam whistle for use in foggy weather.

The names connected with this achievement are the following:—M. Léonce Renaud, director of the lighthouse service, the father of the project, and Messrs. Plauchat, Joly, Cohen, Lacroix, and Probesteau, the engineers and foremen; the names of the sailors who did the hardest part of the work, are, however, unrecorded.

THE MANILLA HEMP PLANTAIN.

The hemp plantain (*Musa Troglodytarum, textoria*), called by the natives of the Philippine islands abaca, is a species of the genus *Musa*, growing wild all over the island. It yields a small, inedible fruit, in appearance like that of the ordinary plantain. The trees attain a height of twenty to thirty feet; grow wild, but are usually cultivated in groves, in which they are placed three to four feet apart. The mode of cultivation is rude, consisting simply in keeping the groves free from weeds and noxious plants. At the age of three years the tree has attained its growth, and is fit to be cut down. After its fruit has ripened, the tree will not yield any hemp. It is the stock or trunk which furnishes the fibre. After this has been cut, there springs up from the same root a number of trees, at intervals of a few months, so that a well-kept grove can be cut about twice a year. The tree is cut a few inches above the ground. The trunk, it will be seen, is composed of overlapping strips or layers. These strips are separated from each other after the trunk has been trimmed of its branches. The strips are from three to four inches wide, and from five to ten feet in length, according to the length of the trunk. The strips are next subdivided into narrow ones, and drawn by hand over a knife, the strip being pressed upon the knife by an underlying piece of hard wood, and the tension managed by a treadle. This operation cleans away from the fibres the watery and fleshy parts of the plant, and it only remains to dry the fibre in open air, when it is ready for market. It is necessary to pass the strip over the knife twice or thrice before the fibres are left perfectly clean throughout the entire length. One man at the knife and one to cut down the trees, transport them, and separate the strips, will clean about 25 lbs. per day, though this is rather above the average. From 150 to 200 trees are needed to produce of fibre one picul (137½ lbs. Spanish, or 140 lbs. English); 3,200 trees for one ton of 2,240 lbs. When we consider the small amount of hemp which an Indian produces per day, about 12 lbs., we are astonished at the enormous quantities of it exported from the East, to England in particular, reaching many hundred thousand bales annually, with yearly increasing proportions (7,347 tons in 1872). At the rate mentioned above, twelve pounds per day, and allowing 300 working days in twelve months, one man could only produce about one and a half tons; and for 500,000 bales, or perhaps 200,000 tons, it would require the constant labour of about 150,000 men all the year round. Nor can we sufficiently wonder

at the extraordinary low earnings of these Indians—not exceeding the price in the islands of his half-share of the hemp, namely, six pounds, worth there about eighteen cents. And yet, this insignificant pittance suffices for the wants of himself and family. This variety of hemp plantain is unknown in the United States. If some specimens were to be imported and propagated, it might become a source of immense profit in the Southern States. No species of the genus *Musa* examined in the West Indies, or South America, possesses the Manilla fibre. The plantains of the continent are too watery to allow of the formation of useful fibre in the trunk. We may call attention to the importance of inventing an effective machine for separating the fibre. Such an invention, in order to be of value to the islanders, must combine cheapness, simplicity, and portability, with economy as compared with their hand process. There are no slaves in the islands. According to established custom, the labourers work either on shares, or as small proprietors. If a machine is costly, they cannot buy it; if it is complicated, there is not the requisite skill either to work or to repair it; if it is not light and easily moved, there are not facilities for transporting the hemp trees; and if it cannot be worked economically, there is no advantage in it.—*Journal of the Department of Agriculture, Washington.*

GENERAL NOTES.

Chinese Collection at the Crystal Palace.—A collection of articles illustrative of Chinese arts and manufactures has just been opened to public view at the Crystal Palace. The specimens are eleven hundred in number, and have nearly all been collected by Archdeacon Gray during a residence of twenty years in China. They comprise works of art in porcelain, of ancient and modern manufacture; implements of war; and articles relating to domestic economy, such as may be seen in use in every-day life in the several parts of China, from which they have been collected. The collection was shown at the Vienna Exhibition, and has been brought over by Mr. E. C. Bowra, the Chinese Commissioner at Vienna. It has been arranged under the superintendence of Dr. David S. Price.

Circular Railway Round Paris.—It is proposed to connect the various lines of the Western Company by a series of five branch lines, forming a half-circle, of which the radius is about twenty-five miles from Paris. Similar connecting branches of the Eastern Railway Company will complete the circle. The total length of all these branches united will be about 156 miles, and the main points touched will be Creil, Uss-Marines, Mantes, Rambouillet, Dourdan, Etampes, Melun, Nangis, Meaux, and Dammartin. This plan leaves untouched the question of the circular line proposed, with a radius of seven or eight miles round Paris. At present only the project of the Western Company is under discussion, comprising the five branches, with a total length of about sixty-three miles. The cost is estimated at £513,200 for a single line of rails, and at £705,600 for a double line. This will form a circumscribing line for the whole department of the Seine-et-Oise.

The German Steel Industry.—A communication has been made to the French Society of Civil Engineers, by M. Cornault, upon the subject of the present state of the steel industry in Germany. It is stated that there are 20 furnaces producing exclusively Bessemer steel to the extent of from 125,000 to 150,000 tons annually. There are, in activity or in construction, 71 converters in Germany, representing an annual production of 450,000 tons of Bessemer steel, and consuming from 525,000 to 550,000 tons of metal. The Bessemer steel is employed almost exclusively for rails. It is further mentioned with regard to the production of steel, that the Martin process has made great progress in Germany, there being, it is estimated, fifty furnaces of this kind capable of producing about 200 tons per day. During the year 1873 there were produced in France 167,677 tons of steel, of which 103,233 tons were Bessemer steel. The production of rails was—Bessemer, 79,206 tons, and ordinary, 22,876 tons.

Testimonial to Mr. John Gibson.—It is proposed to present a testimonial to Mr. John Gibson, the well-known originator of that style of garden embellishment which is called subtropical gardening, and for which Battersea-park, under his superintendence, became a familiar example. Mr. Gibson has for some months past been suffering from a severe attack of paralysis, and a principal object of this testimonial is to meet the manifold expenses which are incidental to a prolonged illness. A committee has been formed to give effect to the proposal, and Mr. H. J. Veitch is acting as hon. secretary.

Production of Wine in France.—The *Journal Vinicole* gives the following statistics, taken from a recently published report of the Minister of Finance as the production of wine in France last year:—Department of the Herault, 13,454,673 hectolitres; Department of the Ande, 2,944,798 hectolitres; Department of Charente Inferieur 1,825,502 hectolitres; Department of the Gard, 1,415,251 hectolitres; Department of the Gironde, 1,441,389 hectolitres; Department of the Eastern Pyrenees, 1,231,832 hectolitres; Department of the Cote d'Or, 368,582 hectolitres; Department of the Saone and Loire, 359,279 hectolitres; Department of the Marne, 142,669 hectolitres; Department of the Yonne, 157,698 hectolitres; total, 35,715,619 hectolitres.

A New Oil.—Mr. M. R. Bonju seeks to introduce into commerce a new oil, obtained from the seeds of the ochro (*Hibiscus esculentus*), passing also under the names of Gombo and Bamee. The seeds have been used roasted as a coffee substitute. The plant is well known in most tropical countries as a vegetable much esteemed for imparting mucilaginous thickening to soups. The seeds may be boiled like barley, and the mucilage they contain is both emollient and demulcent. We doubt, however, if they could be obtained in sufficient quantity to render the production of their oil a commercial success. The yield of oil from the seeds is not stated, but the oil is stated to be of good quality, and fitted to compete with olive, nut, and other oils for comestible purposes.—*Journal of Applied Science.*

Daily Consumption of Ice in Paris.—The consumption of ice in the first-class cafés in Paris averages 1,000 kilogrammes each (1 ton) daily. There are from 20 to 25 cafés that may be considered to belong to that class. The second-class cafés, of which there are from 200 to 300, consume each about 500 kils. (half a ton), and the average consumption at the smaller cafés, restaurants, hotels, private houses, &c., may be roughly taken at 200 kils. (4 cwt.) each. The total daily consumption of ice at Paris is estimated at 400,000 kils. (400 tons). Sweden, Denmark, and more especially Norway, are the chief sources for the supply of ice to Paris. Switzerland only supplies a small quantity. In some establishments ice is produced by machinery.

Tramway Cars.—Chicago has a street car that is propelled by steam, after the plan in use in New Orleans, viz., the boiler on the car is supplied with steam from a stationary boiler, the charge being sufficient for a run of three miles an hour, a speed of twenty miles an hour being attainable. In San Francisco a very novel mode of propelling street cars has just been adopted. An endless steel cable is laid underneath the track, and the car attached by means of clamps. The cable is kept in motion by a stationary engine, and the cars are run at a much higher rate of speed than by horses. When the car is to be stopped the clamps are released and the brakes applied, the cable moving on; when the car is to be started the brakes are released and the clamps re-applied. The arrangement is almost identical with that used many years since on the London and Blackwall Railway, and is said to work well.

The Production of Wool.—This has, according to the *Economiste Français*, been nearly stationary since 1869. The low prices which prevailed in that year checked the production in Australia, South America, and the Cape, to some extent, and had a still more unfavourable effect on that of Europe and the United States. Thus, the number of sheep in the United Kingdom decreased from 35,607,812 in 1868 to 31,403,500 in 1871, although it has since recovered to 33,914,088 in 1873. In the United States a decrease of 10 per cent. in the number of sheep took place during 1869. Prussia has 2,750,000 sheep fewer than in 1867; so it may, in the absence of statistics relating to the rest of the Continent, be assumed that the production of wool in Europe has diminished to an extent fully equal to the increase which has taken place since 1869 of 10 per cent. in the imports.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ENDOWMENT FUND.

The following subscriptions have been received towards the establishment of an Endowment Fund for the Society:—

	£	s.	d.
G. T. Saul	5	0	0
W. R. Spicer	5	0	0
Colonel A. Angus Croll	20	0	0
G. W. Hart	2	2	0
Charles H. L. Woodd, F.G.S.	5	0	0
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Ardaseer Cursetjee, F.R.S.	5	0	0
H. V.	25	0	0

The Council will be glad to see further contributions to this fund. Members can receive full information as to its nature and objects on application to the Secretary.

IMPROVED RAILWAY LAMP.

The Society's Gold Medal, or Twenty Guineas, is offered for an improved lamp or means of illumination, suitable for railway passenger-carriages, that shall produce a good, clear, steady, durable, and safe light.

It must be simple in construction, and capable of being readily cleaned and repaired.

In judging the merits, cost will be taken into consideration.

Specimens, in a condition suitable for trial, to be sent in to the Society's House not later than the 1st of November, 1874.

The Council reserve to themselves the right of withholding the medal or premium offered, if, in the opinion of the judges, none of the articles sent in competition are deserving of reward.

BRITISH ASSOCIATION.

The forty-fourth annual session of the British Association commenced on Wednesday, the 19th inst., at Belfast. The opening meeting was held in Ulster-hall, at eight o'clock, when Professor Williamson, F.R.S., vacated the presidential chair in favour of Professor John Tyndall, F.R.S., D.C.L., LL.D., F.C.P.S., &c., who delivered the following address:—

An impulse inherent in primeval man turned his thoughts and questionings betimes towards the sources of natural phenomena. The same impulse, inherited and intensified, is the spur of scientific action to-day. Determined by it, by a process of abstraction from experience we form physical theories which lie beyond the pale of experience, but which satisfy the desire of the mind to see every natural occurrence resting upon a cause. In forming their notions of the origin of things, our earliest historic (and doubtless, we might add, our prehistoric) ancestors pursued, as far as their intelligence permitted, the same course. They also fell back upon experience, but with this difference—that the particular experiences which furnished the weft and woof of their theories were drawn, not from the study of nature, but from what lay much closer to them, the observation of men. Their theories accordingly took an anthropomorphic form. To supersensual beings, which, "however potent and invisible, were nothing but a species of human creatures, perhaps raised from among mankind, and retaining all human passion and appetites,"* were handed over the rule and governance of natural phenomena.

Tested by observation and reflection, these early notions failed in the long run to satisfy the more penetrating intellects of our race. Far in the depths of history we find men of exceptional power differentiating themselves from the crowd, rejecting these anthropomorphic notions, and seeking to connect natural phenomena with their physical principles. But long prior to these purer efforts of the understanding the merchant had been abroad, and rendered the philosopher possible; commerce had been developed, wealth amassed, leisure for travel and for speculation secured, while races educated under different conditions, and therefore differently formed and endowed, had been stimulated and sharpened by mutual contact. In those regions where the commercial aristocracy of ancient Greece mingled with its eastern neighbours, the sciences were born, being nurtured and developed by freethinking and courageous men. The state of things to be displaced may be gathered from a passage of Euripides quoted by Hume. "There is nothing in the world; no glory, no prosperity. The gods toss all into confusion; mix everything with its reverse, that all of us, from our ignorance and uncertainty, may pay them the more worship and reverence." Now, as science demands the radical extirpation of caprice, and the absolute reliance upon law in nature, there grew with the growth of scientific notions a desire and determination to sweep from the field of theory this mob of gods and demons, and to place natural phenomena on a basis more congruent with themselves.

* Hume, "Natural History of Religion."

The problem which had been previously approached from above, was now attacked from below; theoretic effort passed from the super- to the sub-sensible. It was felt that to construct the universe in idea it was necessary to have some notion of its constituent parts —of what Lucretius subsequently called the "First Beginnings." Abstracting again from experience, the leaders of scientific speculation reached at length the pregnant doctrine of atoms and molecules, the latest developments of which were set forth with such power and clearness at the last meeting of the British Association. Thought no doubt had long hovered about this doctrine before it attained the precision and completeness which it assumed in the mind of Democritus,* a philosopher who may well for a moment arrest our attention. "Few great men," says Lange, in his excellent "History of Materialism," a work to the spirit and letter of which I am equally indebted, have been so despitefully used by history as Democritus. In the distorted images sent down to us through unscientific traditions there remains of him almost nothing but the name of the "laughing philosopher," while figures of immeasurably smaller significance spread themselves at full length before us. Lange speaks of Bacon's high appreciation of Democritus—for ample illustrations of which I am indebted to my excellent friend Mr. Spedding, the learned editor and biographer of Bacon. It is evident, indeed, that Bacon considered Democritus to be a man of weightier metal than either Plato or Aristotle, though their philosophy "was noised and celebrated in the schools, amid the din and pomp of professors." It was not they, but Genseric and Attila and the barbarians, who destroyed the atomic philosophy. "For at a time when all human learning had suffered shipwreck, these planks of Aristotelian and Platonic philosophy, as being of a lighter and more inflated substance, were preserved and came down to us, while things more solid sank, and almost passed into oblivion."

The principles enunciated by Democritus reveal his uncompromising antagonism to those who deduced the phenomena of nature from the caprices of the gods. They are briefly these:—1. From nothing comes nothing. Nothing that exists can be destroyed. All changes are due to the combination and separation of molecules. 2. Nothing happens by chance. Every occurrence has its cause from which it follows by necessity. 3. The only existing things are the atoms and empty space; all else is mere opinion. 4. The atoms are infinite in number, and infinitely various in form; they strike together, and the lateral motions and whirlings which thus arise are the beginnings of worlds. 5. The varieties of all things depend upon the varieties of their atoms, in number, size, and aggregation. 6. The soul consists of free, smooth, round atoms, like those of fire. These are the most mobile of all. They interpenetrate the whole body, and in their motions the phenomena of life arise. Thus the atoms of Democritus are individually without sensation; they combine in obedience to mechanical laws; and not only organic forms, but the phenomena of sensation and thought are also the result of their combination.

That great enigma, "the exquisite adaptation of one part of an organism to another part, and to the conditions of life," more especially the construction of the human body, Democritus made no attempt to solve. Empedocles, a man of more fiery and poetic nature, introduced the nature of love and hate among the atoms to account for their combination and separation. Noticing this gap in the doctrine of Democritus, he struck in with the penetrating thought, linked, however, with some wild speculation, that it lay in the very nature of those combinations which were suited to their ends (in other words, in harmony with their environment) to maintain themselves, while unfit combinations, having no proper habitat, must rapidly disappear. Thus more than 2,000 years ago the doctrine of the "survival of the fittest," which in our day, not on the basis of vague conjecture, but of positive knowledge, has been raised to such extraordinary significance, had received at all events partial enunciation.*

* Born 460 B.C.

Epicurus†, said to be the son of a poor schoolmaster at Samos, is the next dominant figure in the history of the atomic philosophy. He mastered the writings of Democritus, heard lectures in Athens, returned to Samos, and subsequently wandered through various countries. He finally returned to Athens, where he bought a garden, and surrounded himself by pupils, in the midst of whom he lived a pure and serene life, and died a peaceful death. His philosophy was almost identical with that of Democritus; but he never quoted either friend or foe. One main oject of Epicurus was to free the world from superstition and the fear of death. Death he treated with indifference. It merely robs us of sensation. As long as we are, death is not; and when death is, we are not. Life has no more evil for him who has made up his mind that it is no evil not to live. He adored the gods, but not in the ordinary fashion. The idea of divine power, properly purified, he thought an elevating one. Still he taught, "Not he is godless who rejects the gods of the crowd, but rather he who accepts them." The gods were to him eternal and immortal beings, whose blessedness excluded every thought of care or occupation of any kind. Nature pursues her course in accordance with everlasting laws, the gods never interfering. They haunt

> "The lucid interspace of world and world
> Where never creeps a cloud or moves a wind,
> Nor ever falls the least white star of snow,
> Nor ever lowest roll of thunder moans,
> Nor sound of human sorrow monnts to mar
> Their sacred everlasting calm."‡

Lange considers the relation of Epicurus to the gods subjective; the indication probably of an ethical requirement of his own nature. We cannot read history with open eyes, or study human nature to its depths, and fail to discern such a requirement. Man has never been, and he never will be satisfied with the operations and products of the Understanding alone; hence physical science cannot cover all the demands of his nature. But the history of the efforts made to satisfy these demands might be broadly described as a history of errors—the error consisting in ascribing fixity to that which is fluent, which varies as we vary, being gross when we are gross, and becoming as our capacities widen, more abstract and sublime. On one great point the mind of Epicurus was at peace. He neither sought nor expected, here or hereafter, any personal profit from his relation to the gods. And it is assuredly a fact that loftiness and serenity of thought may be promoted by conceptions which involve no idea of profit of this kind. "Did I not believe," said a great man to me once, "that an Intelligence is at the heart of things, my life on earth would be intolerable." The utterer of these words is not, in my opinion, rendered less noble but more noble by the fact that it was the need of ethical harmony here, and not the thought of personal profit hereafter, that prompted his observation.

A century and a half after the death of Epicurus, Lucretius§ wrote his great poem, "On the Nature of Things," in which he, a Roman, developed with extraordinary ardour the philosophy of his Greek predecessor. He wishes to win over his friend Memmius to the school of Epicurus; and although he has no rewards in a future life to offer, although his object appears to be a purely negative one, he addresses his friend with the heat of an apostle. His object, like that of his great forerunner, is the destruction of superstition; and considering that men trembled before every natural event as a direct

* Lange, 2nd edit., p. 23.
† Born 342 B.C.
‡ Tennyson's "Lucretius."
§ Born 99 B.C.

monition from the gods, and that everlasting torture was also in prospect, the freedom aimed at by Lucretius might perhaps be deemed a positive good. "This terror," he says, "and darkness of mind must be dispelled, not by the rays of the sun and glittering shafts of day, but by the aspect and the law of nature." He refutes the notion that any thing can come out of nothing, or that that which is once begotten can be recalled to nothing. The first beginnings, the atoms, are indestructible, and into them all things can be dissolved at last. Bodies are partly atoms, and partly combinations of atoms; but the atoms nothing can quench. They are strong in solid singleness, and by their denser combination, all things can be closely packed and exhibit enduring strength. He denies that matter is infinitely divisible. We come at length to the atoms, without which, as an imperishable substratum, all order in the generation and development of things would be destroyed.

The mechanical shock of the atoms being in his view the all-sufficient cause of things, he combats the notion that the constitution of nature has been in any way determined by intelligent design. The interaction of the atoms throughout infinite time rendered all manner of combinations possible. Of these the fit ones persisted, while the unfit ones disappeared. Not after sage deliberation did the atoms station themselves in their right places, nor did they bargain what motions they should assume. From all eternity they have been driven together, and after trying motions and unions of every kind, they fell at length into the arrangements out of which this system of things has been formed. His grand conception of the atoms falling silently through immeasurable ranges of space and time suggested the nebular hypothesis to Kant, its first propounder. "If you will apprehend and keep in mind these things, nature, free at once, and rid of her haughty lords, is seen to do all things spontaneously by herself, without the meddling of the gods."*

During the centuries between the first of these three philosophers and the last, the human intellect was active in other fields than theirs. The sophists had run through their career. At Athens had appeared the three men, Socrates, Plato, and Aristotle, whose yoke remains to some extent unbroken to the present hour. Within this period also the School of Alexandria was founded, Euclid wrote his "Elements," and he and others made some advance in optics. Archimedes had propounded the theory of the lever and the principles of hydrostatics. Pythagoras had made his experiments on the harmonic intervals, while astronomy was immensely enriched by the discoveries of Hipparchus, who was followed by the historically more celebrated Ptolemy. Anatomy had been made the basis of scientific medicine; and it is said by Draper † that vivisection then began. In fact the science of ancient Greece had already cleared the world of the fantastic images of divinities operating capriciously through natural phenomena. It had shaken itself free from that fruitless scrutiny "by the internal light of the mind alone," which had vainly sought to transcend experience and reach a knowledge of ultimate causes. Instead of accidental observation, it had introduced observation with a purpose; instruments were employed to aid the senses; and scientific method was rendered in a great measure complete by the union of Induction and Experiment.

What, then, stopped its victorious advance? Why was the scientific intellect compelled, like an exhausted soil, to lie fallow for nearly two millenniums before it could regather the elements necessary to its fertility and strength? Bacon has already let us know one cause; Whewell ascribes this stationary period to four causes—obscurity of thought, servility, intolerance of disposition, enthusiasm of temper; and he gives a striking example of each*. But these characteristics must have had their causes, which lay in the circumstances of the time. Rome, and the other cities of the empire, had fallen into moral putrefaction. Christianity had appeared, offering the gospel to the poor, and, by moderation if not asceticism of life, practically protesting against the profligacy of the age. The sufferings of the early Christians and the extraordinary exaltation of mind which enabled them to triumph over the diabolical tortures to which they were subjected†, must have left traces not easily effaced. They scorned the earth, in view of that "building of God, that house not made with hands, eternal in the heavens." The Scriptures which ministered to their spiritual needs were also the measure of their science. When, for example, the celebrated question of antipodes came to be discussed, the Bible was with many the ultimate court of appeal. Augustine, who flourished A.D. 400, would not deny the rotundity of the earth; but he would deny the possible existence of inhabitants at the other side, "because no such race is recorded in Scripture among the descendants of Adam." Archbishop Boniface was shocked at the assumption of a "world of human beings out of the reach of the means of salvation." Thus reined in, Science was not likely to make much progress. Later on the political and theological strife between the Church and civil governments, so powerfully depicted by Draper, must have done much to stifle investigation.

Whewell makes many wise and brave remarks regarding the spirit of the Middle Ages. It was a menial spirit. The seekers after natural knowledge had forsaken that fountain of living waters, the direct appeal to nature by observation and experiment, and had given themselves up to the remanipulation of the notions of their predecessors. It was a time when thought had become abject, and when the acceptance of mere authority led, as it always does in science, to intellectual death. Natural events, instead of being traced to physical, were referred to moral causes; while an exercise of the phantasy, almost as degrading as the spiritualism of the present day, took the place of scientific speculation. Then came the mysticism of the Middle Ages. Magic, Alchemy, the Neo-platonic philosophy, with its visionary though sublime abstractions, which caused men to look with shame upon their own bodies as hindrances to the absorption of the creature in the blessedness of the Creator. Finally came the scholastic philosophy, a fusion, according to Lange, of the least-mature notions of Aristotle with the Christianity of the west. Intellectual immobility was the result. As a traveller without a compass in a fog may wander long, imagining he is making way, and find himself after hours of toil at his starting-point, so the schoolmen, having tied and untied the same knots and formed and dissipated the same clouds, found themselves at the end of centuries in their old position.

With regard to the influence wielded by Aristotle in the Middle Ages, and which, though to a less extent, he still wields, I would ask permission to make one remark. When the human mind has achieved greatness and given evidence of extraordinary power in any domain, there is a tendency to credit it with similar power in all other domains. Thus theologians have found comfort and assurance in the thought that Newton dealt with the question of revelation, forgetful of the fact that the very devotion of his powers, through all the best years of his life, to a totally different class of ideas, not to speak of any natural disqualification, tended to render him less instead of more competent to deal with theological and historic questions. Goethe, starting from his established greatness as a poet, and indeed from his positive discoveries in natural history, produced a pro-

* Munro's translation. In his criticism of this work (Contemporary Review, 1867) Dr. Hayman does not appear to be aware of the really sound and subtile observations on which the reasoning of Lucretius, though erroneous, sometimes rests.

† "History of the Intellectual Development of Europe," p. 295.

* "History of the Inductive Sciences," vol. i.

† Depicted with terrible vividness in Rénan's "Antichrist."

found impression among the painters of Germany, when he published his "Farbenlehre," in which he endeavoured to overthrow Newton's theory of colours. This theory he deemed so obviously absurd, that he considered its author a charlatan, and attacked him with a corresponding vehemence of language. In the domain of natural history Goethe had really made considerable discoveries; and we have high authority for assuming that, had he devoted himself wholly to that side of science, he might have reached in it an eminence comparable with that which he attained as a poet. In sharpness of observation, in the detection of analogies however apparently remote, in the classification and organisation of facts according to the analogies discerned, Goethe possessed extraordinary powers. These elements of scientific inquiry fall in with the discipline of the poet. But, on the other hand, a mind thus richly endowed in the direction of natural history, may be almost shorn of endowment as regards the more strictly called physical and mechanical sciences. Goethe was in this condition. He could not formulate distinct mechanical reasoning; and in regions where such reasoning reigns supreme he became a mere *ignis fatuus* to those who followed him.

I have sometimes permitted myself to compare Aristotle with Goethe, to credit the Stagirite with an almost superhuman power of amassing and systematising facts, but to consider him fatally defective on that side of the mind in respect to which incompleteness has been just ascribed to Goethe. Whewell refers the errors of Aristotle, not to a neglect of facts, but to "a neglect of the idea appropriate to the facts; the idea of mechanical cause, which is force, and the substitution of vague or inapplicable notions, involving only relations of space or emotions of wonder." This is doubtless true; but the word "neglect" implies mere intellectual misdirection, whereas in Aristotle, as in Goethe, it was not, I believe, misdirection, but sheer natural incapacity which lay at the root of his mistakes. As a physicist, Aristotle displayed what we should consider some of the worst attributes of a modern physical investigator—indistinctness of ideas, confusion of mind, and a confident use of language, which led to the delusive notion that he had really mastered his subject, while he as yet failed to grasp even the elements of it. He put words in the place of things, subject in the place of object. He preached induction without practising it, inverting the true order of inquiry by passing from the general to the particular, instead of from the particular to the general. He made of the universe a closed sphere, in the centre of which he fixed the earth, proving from general principles, to his own satisfaction and to that of the world for near 2,000 years, that no other universe was possible. His notions of motion were entirely unphysical. It was natural or unnatural, better or worse, calm or violent—no real mechanical conception regarding it lying at the bottom of his mind. He affirmed that a vacuum could not exist, and proved that if it did exist motion in it would be impossible. He determined *à priori* how many species of animals must exist, and shows on general principles why animals must have such and such parts. When an eminent contemporary philosopher, who is far removed from errors of this kind, remembers these abuses of the *à priori* method, he will be able to make allowance for the jealousy of physicists as to the acceptance of so-called *à priori* truths. Aristotle's errors of detail were grave and numerous. He affirmed that only in man we had the beating of the heart, that the left side of the body was colder than the right, that men have more teeth than women, and that there is an empty space, not at the front, but at the back of every man's head.

There is one essential quality in physical conceptions which was entirely wanting in those of Aristotle and his followers. I wish it could be expressed by a word untainted by its associations; it signifies a capability of being placed as a coherent picture before the mind. The Germans express the act of picturing by the word *vorstellen*, and the picture they call a *Vorstellung*. We have no word in English which comes nearer to our requirements than imagination, and, taken with its proper limitations, the word answers very well; but, as just intimated, it is tainted by its associations, and therefore objectionable to some minds. Compare, with reference to this capacity of mental presentation, the case of the Aristotelian, who refers the ascent of water in a pump to Nature's abhorrence of a vacuum, with that of Pascal when he proposed to solve the question of atmospheric pressure by the ascent of the Puy de Dome. In the one case the terms of the explanation refuse to fall into place as a physical image; in the other the image is distinct, the fall and rise of the barometer being clearly figured as the balancing of two varying and opposing pressures.

During the drought of the Middle Ages in Christendom, the Arabian intellect, as forcibly shown by Draper, was active. With the intrusion of the Moors into Spain, cleanliness, order, learning, and refinement took the place of their opposites. When smitten with disease, the Christian peasant resorted to a shrine, the Moorish one to an instructed physician. The Arabs encouraged translations from the Greek philosophers, but not from the Greek poets. They turned in disgust "from the lewdness of our classical mythology, and denounced as an unpardonable blasphemy all connection between the impure Olympian Jove and the Most High God." Draper traces still further than Whewell the Arab elements in our scientific terms, and points out that the under garment of ladies retains to this hour its Arab name. He gives examples of what Arabian men of science accomplished, dwelling particularly on Alhazen, who was the first to correct the Platonic notion that rays of light are emitted by the eye. He discovered atmospheric refraction, and points out that we see the sun and moon after they have set. He explains the enlargement of the sun and moon, and the shortening of the vertical diameters of both these bodies, when near the horizon. He is aware that the atmosphere decreases in density with increase of height, and actually fixes its height at 58½ miles. In the Book of the Balance of Wisdom, he sets forth the connection between the weight of the atmosphere and its increasing density. He shows that a body will weigh differently in a rare and a dense atmosphere: he considers the force with which plunged bodies rise through heavier media. He understands the doctrine of the centre of gravity, and applies it to the investigation of balances and steelyards. He recognises gravity as a force, though he falls into the error of making it diminish as the distance, and of making it purely terrestrial. He knows the relations between the velocities, spaces, and times of falling bodies, and has distinct ideas of capillary attraction. He improves the hydrometer. The determination of the densities of bodies as given by Alhazen approach very close to our own. "I join," says Draper, "in the pious prayer of Alhazen, that in the day of judgment the All-Merciful will take pity on the soul of Abur-Raihân, because he was the first of the race of men to construct a table of specific gravities." If all this be historic truth (and I have entire confidence in Dr. Draper), well may he "deplore the systematic manner in which the literature of Europe has contrived to put out of sight our scientific obligations to the Mohammedans."*

Towards the close of the stationary period a word-weariness, if I may so express it, took more and more possession of men's minds. Christendom had become sick of the school philosophy and its verbal wastes, which led to no issue, but left the intellect in everlasting haze. Here and there was heard the voice of one impatiently crying in the wilderness, "Not unto Aristotle, not unto subtle hypotheses, not unto church,

* "Intellectual Development of Europe," p. 359.

bible, or blind tradition, must we turn for a knowledge of the universe, but to the direct investigation of nature by observation and experiment." In 1543 the epoch-making work of Copernicus on the paths of the heavenly bodies appeared. The total crash of Aristotle's closed universe with the earth at its centre followed as a consequence; and "the earth moves" became a watchword among intellectual freemen. Copernicus was Canon of the church of Frauenburg, in the diocese of Ermeland. For three and-thirty years he had withdrawn himself from the world and devoted himself to the consolidation of his great scheme of the solar system. He made its blocks eternal; and even to those who feared it and desired its overthrow it was so obviously strong that they refrained for a time from meddling with it. In the last year of the life of Copernicus his book appeared: it is said that the old man received a copy of it a few days before his death, and then departed in peace.

The Italian philosopher Giordano Bruno was one of the earliest converts to the new astronomy. Taking Lucretius as his exemplar, he revived the notion of the infinity of worlds; and combining with it the doctrine of Copernicus, reached the sublime generalisation that the fixed stars are suns, scattered numberless through space and accompanied by satellites, which bear the same relation to them that our earth does to our sun, or our moon to our earth. This was an expansion of transcendent import; but Bruno came closer than this to our present line of thought. Struck with the problem of the generation and maintenance of organisms, and duly pondering it, he came to the conclusion that Nature in her productions does not imitate the technic of man. Her process is one of unravelling and unfolding. The infinity of forms under which matter appears were not imposed upon it by an external artificer; by its own intrinsic force and virtue it brings these forms forth. Matter is not the mere naked, empty capacity which philosophers have pictured her to be, but the universal mother, who brings forth all things as the fruit of her own womb.

This outspoken man was originally a Dominican monk. He was accused of heresy and had to fly, seeking refuge in Geneva, Paris, England, and Germany. In 1592 he fell into the hands of the Inquisition at Venice. He was imprisoned for many years, tried, degraded, excommunicated, and handed over to the Civil power, with the request that he should be treated gently and "without the shedding of blood." This meant that he was to be burnt; and burnt accordingly he was, on the 16th of February, 1600. To escape a similar fate Galileo, 33 years afterwards, abjured, upon his knees and with his hand upon the holy gospels, the heliocentric doctrine. After Galileo came Kepler, who from his German home defied the power beyond the Alps. He traced out from pre-existing observations the laws of planetary motion. The problem was thus prepared for Newton, who bound those empirical laws together by the principles of gravitation.

During the Middle Ages the doctrine of atoms had to all appearance vanished from discussion. In all probability it held its ground among sober-minded and thoughtful men, though neither the church nor the world was prepared to hear of it with tolerance. Once, in the year 1348, it received distinct expression. But retraction by compulsion immediately followed, and thus discouraged, it slumbered till the 17th century, when it was revived by a contemporary of Hobbes and Descartes, the Père Gassendi.

The analytic and synthetic tendencies of the human mind exhibit themselves throughout history, great writers ranging themselves sometimes on the one side, sometimes on the other. Men of lofty feelings, and minds open to the elevating impressions produced by nature as a whole, whose satisfaction, therefore, is rather ethical than logical, have leaned to the synthetic side; while the analytic harmonises best with the more precise and more mechanical bias which seeks the satisfaction of the understanding. Some form of pantheism was usually adopted by the one, while a detached Creator, working more or less after the manner of men, was often assumed by the other.* Gassendi is hardly to be ranked with either. Having formally acknowledged God as the great first cause, he immediately drops the idea, applies the known laws of mechanics to the atoms, and thence deduces all vital phenomena. God who created earth and water, plants and animals, produced, in the first place, a definite number of atoms, which constituted the seed of all things. Then began that series of combinations and decompositions which goes on at the present day, and which will continue in the future. The principle of every change resides in matter. In artificial productions the moving principle is different from the material worked upon; but in nature the agent works within, being the most active and mobile part of the material itself. Thus this bold ecclesiastic, without incurring the censure of the church or the world, contrives to outstrip Mr. Darwin. The same cast of mind which caused him to detach the Creator from his universe led him also to detach the soul from the body, though to the body he ascribes an influence so large as to render the soul almost unnecessary. The aberrations of reason were in his view an affair of the material brain. Mental disease is brain-disease; but then the immortal reason sits apart, and cannot be touched by the disease. The errors of madness are errors of the instrument, not of the performer.

It may be more than a mere result of education, connecting itself probably with the deeper mental structure of the two men, that the idea of Gassendi, above enunciated, is substantially the same as that expressed by Professor Clerk Maxwell at the close of the very noble lecture delivered by him at Bradford last year. According to both philosophers, the atoms, if I understand aright, are the prepared materials, the "manufactured articles," which, formed by the skill of the Highest, produce by their subsequent inter-action all the phenomena of the material world. There seems to be this difference, however, between Gassendi and Maxwell. The one postulates, the other infers his first cause. In his manufactured articles, Professor Maxwell finds the basis of an induction, which enables him to scale philosophic heights considered inaccessible by Kant, and to take the logical step from the atoms to their Maker.

The atomic doctrine, in whole or in part, was entertained by Bacon, Descartes, Hobbes, Locke, Newton, Boyle, and their successors, until the chemical law of multiple proportions enabled Dalton to confer upon it an entirely new significance. In our day there are secessions from the theory, but it still stands firm. Only a year or two ago Sir William Thomson, with characteristic penetration, sought to determine the sizes of the atoms, or rather to fix the limits between which their sizes lie; while only last year the discourses of Williamson and Maxwell illustrate the present hold of the doctrine upon the foremost scientific minds. What these atoms, self-moved and self-posited, can and cannot accomplish in relation to life, is at the present moment the subject of profound scientific thought. I doubt the legitimacy of Maxwell's logic; but it is impossible not to feel the ethic glow with which his lecture concludes. There is, moreover, a Lucretian grandeur in his description of the steadfastness of the atoms:—"Natural causes, as we know, are at work, which tend to modify, if they do not at length destroy, all the arrangements and dimensions of the earth and the whole solar system. But though in the course of ages catastrophes have occurred and may yet occur in the heavens, though ancient systems may be dissolved and new systems evolved out of their ruins, the

* Boyle's model of the universe was the Strasburg clock with an outside Artificer. Goethe, on the other hand sang

"Ihm ziemt's die Welt im Innern zu bewegen,
Natur in sich, sich in Natur zu hegen."

The same repugnance to the Clockmaker conception is manifest in Carlyle.

molecules out of which these systems are built, the foundation stones of the material universe, remain unbroken and unworn."

Ninety years subsequent to Gassendi the doctrine of bodily instruments, as it may be called, assumed immense importance in the hands of Bishop Butler, who in his famous "Analogy of Religion," developed from his own point of view, and with consummate sagacity, a similar idea. The Bishop still influences superior minds; and it will repay us to dwell for a moment on his views. He draws the sharpest distinction between our real selves and our bodily instruments. He does not, as far as I remember, use the word "soul," possibly because the term was so hackneyed in his day, as it had been for many generations previously. But he speaks of "living powers," "perceiving," or "percipient powers," "moving agents," "ourselves," in the same sense as we should employ the term "soul." He dwells upon the fact that limbs may be removed, and mortal diseases assail the body, while the mind, almost up to the moment of death, remains clear. He refers to sleep and to swoon, where the "living powers" are suspended but not destroyed. He considers it quite as easy to conceive of an existence out of our bodies as in them; that we may animate a succession of bodies, the dissolution of all of them having no more tendency to dissolve our real selves, or "deprive us of living faculties —the faculties of perception and action—than the dissolution of any foreign matter which we are capable of receiving impressions from, or making use of for the common occasions of life." This is the key of the Bishop's position: "our organised bodies are no more a part of ourselves than any other matter around us." In proof of this he calls attention to the use of glasses, which "prepare objects" for the "percipient power" exactly as the eye does. The eye itself is no more percipient than the glass, and is quite as much the instrument of the true self, and also as foreign to the true self, as the glass is. "And if we see with our eyes only in the same manner as we do with glasses, the like may justly be concluded from analogy of all our senses."

Lucretius, as you are aware, reached a precisely opposite conclusion; and it certainly would be interesting, if not profitable, to us all, to hear what he would or could urge in opposition to the reasoning of the Bishop. As a brief discussion of the point will enable us to see the bearings of an important question, I will here permit a disciple of Lucretius to try the strength of the Bishop's position, and then allow the Bishop to retaliate, with the view of rolling back, if he can, the difficulty upon Lucretius. Each shall state his case fully and frankly; and you shall be umpire between them.

The argument might proceed in this fashion:—

"Subjected to the test of mental presentation (*Vorstellung*) your views, most honoured prelate, would present to many minds a great, if not an insuperable difficulty. You speak of 'living powers,' 'percipient or perceiving powers,' and 'ourselves;' but can you form a mental picture of any one of these apart from the organism through which it is supposed to act? Test yourself honestly, and see whether you possess any faculty that would enable you to form such a conception. The true self has a local habitation in each of us; thus localised, must it not possess a form? If so, what form? Have you ever for a moment realised it? When a leg is amputated, the body is divided into two parts; is the true self in both of them or in one? Thomas Aquinas might say in both; but not you, for you appeal to the consciousness associated with one of the two parts to prove that the other is foreign matter. Is consciousness, then, a necessary element of the true self? If so, what do you say to the case of the whole body being deprived of consciousness? If not, then on what grounds do you deny any portion of the true self to the severed limb? It seems very singular that, from the beginning to the end of your admirable book (and no one admires its sober strength more than I do), you never once mention the brain or nervous system. You begin at one end of the body, and show that its parts may be removed without prejudice to the perceiving power. What if you begin at the other end, and remove, instead of the leg, the brain? The body, as before, is divided into two parts; but both are now in the same predicament, and neither can be appealed to to prove that the other is foreign matter. Or, instead of going so far as to remove the brain itself, let a certain portion of its bony covering be removed, and let a rhythmic series of pressures and relaxations of pressure be applied to the soft substance. At every pressure 'the faculties of perception and of action,' vanish; at every relaxation of pressure they are restored. Where, during the intervals of pressure is the perceiving power? I once had the discharge of a large Leyden battery passed unexpectedly through me: I felt nothing, but was simply blotted out of conscious existence for a sensible interval. Where was my true self during that interval? Men who have recovered from lightning-stroke have been much longer in the same state; and indeed in cases of ordinary concussion of the brain, days may elapse during which no experience is registered in consciousness. Where is the man himself during the period of insensibility? You may say that I beg the question when I assume the man to have been unconscious, that he was really conscious all the time, and has simply forgotten what has occurred to him. In reply to this, I can only say that no one need shrink from the worst tortures that superstition ever invented if only so felt and so remembered. I do not think your theory of instruments goes at all to the bottom of the matter. A telegraph operator has his instruments, by means of which he converses with the world; our bodies possess a nervous system, which plays a similar part between the perciving power and external things. Cut the wires of the operator, break his battery, demagnetise his needle: by this means you certainly sever his connection with the world; but inasmuch as these are real instruments, their destruction does not touch tbe man who uses them. The operator survives, and he knows that he survives. What is it, I would ask, in the human system that answers to this conscious survival of the operator when the battery of the brain is so disturbed as to produce insensibility, or when it is destroyed altogether?

"Another consideration, which you may consider slight, presses upon me with some force. The brain may change from health to disease, and through such a change the most exemplary man may be converted into a debauchee or a murderer. My very noble and approved good master had, as you know, threatenings of lewdness introduced into his brain by his jealous wife's philter; and sooner than permit himself to run even the risk of yielding to these base promptings he slew himself. How could the hand of Lucretius have been thus turned against himself if the real Lucretius remained as before? Can the brain or can it not act in this distempered way without the intervention of the immortal reason? If it cannot, then the immortal reason, by its mischievous activity in operating upon a broken instrument, must have the credit of committing every imaginable extravagance and crime. I think, if you will allow me to say so, that the gravest consequences are likely to flow from your estimate of the body. To regard the brain as you would a staff or an eye-glass—to shut your eyes to all its mystery, to the perfect correlation that reigns between its conditions and our consciousness, to the fact that a slight excess or defect of blood in it produces that very swoon to which you refer, and that in relation to it our meat, and drink, and air, and exercise have a perfectly transcendental value and significance—to forget all this does, I think, open a way to innumerable errors in our habits of life, and may possibly in some cases initiate and foster that very disease, and consequent mental ruin, which a wiser appreciation of this mysterious organ would have avoided."

I can imagine the Bishop thoughtful after hearing

this argument. He was not the man to allow anger to mingle with the consideration of a point of this kind. After due consideration, and having strengthened himself by that honest contemplation of the facts, which was habitual with him, and which includes the desire to give even adverse facts their due weight, I can suppose the Bishop to proceed thus:—"You will remember that in the 'Analogy of Religion,' of which you have so kindly spoken, I did not profess to prove anything absolutely, and that I over and over again acknowledged and insisted on the smallness of our knowledge, or rather the depth of our ignorance, as regards the whole system of the universe. My object was to show my deistical friends, who set forth so eloquently the beauty and beneficence of Nature and the Ruler thereof, while they had nothing but scorn for the so-called absurdities of the Christian scheme, that they were in no better condition than we were, and that, for every difficulty they found upon our side, quite as great a difficulty was to be found upon theirs. I will now, with your permission, adopt a similar line of argument. You are a Lucretian, and from the combination and separation of atoms deduce all terrestrial things, including organic forms and their phenomena. Let me tell you in the first instance how far I am prepared to go with you. I admit that you can build crystalline forms out of this play of molecular force; that the diamond, amethyst, and snow-star are truly wonderful structures which are thus produced. I will go further, and acknowledge that even a tree or flower might in this way be organised. Nay, if you can show mo an animal without sensation, I will concede to you that it also might be put together by the suitable play of molecular force.

"Thus far our way is clear, but now comes my difficulty. Your atoms are individually without sensation, much more are they without intelligence. May I ask you, then, to try your hand upon this problem. Take your dead hydrogen atoms, your dead oxygen atoms, your dead carbon atoms, your dead nitrogen atoms, your dead phosphorus atoms, and all the other atoms, dead as grains of shot, of which the brain is formed. Imagine them separate and sensationless; observe them running together and forming all imaginable combinations. This, as a purely mechanical process, is seeable by the mind. But can you see, or dream, or in any way imagine, how out of that mechanical act, and from these individually dead atoms, sensation, thought, and emotion are to arise? You speak of the difficulty of mental presentation in my case; is it less in yours? I am not all bereft of this *Vorstellungs-Kraft* of which you speak. I can follow a particle of musk until it reaches the olfactory nerve; I can follow the waves of sound until their tremors reach the water of the labyrinth, and set the otoliths and Corti's fibres in motion; I can also visualise the waves of ether as they cross the eye and hit the retina. Nay more, I am able to follow up to the central organ the motion thus imparted at the periphery, and to see in idea the very molecules of the brain thrown into tremors. My insight is not baffled by these physical processes. What baffles me, what I find unimaginable, transcending every faculty I possess—transcending, I humbly submit, every faculty you possess—is the notion that out of those physical tremors you can extract things so utterly incongruous with them as sensation, thought, and emotion. You say, or think, that this issue of consciousness from the clash of atoms is not more incongruous than the flash of light from the union of oxygen and hydrogen. But I beg to say that it is. For such incongruity as the flash possesses is that which I now force upon your attention. The flash is an affair of consciousness, the objective counterpart of which is a vibration. It is a flash only by your interpretation. You are the cause of the apparent incongruity; and you are the thing that puzzles me. I need not remind you that the great Leibnitz felt the difficulty which I feel, and that to get rid of this monstrous deduction of life from death he displaced your atoms by his monads, which were more or less perfect mirrors of the universe, and out of the summation and integration of which he supposed all the phenomena of life—sentient, intellectual, and emotional—to arise.

"Your difficulty, then, as I see you are ready to admit, is quite as great as mine. You cannot satisfy the human mind in its demand for logical continuity between molecular processes and the phenomena of consciousness. This is a rock on which materialism must inevitably split whenever it pretends to be a complete philosophy of life. What is the moral, my Lucretian? You and I are not likely to indulge in ill-temper in the discussion of these great topics where we see so much room for honest differences of opinion. But there are people of less wit, or more bigotry (I say it with humility) on both sides, who are ever ready to mingle anger and vituperation with such discussions. There are, for example, writers of note and influence at the present day who are not ashamed to assume the 'deep personal sin' of a great logician to be the cause of his unbelief in a theologic dogma. And there are others that hold that we, who cherish our noble Bible, wrought as it has been into the constitution of our forefathers, and by inheritance into us, must necessarily be hypocritical and insincere. Let us disavow and discountenance such people, cherishing the unswerving faith that what is good and true in both our arguments will be preserved for the benefit of humanity, while all that is bad or false will disappear."

It is worth remarking that in one respect the Bishop was a product of his age. Long previous to his day the nature of the soul had been so favourite and general a topic of discussion, that, when the students of the University of Paris wished to know the leanings of a new Professor, they at once requested him to lecture upon the soul. About the time of Bishop Butler the question was not only agitated, but extended. It was seen by the clear-witted men who entered this arena that many of their best arguments applied equally to brutes and men. The Bishop's arguments were of this character. He saw it, admitted it, accepted the consequences, and boldly embraced the whole animal world in his scheme of immortality.

Bishop Butler accepted with unwavering trust the chronology of the Old Testament, describing it as "confirmed by the natural and civil history of the world, collected from common historians, from the state of the earth, and from the late inventions of arts and sciences." These words mark progress; they must seem somewhat hoary to the Bishop's successors of to-day.* It is hardly necessary to inform you that since his time the domain of the naturalist has been immensely extended—the whole science of geology, with its astounding revelations regarding the life of the ancient earth, having been created. The rigidity of old conceptions has been relaxed, the public mind being rendered gradually tolerant of the idea that not for six thousand, nor for sixty thousand, nor for six thousand thousand, but for æons embracing untold millions of years, this earth has been the theatre of life and death. The riddle of the rocks has been read by the geologist and palæontologist, from subcambrian depths to the deposits thickening over the sea-bottoms of to-day. And upon the leaves of that stone book are, as you know, stamped the characters, plainer and surer than those formed by the ink of history, which carry the mind back into abysses of past time compared with which the periods which satisfied Bishop Butler cease to have a visual angle. Everybody now knows this; all men admit it; still when they were first broached these varities of science found loud-tonged denunciators, who proclaimed not only their baselessness considered scientifically, but their immorality considered as questions of ethics and religion: the Book of Genesis had stated the question in a different fashion; and science must necessarily go to pieces

* Only to some; for there are dignitaries who even now speak of the earth's rocky crust as so much building material prepared for man at the Creation. Surely it is time that this loose language should cease.

when it clashed with this authority. And as the seed of a thistle produces a thistle, and nothing else, so these objectors scatter their germs abroad, and reproduce their kind, ready to play again the part of their intellectual progenitors, to show the same virulence, the same ignorance, to achieve for a time the same success, and finally to suffer the same inexorable defeat. Surely the time must come at last when human nature in its entirety, whose legitimate demands it is admitted science alone cannot satisfy, will find interpreters and expositors of a different stamp from those rash and ill-informed persons who have been hitherto so ready to hurl themselves against every new scientific revelation, lest it should endanger what they are pleased to consider theirs.

The lode of discovery once struck, those petrified forms in which life was at one time active, increased to multitudes and demanded classification. The general fact soon became evident that none but the simplest forms of life lie lowest down, that as we climb higher and higher among the super-imposed strata more perfect forms appear. The change, however, from form to form was not continuous—but by steps, some small, some great. "A section," says Mr. Huxley, "a hundred feet thick will exhibit at different heights a dozen species of Ammonite, none of which passes beyond its particular zone of limestone, or clay, into the zone below it, or into that above it." In the presence of such facts it was not possible to avoid the question:—Have these forms, showing, though in broken stages and with many irregularities, this unmistakable general advance, been subjected to no continuous law of growth or variation? Had our education been purely scientific, or had it been sufficiently detached from influences which, however ennobling in another domain, have always proved hindrances and delusions when introduced as factors into the domain of physics, the scientific mind never could have swerved from the search for a law of growth, or allowed itself to accept the anthropomorphism which regarded each successive stratum as a kind of mechanic's bench for the manufacture of new species out of all relation to the old.

Biased, however, by their previous education, the great majority of naturalists invoked a special creative act to account for the appearance of each new group of organisms. Doubtless there were numbers who were clear-headed enough to see that this was no explanation at all, that in point of fact it was an attempt, by the introduction of a greater difficulty, to account for a less. But having nothing to offer in the way of explanation, they for the most part held their peace. Still the thoughts of reflecting men naturally and necessarily simmered round the question. De Maillet, a contemporary of Newton, has been brought into notice by Professor Huxley as one who "had a notion of the modifiability of living forms." In my frequent conversations with him, the late Sir Benjamin Brodie, a man of highly philosophic mind, often drew my attention to the fact that, as early as 1794, Charles Darwin's grandfather was the pioneer of Charles Darwin. In 1801, and in subsequent years, the celebrated Lamarck, who produced so profound an impression on the public mind through the vigorous exposition of his views by the author of the "Vestiges of Creation," endeavoured to show the development of species out of changes of habit and external condition. In 1813, Dr. Wells, the founder of our present Theory of Dew, read before the Royal Society a paper in which, to use the words of Mr. Darwin, "he distinctly recognises the principal of natural selection; and this is the first recognition that has been indicated." The thoroughness and skill with which Wells pursued his work, and the obvious independence of his character, rendered him long ago a favourite with me; and it gave me the liveliest pleasure to alight upon this additional testimony to his penetration. Professor Grant, Mr. Patrick Matthew, Von Buch, the author of the "Vestiges," D'Halloy, and others,* by the enunciation of views more or less clear and correct, showed that the question had been fermenting long prior to the year 1858, when Mr. Darwin and Mr. Wallace simultaneously but independently placed their closely concurrent views upon the subject before the Linnean Society.

These papers were followed in 1859 by the publication of the first edition of the "Origin of Species." All great things come slowly to the birth. Copernicus, as I informed you, pondered his great work for thirty-three years. Newton for nearly twenty years kept the idea of gravitation before his mind; for twenty years also he dwelt upon his discovery of fluxions, and doubtless would have continued to make it the object of his private thought had he not found that Leibnitz was upon his track. Darwin for two and twenty years pondered the problem of the origin of species, and doubtless he would have continued to do so had he not found Wallace upon his track.† A concentrated, but full and powerful epitome of his labours was the consequence. The book was by no means an easy one; and probably not one in every score of those who then attacked it had read its pages through, or were competent to grasp their significance if they had. I do not say this merely to discredit them; for there were in those days some really eminent scientific men, entirely raised above the heat of popular prejudice, willing to accept any conclusion that science had to offer, provided it was duly backed by fact and argument, and who entirely mistook Mr. Darwin's views. In fact the work needed an expounder; and it found one in Mr. Huxley. I know nothing more admirable in the way of scientific exposition than those early articles of his on the origin of species. He swept the curve of discussion through the really significant points of the subject, enriched his exposition with profound original remarks and reflections, often summing up in a single pithy sentence an argument which a less compact mind would have spread over pages. But there is one impression made by the book itself which no exposition of it, however luminous, can convey; and that is the impression of the vast amount of labour, both of observation and of thought, implied in its production. Let us glance at its principles.

It is conceded on all hands that what are called varieties are continually produced. The rule is probably without exception. No chick and no child is in all respects and particulars the counterpart of its brother or sister; and in such differences we have "variety" incipient. No naturalist could tell how far this variation could be carried; but the great mass of them held that never by any amount of internal or external change, nor by the mixture of both, could the offspring of the same progenitor so far deviate from each other as to constitute different species. The function of the experimental philosopher is to combine the conditions of nature, and to produce her results; and this was the method of Darwin.‡ He made himself acquainted with what could, without any manner of doubt, be done in the way of producing variation. He associated himself with pigeon-fanciers—bought, begged, kept, and observed every breed that he could obtain. Though derived from a common stock, the diversities of these pigeons were such that "a score of them might be chosen which, if shown to an ornithologist, and he were told that they were wild birds, would certainly be ranked by him as well-defined species." The simple principle which guides the pigeon-fancier, as it does the cattle-breeder, is the selection of

* In 1855, Mr. Herbert Spencer ("Principles of Psychology," 2nd edit. vol. i. p. 465) expressed "the belief that life under all its forms has arisen by an unbroken evolution, and through the instrumentality of what are called natural causes."

† The behaviour of Mr. Wallace in relation to this subject has been dignified in the highest degree.

‡ The first step only towards experimental demonstration has been taken. Experiments now begun might, a couple of centuries hence, furnish data of incalculable value, which ought to be supplied to the science of the future.

some variety that strikes his fancy, and the propagation of this variety by inheritance. With his eye still upon the particular appearance which he wishes to exaggerate, he selects it as it reappears in successive broods, and thus adds increment to increment until an astonishing amount of divergence from the parent type is effected. Man in this case does not produce the elements of the variation. He simply observes them, and by selection adds them together until the required result has been obtained. "No man," says Mr. Darwin, "would ever try to make a fantail till he saw a pigeon with a tail developed in some slight degree in an unusual manner, or a pouter until he saw a pigeon with a crop of unusual size." Thus nature gives the hint, man acts upon it, and by the law of inheritance exaggerates the deviation.

Having thus satisfied himself by indubitable facts that the organisation of an animal or of a plant (for precisely the same treatment applies to plants) is to some extent plastic, he passes from variation under domestication to variation under nature. Hitherto we have dealt with the adding together of small changes by the conscious selection of man. Can Nature thus select? Mr. Darwin's answer is, "Assuredly she can." The number of living things produced is far in excess of the number that can be supported; hence at some period or other of their lives there must be a struggle for existence; and what is the infallible result? If one organism were a perfect copy of the other in regard to strength, skill, and agility, external conditions would decide. But this is not the case. Here we have the fact of variety offering itself to nature, as in the former instance it offered itself to man; and those varieties which are least competent to cope with surrounding conditions will infallibly give way to those that are most competent. To use a familiar proverb, the weakest come to the wall. But the triumphant fraction again breeds to overproduction, transmitting the qualities which secured its maintenance, but transmitting them in different degrees. The struggle for food again supervenes, and those to whom the favourable quality has been transmitted in excess will assuredly triumph. It is easy to see that we have here the addition of increments favourable to the individual still more rigorously carried out than in the case of domestication; for not only are unfavourable specimens not selected by nature, but they are destroyed. This is what Mr. Darwin calls "Natural Selection," which "acts by the preservation and accumulation of small inherited modifications, each profitable to the preserved being." With this idea he interpenetrates and leavens the vast store of facts that he and others have collected. We cannot, without shutting our eyes through fear or prejudice, fail to see that Darwin is here dealing, not with imaginary, but with true causes; nor can we fail to discern what vast modifications may be produced by natural selection in periods sufficiently long. Each individual increment may resemble what mathematicans call a "differential" (a quantity indefinitely small); but definite and great changes may obviously be produced by the integration of these infinitesimal quantities through practically infinite time.

If Darwin, like Bruno, rejects the notion of creative power acting after human fashion, it certainly is not because he is unacquainted with the numberless exquisite adaptations on which this notion of a supernatural artificer has been founded. His book is a repository of the most startling facts of this description. Take the marvellous observation which he cites from Dr. Crüger, where a bucket with an aperture, serving as a spout, is formed in an orchid. Bees visit the flower: in eager search of material for their combs they push each other into the bucket, the drenched ones escaping from their involuntary bath by the spout. Here they rub their backs against the viscid stigma of the flower and obtain glue; then against the pollen-masses, which are thus stuck to the back of the bee and carried away. "When the bee, thus provided, flies to another flower, or to the same flower a second time, and is pushed by its comrades into the bucket, and then crawls out by the passage, the pollen-mass upon its back necessarily comes first into contact with the viscid stigma," which takes up the pollen; and this is how that orchid is fertilised. Or take this other case of the *Catasetum*. "Bees visit these flowers in order to gnaw the labellum; on doing this they inevitably touch a long, tapering, sensitive projection. This, when touched, transmits a sensation or vibration to a certain membrane, which is instantly ruptured, setting free a spring, by which the pollen-mass is shot forth like an arrow in the right direction, and adheres by its viscid extremity to the back of the bee." In this way the fertilising pollen is spread abroad.

It is the mind thus stored with the choicest materials of the teleologist that rejects teleology, seeking to refer these wonders to natural causes. They illustrate, according to him, the method of nature, not the "technic" of a man-like artificer. The beauty of flowers is due to natural selection. Those that distinguish themselves by vividly contrasting colours from the surrounding green leaves are most readily seen, most frequently visited by insects, most often fertilised, and hence most favoured by natural selection. Coloured berries also readily attract the attention of birds and beasts, which feed upon them, spread their manured seeds abroad, thus giving trees and shrubs possessing such berries a greater chance in the struggle for existence.

With profound analytic and synthetic skill, Mr. Darwin investigates the cell-making instinct of the hive-bee. His method of dealing with it is representative. He falls back from the more perfectly to the less perfectly developed instinct—from the hive-bee to the humble-bee, which uses its own cocoon as a comb, and to classes of bees of intermediate skill, endeavouring to show how the passage might gradually be made from the lowest to the highest. The saving of wax is the most important point in the economy of bees. Twelve to fifteen pounds of dry sugar are said to be needed for the secretion of a single pound of wax. The quantities of nectar necessary for the wax must therefore be vast; and every improvement of constructive instinct which results in the saving of wax is a direct profit to the insect's life. The time that would otherwise be devoted to the making of wax is now devoted to the gathering and storing of honey for winter food. He passes from the humble-bee with its rude cells, through the Melipona with its more artistic cells, to the hive-bee with its astonishing architecture. The bees place themselves at equal distances apart upon the wax, sweep and excavate equal spheres round the selected points. The spheres intersect, and the planes of intersection are built up with thin laminæ. Hexagonal cells are thus formed. This mode of treating such questions is, as I have said, representative. He habitually retires from the more perfect and complex, to the less certain and simple, and carries you with him though stages of perfecting, adds increment to increment of infinitesimal change, and in this way gradually breaks down your reluctance to admit that the exquisite climax of the whole could be a result of natural selection.

Mr. Darwin shirks no difficulty; and, saturated as the subject was with his own thought, he must have known, better than his critics, the weakness as well as the strength of his theory. This of course would be of little avail were his object a temporary dialectic victory instead of the establishment of a truth which he means to be everlasting. But he takes no pains to disguise the weakness he has discerned; nay, he takes every pains to bring it into the strongest light. His vast resources enable him to cope with objections started by himself and others, so as to leave the final impression upon the reader's mind that, if they be not completely answered, they certainly are not fatal. Their negative force being thus destroyed, you are free to be influenced by the vast positive mass of evidence he is able to bring before you. This largeness of knowledge and readiness of resource render Mr. Darwin the most terrible

of antagonists. Accomplished naturalists have levelled heavy and sustained criticisms against him — not always with the view of fairly weighing his theory, but with the express intention of exposing its weak points only. This does not irritate him. He treats every objection with a soberness and thoroughness which even Bishop Butler might be proud to imitate, surrounding each fact with its appropriate detail, placing it in its proper relations, and usually giving it a significance which, as long as it was kept isolated, failed to appear. This is done without a trace of ill-temper. He moves over the subject with the passionless strength of a glacier; and the grinding of the rocks is not always without a counterpart in the logical pulverisation of the objector. But though in handling this mighty theme all passion has been stilled, there is an emotion of the intellect incident to the discernment of new truth which often colours and warms the pages of Mr. Darwin. His success has been great; and this implies not only the solidity of his work, but the preparedness of the public mind for such a revelation. On this head a remark of Agassiz impressed me more than anything else. Sprung from a race of theologians, this celebrated man combated to the last the theory of natural selection. One of the many times I had the pleasure of meeting him in the United States was at Mr. Winthrop's beautiful residence at Brooklyn, near Boston. Rising from luncheon, we all halted as if by common impulse in front of a window, and continued there a discussion which had been started at table. The maple was in its autumn glory; and the exquisite beauty of the scene outside seemed, in my case, to interpretate without disturbance the intellectual action. Earnestly, almost sadly, Agassiz turned, and said to the gentlemen standing round, "I confess that I was not prepared to see this theory received as it has been by the best intellects of our time. Its success is greater than I could have thought possible."

In our day great generalisations have been reached. The theory of the origin of species is but one of them. Another, of still wider grasp and more radical significance, is the doctrine of the Conservation of Energy, the ultimate philosophical issues of which are as yet but dimly seen—that doctrine which "binds nature fast in fate" to an extent not hitherto recognised, exacting from every antecedent its equivalent consequent, from every consequent its equivalent antecedent, and bringing vital as well as physical phenomena under the dominion of that law of casual connexion which, as far as the human understanding has yet pierced, asserts itself everywhere in nature. Long in advance of all definite experiment upon the subject, the constancy and indestructibility of matter had been affirmed; and all subsequent experience justified the affirmation. Later researches extended the attribute of indestructibility to force. This idea, applied in the first instance to inorganic, rapidly embraced organic nature. The vegetable world, though drawing almost all its nutriment from invisible sources, was proved incompetent to generate anew either matter or force. Its matter is for the most part transmuted air; its force transformed solar force. The animal world was proved to be equally uncreative, all its motive energies being referred to the combustion of its food. The activity of each animal as a whole was proved to be the transferred activities of its molecules. The muscles were shown to be stores of mechanical force, potential until unlocked by the nerves, and then resulting in muscular contractions. The speed at which messages fly to and fro along the nerves was determined, and found to be, not as had been previously supposed, equal to that of light or electricity, but less than the speed of a flying eagle.

This was the work of the physicist: then came the conquests of the comparative anatomist and physiologist, revealing the structure of every animal, and the function of every organ in the whole biological series, from the lowest zoophyte up to man. The nervous system had been made the object of profound and continued study, the wonderful and, at bottom, entirely mysterious, controlling power which it exercises over the whole organism, physical and mental, being recognised more and more. Thought could not be kept back from a subject so profoundly suggestive. Besides the physical life dealt with by Mr. Darwin, there is a psychical life presenting similar gradations, and asking equally for a solution. How are the different grades and orders of mind to be accounted for? What is the principle of growth of that mysterious power which on our planet culminates in reason? These are questions which, though not thrusting themselves so forcibly upon the attention of the general public, had not only occupied many reflecting minds, but had been formally broached by one of them before the "Origin of Species" appeared.

With the mass of materials furnished by the physicist and physiologist in his hands, Mr. Herbert Spencer, twenty years ago, sought to graft upon this basis a system of psychology; and two years ago a second and greatly amplified edition of his work appeared. Those who have occupied themselves with the beautiful experiments of Plateau will remember that when two spherules of olive-oil, suspended in a mixture of alcohol and water of the same density as the oil, are brought together, they do not immediately unite. Something like a pellicle appears to be formed around the drops, the rupture of which is immediately followed by the coalescence of the globules into one. There are organisms whose vital actions are almost as purely physical as that of these drops of oil. They come into contact and fuse themselves thus together. From such organisms to others a shade higher, and from these to others a shade higher still, and on through an ever ascending series, Mr. Spencer conducts his argument. There are two obvious factors to be here taken into account—the creature and the medium in which it lives, or, as it is often expressed, the organism and its environment. Mr. Spencer's fundamental principle is, that between these two factors there is incessant interaction. The organism is played upon by the environment, and is modified to meet the requirements of the environment. Life he defines to be a "continuous adjustment of internal relations to external relations."

In the lowest organisms we have a kind of tactual sense diffused over the entire body; then, through impressions from without and their corresponding adjustments, special portions of the surface become more responsive to stimuli than others. The senses are nascent, the basis of all of them being that simple tactual sense which the sage Democritus recognised 2,300 years ago as their common progenitor. The action of light, in the first instance, appears to be a mere disturbance of the chemical processes in the animal organism, similar to that which occurs in the leaves of plants. By degrees the action becomes localised in a few pigment-cells, more sensitive to the light than the surrounding tissue. The eye is here incipient. At first it is merely capable of revealing differences of light and shade produced by bodies close at hand. Followed as the interception of the light is in almost all cases by the contact of the closely adjacent opaque body, sight in this condition becomes a kind of "anticipatory touch." The adjustment continues; a slight bulging out of the epidermis over the pigment-granules supervenes. A lens is incipient, and, through the operation of infinite adjustments, at length reaches the perfection that it displays in the hawk and eagle. So of the other senses; they are special differentiations of a tissue which was originally vaguely sensitive all over.

With the development of the senses the adjustments between the organism and its environment gradually extend in space, a multiplication of experiences and corresponding modification of conduct being the result. The adjustments also extend in time, covering continually greater intervals. Along with this extension in space and time the adjustments also increase in speciality

and complexity, passing through the various grades of brute life, and prolonging themselves into the domain of reason. Very striking are Mr. Spencer's remarks regarding the influence of the sense of touch upon the development of intelligence. This is, so to say, the mother-tongue of all the senses, into which they must be translated to be of service to the organism. Hence its importance. The parrot is the most intelligent of birds, and its tactual power is also greatest. From this sense it gets knowledge unattainable by birds which cannot employ their feet as hands. The elephant is the most sagacious of quadrupeds—its tactual range and skill, and the consequent multiplication of experiences, which it owes to its wonderfully adaptable trunk, being the basis of its sagacity. Feline animals, for a similar cause, are more sagacious than hoofed animals—atonement being to some extent made, in the case of the horse, by the possession of sensitive prehensible lips. In the *Primates* the evolution of intellect and the evolution of tactual appendages go hand in hand. In the most intelligent anthropoid apes we find the tactual range and delicacy greatly augmented, new avenues of knowledge being thus opened to the animal. Man crowns the edifice here, not only in virtue of his own manipulatory power, but through the enormous extention of his range of experience, by the invention of instruments of precision, which serve as supplemental senses and supplemental limbs. The reciprocal action of these is finely described and illustrated. That chastened intellectual emotion to which I have referred in connection with Mr. Darwin is, I should say, not absent in Mr. Spencer. His illustrations possess at times exceeding vividness and force; and from his style on such occasions it is to be inferred that the ganglia of this apostle of the understanding are sometimes the seat of a nascent poetic thrill.

It is a fact of supreme importance that actions the performance of which at first requires even painful effort and deliberation, may by habit be rendered automatic. Witness the slow learning of its letters by a child, and the subsequent facility of reading in a man, when each group of letters which forms a word is instantly, and without effort, fused to a single perception. Instance the billiard-player, whose muscles of hand and eye, when he reaches the perfection of his art, are unconsciously co-ordinated. Instance the musician, who, by practice, is enabled to fuse a multitude of arrangements, auditory, tactual and muscular, into a process of automatic manipulation. Combining such facts with the doctrine of hereditary transmission, we reach a theory of instinct. A chick, after coming out of the egg, balances itself correctly, runs about, picks up food, thus showing that it possesses a power of directing its movements to definite ends. How did the chick learn this very complex co-ordination of eye, muscles, and beak? It has not been individually taught; its personal experience is *nil;* but it has the benefit of ancestral experience. In its inherited organisation are registered all the powers which it displays at birth. So also as regards the instinct of the hive-bee, already referred to. The distance at which the insects stand apart when they sweep their hemispheres and build their cells is "organically remembered." Man also carries with him the physical texture of his ancestry as well as the inherited intellect bound up with it. The defects of intelligence during infancy and youth are probably less due to a lack of individual experience than to the fact that in early life the cerebral organisation is still incomplete. The period necessary for completion varies with the race and with the individual. As a round shot outstrips a rifled one on quitting the muzzle of the gun, so the lower race in childhood may outstrip the higher. But the higher eventually overtakes the lower, and surpasses it in range. As regards individuals, we do not always find the precocity of youth prolonged to mental power in maturity; while the dulness of boyhood is sometimes strikingly contrasted with the intellectual energy of after years. Newton, when a boy, was weakly, and he showed no particular aptitude at school; but in his eighteenth year he went to Cambridge, and soon afterwards astonished his teachers by his power of dealing with geometrical problems. During his quiet youth his brain was slowly preparing itself to be the organ of those energies which he subsequently displayed.

By myriad blows (to use a Lucretian phrase) the image and superscription of the external world are stamped as states of consciousness upon the organism, the depth of the impression depending upon the number of the blows. When two or more phenomena occur in the environment invariably together, they are stamped to the same depth or to the same relief, and indissolubly connected. And here we come to the threshold of a great question. Seeing that he could in no way rid himself of the consciousness of space and time, Kant assumed them to be necessary "forms of thought," the moulds and shapes into which our intuitions are thrown, belonging to ourselves solely and without objective existence. With unexpected power and success Mr. Spencer brings the hereditary experience theory, as he holds it, to bear upon this question. "If there exist certain external relations which are experienced by all organisms at all instants of their waking lives—relations which are absolutely constant and universal—there will be established answering internal relations that are absolutely constant and universal. Such relations we have in those of space and time. As the substratum of all other relations of the Non-Ego, they must be responded to by conceptions that are the substrata of all other relations in the Ego. Being the constant and infinitely repeated elements of thought, they must become the automatic elements of thought—the elements of thought which it is impossible to get rid of—the 'forms of intuition.'"

Throughout this application and extension of the "Law of Inseparable Association," Mr. Spencer stands on totally different ground from Mr. John Stuart Mill, invoking the registered experiences of the race instead of the experiences of the individual. His overthrow of Mr. Mill's restriction of experience is, I think, complete. That restriction ignores the power of organising experience furnished at the outset to each individual; it ignores the different degrees of this power possessed by different races and by different individuals of the same race. Were there not in the human brain a potency antecedent to all experience, a dog or cat ought to be as capable of education as a man. These predetermined internal relations are independent of the experiences of the individual. The human brain is the "organised register of infinitely numerous experiences received during the evolution of life, or rather during the evolution of that series of organisms through which the human organism has been reached. The effects of the most uniform and frequent of these experiences have been successively bequeathed, principal and interest, and have slowly mounted to that high intelligence which lies latent in the brain of the infant. Thus it happens that the European inherits from twenty to thirty cubic inches more of brain than the Papuan. Thus it happens that faculties, as of music, which scarcely exist in some inferior races, become congenital in superior ones. Thus it happens that out of savages unable to count up to the number of their fingers, and speaking a language containing only nouns and verbs, arise at length our Newtons and Shakspeares.

At the outset of this address it was stated that physical theories which lie beyond experience are derived by a process of abstraction from experience. It is instructive to note from this point of view the successive introduction of new conceptions. The idea of the attraction of gravitation was preceded by the observation of the attraction of iron by a magnet, and of light bodies by rubbed amber. The polarity of magnetism and electricity appealed to the senses; and thus became the substratum of the conception that atoms and molecules are

endowed with definite attractive and repellant poles, by the play of which definite forms of crystalline architecture are produced. Thus molecular force becomes structural. It required no great boldnesss of thought to extend its play into organic nature, and to recognise in molecular force the agency by which both plants and animals are built up. In this way out of experience arise conceptions which are wholly ultra-experiential.

The origination of life is a point lightly touched upon, if at all, by Mr. Darwin and Mr. Spencer. Diminishing gradually the number of progenitors, Mr. Darwin comes at length to one "primordial form;" but he does not say, as far as I remember, how he supposes this form to have been introduced. He quotes with satisfaction the words of a celebrated author and divine who had "gradually learnt to see that it is just as noble a conception of the Deity to believe He created a few original forms, capable of self-development into other and needful forms, as to believe that He required a fresh act of creation to supply the voids caused by the action of His laws." What Mr. Darwin thinks of this view of the introduction of life I do not know. Whether he does or does not introduce his "primordial form" by a creative act I do not know. But the question will inevitably be asked, "How came the form there?" With regard to the diminution of the number of created forms, one does not see that much advantage is gained by it. The anthropomorphism, which it seemed the object of Mr. Darwin to set aside, is as firmly associated with the creation of a few forms as with the creation of a multitude. We need clearness and thoroughness here. Two courses and two only are possible. Either let us open our doors freely to the conception of creative acts, or abandoning them let us radically change our notions of matter. If we look at matter, as pictured by Democritus, and as defined for generations in our scientific text-books, the absolute impossibility of any form of life coming out of it would be sufficient to render any other hypothesis preferable; but the definitions of matter given in our text-books were intended to cover its purely physical and mechanical properties. And taught as we have been to regard these definitions as complete, we naturally and rightly reject the monstrous notion that out of such matter any form of life could possibly arise. But are the definitions complete? Everything depends on the answer to be given to this question. Trace the line of life backwards, and see it approaching more and more to what we call the purely physical condition. We reach at length those organisms which I have compared to drops of oil suspended in a mixture of alcohol and water. We reach the *protogenes* of Haeckel, in which we have "a type distinguishable from a fragment of albumen only by its finely granular character." Can we pause here? We break a magnet, and find two poles in each of its fragments. We continue the process of breaking, but however small the parts, each carries with it, though enfeebled, the polarity of the whole. And when we break no longer, we prolong the intellectual vision to the polar molecules. Are we not urged to do something similar in the case of life? Is there not a temptation to close to some extent with Lucretius, when he affirms that "nature is seen to do all things spontaneously of herself without the meddling of the gods?" or with Bruno, when he declares that matter is not "that mere empty capacity which philosophers have pictured her to be, but the universal mother who brings forth all things as the fruit of her own womb?" The questions here raised are inevitable. They are approaching us with accelerated speed, and it is not a matter of indifference whether they are introduced with reverence or with irreverence. Abandoning all disguise, the confession that I feel bound to make before you is, that I prolong the vision backward across the boundary of the experimental evidence, and discern in that matter which we in our ignorance, and notwithstanding our professed reverence for its Creator, have hitherto covered with opprobrium, the promise and potency of every form and quality of life.

The "materialism" here enunciated may be different from what you suppose, and I therefore crave your gracious patience to the end. "The question of an external world," says Mr. J. S. Mill, "is the great battle-ground of metaphysics."* Mr. Mill himself reduces external phenomena to "possibilities of sensation." Kant, as we have seen, made time and space "forms" of our own intuitions. Fichte, having first by the inexorable logic of his understanding proved himself to be a mere link in that chain of causation which holds so rigidly in nature, violently broke the chain by making nature and all that it inherit an apparition of his own mind.† And it is by no means easy to combat such notions. For when I say I see you, and I have not the least doubt about it, the reply is, that what I am really conscious of is an affection of my own retina. And if I urge that I can check my sight of you by touching you, the retort would be that I am equally transgressing the limits of fact; for what I am really conscious of is, not that you are there, but that the nerves of my hand have undergone a change. All we hear, and see, and touch, and taste, and smell, are, it would be urged, mere variations of our own condition, beyond which, even to the extent of a hair's breadth, we cannot go. That anything answering to our impressions exists outside of ourselves is not a fact, but an inference, to which all validity would be denied by an idealist like Berkeley, or by a sceptic like Hume. Mr. Spencer takes another line. With him, as with the uneducated man, there is no doubt or question as to the existence of an external world. But he differs from the uneducated, who think that the world really is what consciousness represents it to be. Our states of consciousness are mere symbols of an outside entity which produces them and determines the order of their succession, but the real nature of which we can never know.‡ In fact, the whole process of evolution is the manifestation of a power absolutely inscrutable to the intellect of man. As little in our day as in the days of Job can man by searching find this Power out. Considered fundamentally, it is by the operation of an insoluble mystery that life is evolved, species differentiated, and mind unfolded from their prepotent elements in the immeasurable past. There is, you will observe, no very rank materialism here.

The strength of the doctrine of evolution consists, not in an experimental demonstration (for the subject is hardly accessible to this mode of proof), but in its general harmony with the method of nature as hitherto known. From contrast, moreover, it derives enormous relative strength. On the one side we have a theory (if it could with any propriety be so called) derived, as were the theories referred to at the beginning of this address, not from the study of nature, but from the observations of men—a theory which converts the Power whose garment is seen in the visible universe into an artificer, fashioned after the human model, and acting by broken efforts as man is seen to act. On the other side we have the conception that all we see around us, and all we feel within us—the phenomena of physical nature as well as those of the human mind—have their

* "Examination of Hamilton," p. 154.

† "Bestimmung des Menschen."

‡ In a paper, at once popular and profound, entitled "Recent Progress in the Theory of Vision," contained in the volume of Lectures by Helmholtz, published by Longmans, this symbolism of our states of consciousness is also dwelt upon. The impressions of sense are the mere signs of external things. In this paper Helmholtz contends strongly against the view that the consciousness of space is inborn; and he evidently doubts the power of the chick to pick up grains of corn without some preliminary lessons. On this point, he says, further experiments are needed. Such experiments have been since made by Mr. Spalding, aided, I believe, in some of his observations by the accomplished and deeply lamented Lady Amberley; and they seem to prove conclusively that the chick does not need a single moment's tuition to teach it to stand, run, govern the muscles of its eyes, and peck. Helmholtz, however, is contending against the notion of pre-established harmony; and I am not aware of his views as to the organisation of experiences of race or breed.

unsearchable roots in a cosmical life, if I dare apply the term, an infinitesimal span of which only is offered to the investigation of man. And even this span is only knowable in part. We can trace the development of a nervous system, and correlate with it the parallel phenomena of sensation and thought. We see with undoubting certainty that they go hand in hand. But we try to soar in a vacuum the moment we seek to comprehend the connection between them. An Archimedean fulcrum is here required which the human mind cannot command; and the effort to solve the problem, to borrow an illustration from an illustrious friend of mine, is like the effort of a man trying to lift himself by his own waistband. All that has been here said is to be taken in connection with this fundamental truth. When "nascent senses" are spoken of, when "the differentiation of a tissue at first vaguely sensitive all over" is spoken of; and when these processes are associated with "the modification of an organism by its environment," the same parallelism, without contact, or even approach to contact, is implied. There is no fusion possible between the two classes of facts—no motor energy in the intellect of man to carry it without logical rupture from the one to the other.

Further, the doctrine of evolution derives man, in his totality, from the interaction of organism and environment through countless ages past. The human understanding, for example—that faculty which Mr. Spencer has turned so skilfully round upon its own antecedents—is itself a result of the play between organism and environment through cosmic ranges of time. Never surely did prescription plead so irresistible a claim. But then it comes to pass that, over and above his understanding, there are many other things appertaining to man whose prescriptive rights are quite as strong as that of the understanding itself. It is a result, for example, of the play of organism and environment that sugar is sweet and that aloes are bitter, that the smell of henbane differs from the perfume of a rose. Such facts of consciousness (for which, by the way, no adequate reason has ever yet been rendered) are quite as old as the understanding itself; and many other things can boast an equally ancient origin. Mr. Spencer at one place refers to that most powerful of passions—the amatory passion—as one which, when it first occurs, is antecedent to all relative experience whatever; and we may pass its claim as being at least as ancient and as valid as that of the understanding itself. Then there are such things woven into the texture of men as the feeling of Awe, Reverence, Wonder—and not alone the sexual love just referred to, but the love of the beautiful, physical and moral, in nature, poetry and art. There is also that deep-set feeling which, since the earliest dawn of history, and probably for ages prior to all history, incorporated itself in the religions of the world. You who have escaped from these religions into the high-and-dry light of the understanding may deride them; but in so doing you deride accidents of form merely, and fail to touch the immoveable basis of the religious sentiment in the emotional nature of man. To yield this sentiment reasonable satisfaction is the problem of problems at the present hour. And grotesque in relation to scientific culture as many of the religions of the world have been and are—dangerous, nay, destructive, to the dearest privileges of freemen as some of them undoubtedly have been, and would, if they could, be again—it will be wise to recognise them as the forms of a force, mischievous, if permitted to intrude on the region of knowledge, over which it holds no command, but capable of being guided by liberal thought to noble issues in the region of emotion, which is its proper sphere. It is vain to oppose this force with a view to its extirpation. What we should oppose, to the death if necessary, is every attempt to found upon this elemental bias of man's nature a system which should exercise despotic sway over his intellect. I do not fear any such consummation. Science has already to some extent leavened the world, and it will leaven it more and more. I should look upon the mild light of science breaking in upon the minds of the youth of Ireland, and strengthening gradually to the perfect day, as a surer check to any intellectual or spiritual tyranny which might threaten this island, than the laws of princes or the swords of emperors. Where is the cause of fear? We fought and won our battle even in the Middle Ages: why should we doubt the issue of a conflict now?

The impregnable position of science may be described in a few words. All religious theories, schemes, and systems, which embrace notions of cosmogony, or which otherwise reach into its domain, must, in so far as they do this, submit to the control of science, and relinquish all thought of controlling it. Acting otherwise proved disastrous in the past, and it is simply fatuous to-day. Every system which would escape the fate of an organism too rigid to adjust itself to its environment, must be plastic to the extent that the growth of knowledge demands. When this truth has been thoroughly taken in, rigidity will be relaxed, exclusiveness diminished, things now deemed essential will be dropped, and elements now rejected will be assimilated. The lifting of the life is the essential point; and as long as dogmatism, fanaticism, and intolerance are kept out, various modes of leverage may be employed to raise life to a higher level. Science itself not unfrequently derives motive power from an ultra-scientific source. Whewell speaks of enthusiasm of temper as a hindrance to science; but he means the enthusiasm of weak heads. There is a strong and resolute enthusiasm in which science finds an ally; and it is to the lowering of this fire, rather than to a diminution of intellectual insight, that the lessening productiveness of men of science in their mature years is to be ascribed. Mr. Buckle sought to detach intellectual achievement from moral force. He gravely erred; for without moral force to whip it into action, the achievements of the intellect would be poor indeed.

It has been said that science divorces itself from literature: the statement, like many others, arises from lack of knowledge. A glance at the less technical writings of its leaders—of its Helmholtz, its Huxley, and its Du Bois-Reymond—would show what breadth of literary culture they command. Where among modern writers can you find their superiors in clearness, and vigour of literary style? Science desires not isolation, but freely combines with every effort towards the bettering of man's estate. Single-handed, and supported not by outward sympathy, but by inward force, it has built at least one great wing of the many-mansioned home which man in his totality demands. And if rough walls and protruding rafter-ends indicate that on one side the edifice is still incomplete, it is only by wise combination of the parts required with those already irrevocably built that we can hope for completeness. There is no necessary incongruity between what has been accomplished and what remains to be done. The moral glow of Socrates, which we all feel by ignition, has in it nothing incompatible with the physics of Anaxagoras which he so much scorned, but which he would hardly scorn to-day. And here I am reminded of one amongst us, hoary, but still strong, whose prophet-voice some thirty years ago, far more than any other of this age, unlocked whatever of life and nobleness lay latent in its most gifted minds—one fit to stand beside Socrates or the Maccabean Eleazar, and to dare and suffer all that they suffered and dared—fit, as he once said of Fichte, "to have been the teacher of the Stoa, and to have discoursed of Beauty and Virtue in the groves of Academe." With a capacity to grasp physical principles which his friend did not possess, and which even total lack of exercise has not been able to reduce to atrophy, it is the world's loss that he, in the vigour of his years, did not open his mind and sympathies to science, and make its conclusions a portion of his message to mankind. Marvellously endowed as he was—

equally equipped on the side of the heart and of the understanding — he might have done much towards teaching us how to reconcile the claims of both, and to enable them in coming times to dwell together in unity of spirit and in the bond of peace.

And now the end is come. With more time, or greater strength and knowledge, what has been here said might have been better said, while worthy matters here omitted might have received fit expression. But there would have been no material deviation from the views set forth. As regards myself, they are not the growth of a day; and as regards you, I thought you ought to know the environment which, with or without your consent, is rapidly surrounding you, and in relation to which some adjustment on your part may be necessary. A hint of Hamlet's, however, teaches us all how the troubles of common life may be ended; and it is perfectly possible for you and me to purchase intellectual peace at the price of intellectual death. The world is not without refuges of this description; nor is it wanting in persons who seek their shelter and try to persuade others to do the same. I would exhort you to refuse such shelter, and to scorn such base repose—to accept, if the choice be forced upon you, commotion before stagnation, the leap of the torrent before the stillness of the swamp. In the one there is at all events life, and therefore hope; in the other none. I have touched on debatable questions, and led you over dangerous ground—and this partly with the view of telling you, and through you the world, that as regards these questions science claims unrestricted right of search. It is not to the point to say that the views of Lucretius and Bruno, of Darwin and Spencer, may be wrong. Here I should agree with you, deeming it indeed certain that these views will undergo modification. But the point is, that, whether right or wrong, we claim the freedom to discuss them. The ground which they cover is scientific ground; and the right claimed is one made good through tribulation and anguish, inflicted and endured in darker times than ours, but resulting in the immortal victories which science has won for the human race. I would set forth equally the inexorable advance of man's understanding in the path of knowledge, and the unquenchable claims of his emotional nature which the understanding can never satisfy. The world embraces not only a Newton, but a Shakspeare—not only a Boyle, but a Raphael—not only a Kant, but a Beethoven—not only a Darwin, but a Carlyle. Not in each of these, but in all, is human nature whole. They are not opposed, but supplementary—not mutually exclusive, but reconcilable. And if, still unsatisfied, the human mind, with the yearning of a pilgrim for his distant home, will turn to the mystery from which it has emerged, seeking so to fashion it as to give unity to thought and faith, so long as this is done, not only without intolerance or bigotry of any kind, but with the enlightened recognition that ultimate fixity of conception is here unattainable, and that each succeeding age must be held free to fashion the mystery in accordance with its own needs—then, in opposition to all the restrictions of materialism, I would affirm this to be a field for the noblest exercise of what, in contrast with the knowing faculties, may be called the creative faculties of man. Here, however, I must quit a theme too great for me to handle, but which will be handled by the loftiest minds ages after you and I, like streaks of morning cloud, shall have melted into the infinite azure of the past.

The returns of Mr. William Donnelly, the Registrar-General, of the flax crops in each county and province of Ireland in 1873 and 1874 have been issued. The total extent of land under flax in Ulster this year is 102,789 acres, as against 123,315 in 1873, being a decrease of 20,526 acres. In Antrim there is a decrease of 2,567 acres; in Down, 4,726; in Monaghan, 2,866; and in Donegal, 3,079.

EXHIBITIONS.

EXHIBITION IN PARIS.

(*From a Correspondent.*)

The Industrial Art Exhibitions have opened with great *éclat* in Paris, and are attracting considerable numbers of people.

The Governmental Exhibition was quite complete on the opening day, and there being no charge for admission, visitors are not scarce. It is a splendid show, occupying one of the largest rooms in the Palais de l'Industrie, the productions of Sèvres occupying the whole of the central floor space, and the walls being covered with the tapestry of the Gobelins and Beauvais.

Sèvres has sent its choicest productions of course in the way of porcelain, but the enamels on copper attract the most attention as being a comparatively new production of the National factory, and also on account of the great size of some of the examples, one plaque being very nearly five feet high. What is still more important is that the colours are fine and harmonious, and the composition artistic. A very interesting feature also is a collection of the designs which have been used in the Sèvres works from the time of its establishment, a century and a-half.

The Gobelins sends the panels for the New Opera-house, portions of tapestry carpets (unfinished), and a remarkable work after Andre del Sarto's picture of "Charity."

Beauvais presents no novelties, but a capital collection of tapestry for chairs, sofas, &c., in its usual style.

The exhibition of the Union Centrale, in another portion of the same building, is of great extent, and although not yet complete is full of interest. It occupies nearly as much space as the Annual Exhibition of Paintings and Sculpture. The works of the pupils in the public drawing schools present nothing novel, but they have a real interest. The retrospective collection of costumes and illustrations of the various periods is large and remarkable. It is divided into two portions—Dresses, royal, pontifical, military, and civil, and theatrical costumes of all nations and periods; and ancient works of art, illustrating costumes or parts of costumes, such as statuettes, medallions, vases, paintings, drawings, frescoes, and tissues. Amongst those which attract the greatest attention at present are a number of garments composed of Italian tissues of the sixteenth century, Persian, Indian, Chinese, and Japanese robes, and some armour of the finest workmanship.

The collection of decorated furniture, bronze and other metal work, jewellery, enamels, and minor productions is fine, but it is not yet complete.

A great charm in this, as in former exhibitions of the Union Centrale, but in which the present certainly surpasses its predecessors, is the evidence of a true artistic direction. On entering the central court of the Palais de l'Industrie the eye is at once attracted by the harmonious effect of the whole. The sides are hung uniformly with rich coloured stuffs, the names of the exhibitors is exhibited in handsome and uniform letters of gold, the stalls in the centre are elegant positions, and the whole is enlivened by flowers, fountains, and music, so that even without the exhibition proper the place has all the elegant attractions of a fashionable lounge. At the end of the central court, or nave, is an elegant double staircase which leads directly to the rooms above, in which are the costume exhibition and the drawings.

A large sum of money must have been spent on the exhibition—the costume portion is said to have cost six thousand pounds—but its attractions are so great that it cannot fail of success.

It may be mentioned here, for the benefit of those who think of visiting Paris, that the exhibition of the

series of decorative works painted by M. Baudry for the grand saloon of the New Opera-house, now ready to receive them, is announced to open at the Ecole des Beaux Arts on the 20th instant.

THE WATER SUPPLY TO THE CITY.

On Monday last a report was issued to the members of the Common Council by the Gas and Water Committee of that body, in answer to the question "whether any improvement can be suggested in the supply of water to the City of London, in case of fire," and some other points referred to them. The report, after furnishing a statement of past legislation, refers to the present condition of the water supply of the City, which is received almost entirely from the New River Company. The company have now provision for a continuous daily delivery of more than 36,000,000 gallons, with a present daily demand of about 25,000,000 gallons; they also have a right to pump to any extent from the river Thames, below Blackfriars, for any service of a "non-domestic" kind, and can store about 150,000,000 gallons, all available for use in the City, where they have 78 miles of pipes, 25 miles of which are constantly under pressure. With regard to the water supply required for the extinction of fire, Captain Shaw reported that in the whole of the metropolis it had not been much in excess of 8,000,000 gallons, and that there had been no difficulty from any insufficiency of water supply in the City, whatever occasional delay there might have been in obtaining the service. The committee are of opinion that the system of street plugs, which makes the attendance of a turncock necessary before water can be obtained, is not suitable to meet the sudden emergencies which necessarily occur in every case of fire, and that it is absolutely essential for the protection of public property that a proper number of hydrants be fixed. As to their cost, it was a question whether it should be borne by the Corporation or the Metropolitan Board. Having in view the immense amount of property within the City, and the extensive fires which from time to time occur within its area, the committee think it highly desirable that the Corporation should take the lead in establishing a system which there could be no doubt would be a most useful adjunct in preventing the extension of fires. If the Court agreed with this, the committee asked that the report should be referred back to them to consider the means of carrying it out.

The *Straits Times* (of Singapore) states that an assay of ten tons of quartz, crushed at Port Darwin, had resulted in a yield of 771 ounces of gold. This gives a money return of more than £250 per ton. Victorian companies find that it pays to work reefs where the crushed quartz yields only five pennyweights, or gold to the value of about £1 per ton. The position of Port Darwin is very favourable to its future trade with Singapore, and it is suggested that it will be to the advantage of the colonists to make that place their *entrepot*.

According to the report presented to Congress before the close of this year's session, there are in the United States 66,237 miles of railways, the combined cost of which amounted to 3,000,700,000,000 dollars. The relation between the mileage of railways and the population was, in 1873, in the ratio of one mile to every 582 persons.

The length of railway in operation in France at the close of March, 1873, was 11,162¼ miles. At the close of March, 1874, the corresponding total had grown to 11,601⅞ miles, so that during the 12 months ending with March, 1874, new railway was opened in France to the extent of 439⅝ miles.

From the last Report of the Royal Society of Tasmania, it appears that the Society's Gardens were visited by 24,666 persons, and the Museum by 14,956 persons during the year 1873. The Society receives a Government grant of £400 for the gardens, and one of £200 for the museum.

THE PROGRESS OF PORTUGAL.

A series of papers upon the material progress of Portugal have recently appeared in the *Memorial Diplomatique* of Paris, which are worthy the perusal of those interested in the well-being of that country. The survey extends over the last 22 years, commencing with the year 1851, when there was not a single kilometre of carriage road in the country, with the exception of the road from Lisbon to Cintra, and of another begun in the direction of Oporto; not a single railway; not one regular line of steamers between the metropolis and its dependent islands and colonies; the ports were silted up; the rivers were without bridges, except a few built ages ago; commerce was dying of atrophy for want of communications; there were only two banks, one at Lisbon, the other in Oporto; the post, conveyed by mules, left Lisbon only thrice a week; and a journey from the capital to the frontier was longer and more expensive than a trip from Paris to St. Petersburg is now. In 1873, Portugal possessed 3,500 kilos. of good roads, while fresh roads were still in course of construction throughout the country; 715 kilos. of railway in working, 131 kilos. more almost complete, and two new lines of which the works were already begun; more than 200 bridges over the rivers and smaller streams; more than 3,000 kilos. of telegraphic lines; improved harbours; regular lines of steamers subsidised by the State running between Lisbon and Algarve, the Azores, Madeira, and the West African colonies. She has built during this period several large edifices for the service of the State, and raised many important monuments in honour of her great men or in commemoration of remarkable events in her history.

The economical progress has not been less sensible. Several banks and discount establishments, with a large subscribed share capital, have been added to the two which existed in 1851; and it is calculated that the money investments of Portugal in national and foreign funds, and in shares or debentures of banks and public companies, had quadrupled in the fifteen years immediately preceding 1870, or, to come to figures, that whereas these commitments amounted only to 155,000,000 francs in 1854, they had risen to 600,000,000 frs. by the end of 1869. The opening up of means of communication and the development of credit exerted, moreover, their natural influence on trade. The sum total of exports and imports doubled in fifteen years. In 1851 they amounted to 116,500,000 frs.; in 1867 they were 256,000,000 frs. Of this great increase, a large proportion was due to exports, the value of agricultural produce exported in 1851 having been 34,000,000 frs., and 63,000,000 in 1867. The export of minerals, which in 1851 did not exist, amounted in 1867 to 5,000,000 frs., and has increased since then. During the same period the imports of raw material for manufactures rose from 15,000,000 frs. to 36,000,000 frs., while the imports of colonial produce, and especially of sugar, more than doubled. With regard to manufactures, although it may be said that they are for the most part stationary, and dependent for their existence on a protective custom tariff, some branches, nevertheless, are in a fair way to emancipate themselves from this tutelage. It is not uncommon to find, in Lisbon warehouses, fine cloth manufactured in the country and yet resembling in quality those of Leeds or Birmingham, or silk fabrics dyed with certain colours which suggest a comparison with those of Lyons. Ordinary printing paper again is almost entirely furnished by Portuguese factories, while typography, which was so far behind-hand twenty years ago, has been perfected to such a degree that many of the books printed in Lisbon have nothing to fear from comparison with works issuing from the presses of the first firms in Paris and London. A great deal of good common earthenware, and even of fine faïence, is now also produced in Portugal; as well as some very good glass, both useful and ornamental.

This sketch, the writer maintains, resting as it does mainly on published statistics or facts which are notorious, cannot be accused of exaggeration, and it must be admitted that the surprising progress of this country, at the far extremity of the European system, is creditable both to Government and people; while it promises, now that the greatest difficulties are overcome, and that a sure and liberal system has been, however timidly and haltingly, inaugurated, to proceed in an accelerated ratio to the development of a degree of material prosperity which it would be perhaps difficult to over-estimate.

TRADE OF WESTERN GREECE.

There is one portion of Western Greece possessing unusual interest which has been depicted by Vice-Consul Pandazy in his account of the trade that is carried on between Missolonghi and Acarnania. The town of Missolonghi is situated in the midst of a lake or lagoon on the north side of the outer Gulf of Lepanto. It contains about 6,000 inhabitants within its ruined walls, and 2,300 more in the immediate dependent villages, and it is the chief seat of the civil and military government of the Prefecture of Acarnania and Ætolia, with a total population of 110,000 souls. But Missolonghi, in truth, is altogether a wretched place, according to European ideas. It has very few large houses, and their arrangements are completely opposed to all our notions of comfort; the remainder of the buildings are of a miserable description, and covered with the filth of years; its streets are intricate and squalid, and the general misery of the town is complete. The absence of British trade is solely attributable to the wretched state of the port itself, as only small vessels can enter. The actual anchorage is at the Island of San Sosty, about seven miles distant, at the entrance of the lagoon, and the passage is marked by poles and trunks of trees stuck in the mud. In consequence of the inconvenience of this access to the coast, behind which is the rich vale of the River Æcheloüs, public attention has long been drawn to what could be done towards making this naturally fertile district subservient to a larger foreign and domestic trade. The inhabitants have been for years pressing upon the Government to execute certain works which would give a commercial life to all Western Greece.

The exports to foreign countries consist of valonea, tobacco, wool, Indian corn, and oats. Valonea is produced chiefly in the woody districts of Acarnania, to the west of the River Æcheloüs. The fine quality, "chamada," falls by itself in June, and the "grossa" is shaken off the trees artificially in September. The tobacco of this coast is of excellent quality, resembling the Turkish of Yenje, the most abundant production being at Agrinium. The staple produce of the district is currants, amounting usually to 2,500,000 lbs.; but this article does not figure in the foreign exports, as it all goes to Patras for export to England. One of the resources of the country is salt. There are two salt-fields on the coast, one of which produces white salt, and the other so-called black salt, which is of a slightly grey colour. Compartments are made in the soil, the salt water of the lagoon is let in, and the process of evaporation by the solar rays completes the production, unless damaged by rain-water. The great article of export ought to be wheat, because the vale of Æcheloüs is both rich and well-watered; but with no roads and with no port, the non-export of this and other articles is not surprising. The style of agriculture is very primitive—it is carried on by the inadequate and slow method now practised by the farmers in all Oriental countries, the plough, with the oxen yoked together by a bar of wood; and this is why large tracts of fertile land lie uncultivated, and the whole country is nothing but pasture land, timber, and plantations of valonea trees. The system of farming is a kind of voluntary renunciation of all interest in the soil on the part of the owner and the agriculturist. The owner gives his land and as much cattle as may be required to cultivate it, to a man who merely brings his labour and a family destitute of everything, and who, in consideration for some advances to live on and feed the cattle, engages to till the ground and take charge of the cattle, with the understanding that he is to share at the harvest the produce of the one, and at sales the increase of the other. In this state of things the owner only thinks of making the most of his farmer; in the first place he makes him pay half the taxes, and often purchase the seed. If there are many valonea trees on the farm, he will require half of this spontaneous production. In one word, the owner squeezes as much out of the farmer as he can; on the other hand, the farmer strives to live with the least possible labour to lay out the ground in pasture, because the profit arising from the increase of cattle costs him no trouble. The little he tills is to raise provisions of small value, fit only sometimes for his food, such as wheat, Indian corn, oats, &c. Indeed, as such agriculturists have neither the will nor the means of paying wages, they can be helped in their labours only by their own family, which becomes for them, if not a fortune, an absolute necessity. The rest of the people consist of peasant proprietors, having a small holding, and shepherds, and of some families who have some trifling means; but a much greater number are "klefts," or partners, and supporters of the "klefts," and these latter are confessedly the destroyers of the prosperity of the country.

The Vice Consul remarks that the Greeks have made use of their opportunities to raise a respectable mercantile marine, and yet have shown complete incapacity to utilise the resources of the dry land. Possessing within the legitimate limits of their own kingdom, means of boundless wealth and prosperity, they occupy their minds with a hopeless desire for an extension of their boundaries. The spirit of the people in Western Greece is quite in favour of social equality, while the Government is practically absolute, the deputies being the nominees of the Central Government. The reason of this is that there is no large or influential proprietary class independent of the Government; and Mr. Pandazy is not cognisant of the existence of a single country proprietor in his locality who lives with any degree of opulence or ease on his land, or who can exercise a patriarchal influence on the peasantry around him. Consequently the whole of the political power is in the hands of the Government. The subdivision of land is another cause of this state of things. Thousands of peasants, private soldiers, sailors, and even domestic servants, are all petty proprietors. The French education and ideas of so many young men have contributed largely to this passion for social equality as a substitute for political freedom.

In the year 1873 there were coined in the Mint 2,382,832 sovereigns and 2,003,464 half-sovereigns, 5,965,740 florins, 6,486,480 shillings, 4,395,600 sixpences, 4,158 fourpences, 4,059,528 threepences, 4,752 twopences, 7,920 silver pence; and of bronze, 8,494,080 pence; 3,584,000 halfpence, and 3,225,600 farthings. The pieces of money coined, therefore, exceeded 40,000,000 in number, and would pass for sums amounting to £4,500,000 sterling. The Sydney branch of the Mint coined and issued 1,478,000 sovereigns in 1873, and the Melbourne branch 752,000 sovereigns and 165,000 half-sovereigns.

Analyses of a considerable number of wines have been made by M. C. Mène, and communicated to the French Academy. The same chemist has also published the results of a comparative examination of a number of beers, chiefly from French and Belgian breweries.

The whole production of the precious metals throughout the world during 1873 is estimated to have been worth nearly £44,000,000.

CHANNEL PASSAGE.

In an article on this subject in the *Engineer* the following conclusions are given as to the present aspect of the question. The writer says that "Recent experiments, which have not received much publicity, and the opinions of many eminent men in the profession, lead to the belief that there is, so far, a reasonable prospect of success in an attempt to drive a tunnel from the opposite shores of the Channel." He continues:—

"If we sum up the opinions hitherto expressed by geologists and engineers respecting the Channel Tunnel, it will be found that while the former do not go so far as to deny the possibility of the undertaking, yet they entertain grave doubts of its feasibility. They unquestionably regard the scheme from a purcly theoretical point of view, and possibly cxaggerate difficulties which might occur, and imagine others which would never be present. Engineers, on the other hand, from the habit of dealing every day with the obstacles which are inseparable from the construction of any tunnel in which water is met with—and there are few in which such a contingency has not to be encountered and provided for—take a more hopeful view of the project. Without in any degree underrating the magnitude and importance of the work, and the hcavy responsibility which it would entail upon all parties connected with it, they nevertheless consider it as differing more in degree than in kind from works of a somewhat similar character already successfully constructed. As an instance of an obstacle which geologists regard as calculated seriously to imperil the success of engineering subterranean works, may be mentioned land springs. These certainly give a great deal of trouble occasionally, but no engincer would be deterred solely on their account from carrying out the undertaking. Assuming uniform conditions to prevail in the same strata, the remark of Sir John Hawkshaw is very appropriate. He has observed that at a sufficient depth it is of no more consequence that the sea may be above the tunnel than a mountain.

"It is admitted by geologists that a tunnel might be constructed with perfect safety under the Channel through the London clay, a well-known tenacious and impermeable stratum. Unfortunately for the practical adoption of this route, it would necessitate the tunnel being one hundred miles in length, or nearly five times the proposed distance. Consequently, however favourable that stratum may be for submarine tunnelling, other obvious reasons altogether preclude the suggestion to use it. Geologically, the Kimmeridge clay might be made an available stratum, but only for about half the distance from shore to shore. As no one would be guilty of the folly of driving a tunnel halfway under the Channel, upon the bare chance of being able to carry it right through, this route must be likewise abandoned. We have nothing now left but the palæozoic rocks, which, similar to the London clay, offer a sure and safe means of submarine intercommunication. But as the distance in the one case presents an insurmountable impediment, so the depth in the other proves equally fatal to the project. But besides these strata there is the lower or grey chalk. If it were once established that there were no open fissures in this formation, and that it was continuous from shore to shore, the project would wear a different aspect. The private experiments of Sir John Hawkshaw with respect to the continuity of the chalk, while they cannot be received as actually confirmatory, nevertheless tend to favour the supposition of continuity. The question of fissures must remain a matter of conjecture, until some decisive experiment on a sufficiently extensive scale is undertaken, which will set the matter at rest. The cost of running preparatory driftways in order to determine the ultimate practicability of the scheme has been estimated at £80,000. It has been stated that the Great Northern Railway of France is willing to contribute a portion of this, provided the London, Chatham, and Dover, and South-Eastern lines on this side of the Channel will furnish their quota. The proposition is fair and reasonable. Until some trial of this description is made it is idle to speculate upon the contingencies which may occur, or to enter into details respecting the character of the permanent structure. The best form to be adopted, the most suitable materials, and the mechanical arrangements for their transport and for insuring ventilation, are all matters which it is quite premature to discuss at present."

THE SILK INDUSTRY OF LYONS.

The trade of the large and important city of Lyons has not, according to the account given by Consul Mark, been of late years in a satisfactory condition, and as it depends largely for its prosperity upon the silk manufacture, which has suffered a serious depression, the state of affairs has led to much distress and suffering. Besides the prcssure of a declining demand and adverse prices, both for the raw and manufactured material, production has diminished, and the result is no progress, not to say worse. It is even to be doubted if Lyons is holding its own against the active and intelligent competition of Switzerland and Rhenish Prussia. The rise in wages, the constantly increasing exigencies of the weaver as to the nature of the work he will undertake, and the hard and fast line of tariff applied to labour, are all so many elements in favour of the foreigner, and stumbling-blocks to the Lyonnese. No doubt so large and educated an industry cannot fall in a day, but certainly it is more or less undermined.

Another feature is the transfer of the looms from town to country villages adjacent, where living costs less and where the weaver can combine field with loom works, and so be content with less wages than in the town. In this way some 10,000 looms have, within the last few years, left Lyons, and with them have gone the majority of the journeymen, who formerly were so numerous and so compact a body among the weavers. Workshops formerly of eight or twelve looms now scarcely exceed four, and these are worked by the master himself and his immediate relatives (to the exclusion of the journeymen), who do not care to take more work than they can get through. These country looms introduce also into the manufacture of silks the female element, and in this respect are followed by the power-looms, which are springing up wherever water power is to be met with in some outlying spots in this or the neighbouring departments. These power-looms are now very numerous, and they are principally worked by women, and it is to their production that the dead level is owing which exists, and which replaces the decadence that would otherwise have been more marked. Within the last few years wages have much increased. For velvet weaving 50 to 60 per cent.; for rich figured silks, 30 to 40 per cent.; for plain silks, 15 to 20 per cent. Within two years only dyers have had to pay a rise of 10 to 12 per cent., and within a brief period the building trade, which employed some 25,000 persons, has established an advance of 25 to 30 per cent. According to the syndical report, the wages range from 45c. for unskilled to 70c. for skilled men for the day of ten hours.

OBITUARY.

Sir William Fairbairn, F.R.S.—Sir William Fairbairn died on Tuesday last, in his 83rd year, at Farnham, Surrey. He was the son of Mr. Andrew Fairbairn, of Smailholm. He was born at Kelso, in Roxburghshire, in the early part of the year 1789, and received his education as a boy at a small school at Mullochy, in Ross-shire, subsequently acquiring his professional training at Newcastle-on-Tyne. He settled at Manchester in 1817, in partnership with Mr. Lillie, in conjunction

with whom his name rose to become that of one of the leading firms among the machine makers of that city. Mr. Fairbairn acted in conjunction with Robert Stephenson in the planning and execution of the celebrated Britannia and Conway tubular railway bridge across the Menai Straits. In 1850 he published in the Philosophical Transactions of the Royal Society his "Experimental inquiry into the strength of wrought-iron plates and their riveted joints, as applied to ship-building and to vessels exposed to severe strains." To him also we owe many useful researches into the causes of explosions in steam boilers. He was a Fellow of the Royal Society, a Corresponding Member of the French Institute, an active or honorary member of almost every society connected with engineering science in this country, and of many philosophical societies; and had received medals or other marks of recognition for his services to science from most of the crowned heads of Europe. He was one of Her Majesty's Commissioners for the Great Exhibition of 1851, and again took an active part in the organisation of the second Great Exhibition in 1862, in the same capacity. He was also a member of the jury of the Mechanical Department of the Great Exhibition of 1851, and acted as President of the Jury of the corresponding section of the Exhibition of Industry at Paris in 1855. In 1861 he occupied the position of President of the British Association for the Advancement of Science. He was created a Baronet at the recommendation of Mr. Gladstone, in 1869. The greater part of Sir William Fairbairn's acknowledged publications appeared in the Philosophical Transactions of the Royal Society, in the Reports of the British Association, and in the Transactions of the Philosophical Society of Manchester, in which he filled the chair at Dalton. Some of his works, however, were also published separately. Among his chief productions may be specified treatises on "Canal Navigation," on "The Strength and other Properties of Hot and Cold Blast Iron," on "The Strength of Locomotive Boilers," on "The Strength of Iron at Different Temperatures," on "The Effect of Repeated Melting upon the Strength of Cast Iron," on "The Irons of Great Britain," on "The Strength of Iron Plates and Riveted Joints," on "The Application of Iron to Building Purposes in General," on "Useful Information for Engineers," &c. Sir William became a member of this Society in 1843. He was a Vice-President and member of Council for some time, and he for long took an active interest in its affairs. He contributed communications on various subjects, and on several occasions occupied the chair at meetings.

GENERAL NOTES.

The New Ironworks at Outwood.—The *Manchester Evening News* says that a large blast furnace which has been erected at Outwood, near Manchester, by the Outwood Iron Company, has just been blown in. The works are interesting, inasmuch as this is the first attempt at manufacturing pig-iron that has been made in the neighbourhood of Manchester; but, as they are situated in the centre of the manufacturing and engineering district of Lancashire, it is believed that the whole of the pig-iron produced can be sold in the immediate vicinity at remunerative prices. Its construction has occupied upwards of two years. The works consist of a blast furnace, 70 feet high and 20 feet "bosh," which is furnished with six water tuyeres. The blast is heated by a series of four stoves, each stove containing about seventy tons of cast-iron pipes, and the blast itself is supplied by means of an engine, with a cylinder 90 in. diameter and 7 ft. 4 in. stroke. The hot blast is delivered into the furnace at from 700 to 800 degrees Fahrenheit. The steam power is supplied from three boilers, each 45 ft. long, and these, together with the stoves supplying the hot blast, are heated by means of the waste gas which is conveyed from the top of the furnace by gas mains fitted with safety valves, outlets, and burners. The furnace is capable of turning out 300 tons of pig-iron per week, and preparations have been made for a second furnace, which it is expected will be erected without delay, as the foundations have already been laid. When both furnaces are in operation, it is computed that the annual output will be 31,200 tons.

Public Instruction in France.—A report, of which the following is a *résumé*, has lately been published by the Minister of Public Instruction in France. In 1865 the number of scholastic libraries was only 4,833, containing 180,854 volumes; in 1869 this number was increased to 14,395, containing 1,239,165 volumes; and at the present time there are, not taking account of those of the Department of the Seine, no fewer than 15,623 of these libraries, with 1,474,637 volumes. The number of books increase daily, and whilst in 1865 the number of volumes lent to families, pupils, and adults was only 179,267, in 1869 the number had increased to 955,121, and in the course of the past year the number of volumes lent was 925,358. These figures show plainly the incontestable benefits conferred upon the people by these libraries, and notwithstanding the political events of the last few years, the State, provinces, communes, and private individuals have not been behindhand in furnishing the requisite funds for maintaining such an important work. During 1873 upwards of 50,000 volumes were distributed by the Government to 1,181 libraries.

Cotton Demand and Production.—The *United States Economist* believes that cotton is being over-produced. According to that journal, the present annual consumption of cotton by the mills of the manufacturing world is in round numbers 2,500,000,000 lbs. Of this amount the United States work up 500,000,000 lbs., the United Kingdom, 1,200,000,000 lbs., and Continental Europe, 800,000,000 lbs. The present annual supply to the countries manufacturing cotton is:—By the United States (the total crop), 1,450,000,000; East Indies, 620,000,000 lbs; Brazil, 50,000,000; Egypt, 210,000,000; other countries, 70,000,000 lbs.; total, 2,500,000,000 lbs. This may be regarded as the normal demand and supply of cotton. As to the prospects of the immediate future, the supply to manufacturing countries during the coming year ending September 30, 1874, is at present advices estimated as follows.—The United States, 1,800,000,000 lbs.; all other countries, 1,050,000,000 lbs.; total, 2,850,000,000 lbs. This is predicted on the basis of a normal supply from other countries, and an increase of the American crop from 1,700,000,000 lbs. in the year ending September 30, 1873, to 1,800,000,000 lbs. this year. The demand is estimated as follows:—The United States, 550,000,000 lbs.; Europe, 2,150,000,000 lbs.; total, 2,700,000,000 lbs. This is predicted on the basis of an increased consumption in the United States of 10 per cent., and in Europe of 5 per cent. on that of the preceding year. Should these estimates prove well-founded, there will be an over supply in 1874 amounting to no less than 150,000,000 lbs.

NOTICES.

THE LIBRARY.

The following works have been presented to the Library:—

Statistics of the Colony of Victoria for 1872, parts 7 to 9, with Index, and for 1873, parts 1 to 4. Presented by the Registrar-General for Victoria.

Annual Report of the Board of Regents of the Smithsonian Institution (Washington) for 1872. Presented by the Institution.

The Complete Works of Count Rumford. Vol. III. Presented by the American Academy of Arts and Sciences.

The Fifth Annual Report of the State Board of Health of Massachusetts. Presented by the State Board.

The following works have been purchased for the Library:—

The Dictionary of Biographical Reference. By Lawrence B. Phillips, F.R.A.S.

Annual Record of Science and Industry for 1873 (New York). Edited by Spencer F. Baird.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,136. Vol. XXII.

FRIDAY, AUGUST 28, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

FOREIGN WINES COMMITTEE.

This Committee held its first meeting at the offices of the International Exhibition, Royal Albert Hall, on Friday, the 21st inst.:—Present—Lord Methuen (in the chair), Mr. R. Brudenell Carter, Lieut. H. H. Cole, R.E., Dr. Druitt, and Dr. Hogg; with Mr. G. H. Scrivenor (H.M. Customs), and Mr. H. T. Wood.

ENDOWMENT FUND.

The following subscriptions have been received towards the establishment of an Endowment Fund for the Society:—

	£	s.	d.
G. T. Saul	5	0	0
W. R. Spicer	5	0	0
Colonel A. Angus Croll	20	0	0
G. W. Hart	2	2	0
Charles H. L. Woodd, F.G.S.	5	0	0
John E. Evans	2	2	0
Sir Walter E. Trevelyan	50	0	0
E. T. Blakely	1	1	0
W. R. Sandbach	50	0	0
Thomas Dixon	1	1	0
W. Atkinson	50	0	0
John Noble	20	0	0
James Bentley	20	0	0
J. Jonas	1	1	0
Samuel Jackson	5	5	0
Charles Goding	20	0	0
F. Mocatta	10	10	0
Jonah J. Wells	10	10	0
Charles Downes	2	2	0
G. T. Saul	2	2	0
Mrs. Charlotte Holmes	10	0	0
John Knowles	25	0	0
Sir John Le Couteur	1	0	0
John Peckover	5	5	0
Frederick Braby	2	2	0
Decimus Burton, F.R.S.	5	5	0
Percy Rowlands	2	2	0
The Right Hon. Lord Hatherley	20	0	0
Colonel John Thomas Smith, R.E.	2	2	0
Ardaseer Cursetjee, F.R.S.	5	0	0
H. V.	25	0	0

The Council will be glad to see further contributions to this fund. Members can receive full information as to its nature and objects on application to the Secretary.

GENERAL EXAMINATIONS, 1875.

The Programme is now in preparation, and will shortly be published. "English History" and "Logic" will be discontinued; and the general subject of "Gardening" will be substituted for the two subjects of "Floriculture" and "Fruit and Vegetable Culture." A new subject, to be called "Commercial History and Geography," will be added to the Programme, which in other respects will be similar to that for the present year.

ANNUAL INTERNATIONAL EXHIBITIONS

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

MACHINERY, ENGINEERING, AND CONSTRUCTION.

(*Continued from page* 826.)

III.—Wood-working Machinery.

The industrial application and use of machinery in aid or supersession of skilled manual labour, is not only more thorough and varied in this department, but also more thoroughly and variously exemplified in the Machinery Annexe than under any of the other heads into which this subject has, arbitrarily, and for convenience, been subdivided; and this may be regarded almost as the natural result of the physical qualities and characteristics of wood, and its universality of use. In a critical examination of the mechanical devices adopted and adapted for the treatment of specific materials, it is impossible to overlook entirely the varying qualities of these, the subjects of treatment, and the natural influence attaching thereto. The hardness, rigidity, and brittle nature, the granular or laminated structure of stone, determine strictly the kind of process and treatment to which it is amenable; and, similarly, in relation to iron, consideration is due, not merely to the characteristics of its normal state, but also to the capabilities of its fluid or molten condition, admitting of its being cast in moulds of any desired shape, and yet more to the characteristic differences between its cold and heated states, its fibrous and its crystalline forms, wrought or malleable and cast iron, with the varieties of steel and iron alloys, manganesic, titanic, and others. Timber, differing in all respects from stone and iron, both in its strength and in its weakness, is, of all others, the material that lends itself the most happily to mechanical treatment of manipulation. Indeed, it is not too much to say that there is no manual process, in the preparation and treatment of timber, from sawing to moulding, mortising, mitreing, dovetailing, &c., that cannot be effected at least as well, if not better, by mechanical means. It is not, therefore, surprising that, in contrast to the isolated examples of the industrial mechanics of iron and stone, sparsely scattered throughout the Western Annexe, the number and variety of wood-working machines should attract attention and challenge remark.

In room V, No. 6,050, Messrs. Thomas Robinson and Sons have a good though limited selection of their well-known wood-working machines, comprising the following:—Endless Band Sawing Machine; Bench for Tongueing and Sawing, Grooving, Rabbeting, Boring, and Cross-cutting; Patent Moulding and Planing Machine; and Patent Dovetailing Machine.

Of these the last-named, the dovetailing machine—which is an American invention, Armstrong's patent—is the most novel and interesting speciality, inasmuch as no other process has been found to present so many difficulties in the effectual adaptation of labour-saving machinery for the working of wood; and also by reason of the ingenuity and simplicity of the mechanism. This

machine is shown in the accompanying engraving, Fig. 1, and consists mainly of two parts, a cutting and a holding part, carried upon a suitable plain frame or table. The cutting mechanism consists of two discs, in the shape of very flat cones, set face to face in planes inclined to the vertical, at opposite but equal angles, and coming nearly in contact at the bottom. On their faces these discs are fitted with toothed rings, or very flat bevelled wheels gearing into each other so as to effect perfect parity of revolution in the discs, which are fitted with circular saws at their peripheries. The shafts on which these *quasi*-circular saws revolve are carried in suitable bearings; and in connection with each disc and its shaft there is a quadrant arm, or spur-wheel segment, engaging into a spur-pinion on a small horizontal shaft carried in bearings and brackets at the back of the frame: a hand-lever on this shaft effects the partial reversal of the disc-saws for cutting the pins. Of these two discs the one is driven and the other is the driver, which is fitted on the back with another bevel-wheel or ring, gearing with and driven by one of a pair of inclined bevel-pinions, whereof the other is the driver, and fixed on the horizontal first-motion shaft, which by fast and loose pulleys and a belt, drives the whole machine, receiving power from any suitable prime-motor. All this driving and cutting mechanism is fixed to the back part of the surface of the table or frame; while on the front part is located the holding appliance, consisting of a travelling slide, with duplicate traversing and screw-motions. Upon the upper surface of this slide-rest, the planks to be dovetailed are placed and fastened down by a clamp, with their ends towards the disc-saws, which it must be noted form spirals, not perfect circles; thus their action is to cut a slot of a certain width, not a simple saw cut, the slide with the board-end being fed or traversed forward till the cut has reached the required depth: thereupon it is withdrawn, and the slide is traversed a sufficient

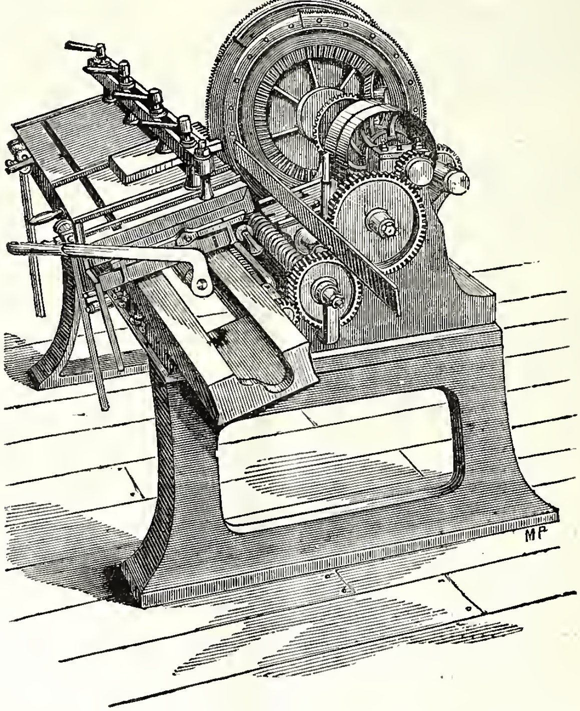

Fig. 1.—Robinson's Patent Dovetailing Machine.

distance for the interval between the dovetails and so on. In this manner one side of the dovetail is undercut to the bevel by one of the spiral disc-saws, and the other side by the other disc. The required motions are communicated from the first motion shaft to the feed-screws, by means of suitable intermediate gearing at the end or side of the framing or table. By this machine twenty feet lineal of board-ends per minute can be cut in clean dovetail-holes; and for the operation of cutting the pins to fit the dovetailed holes, all that is necessary is to give a half-turn to the handle for a partial reversal of the discs. All the machines are arranged for cutting not only ordinary but blind dovetails and dovetails on the angle; and the rate of production is such, that whereas formerly it has been customary to put packing-cases together with nails, on account of the cost of hand dovetailing, now boxes and cases can be dovetailed together by the machine cheaper than by nailing. There are three sizes of the machine, all for boards from $\frac{1}{4}$ inch to $1\frac{1}{4}$ inch in thickness, viz., for any width of board up to 15 inches, weight of machine 1 ton, power requisite $\frac{1}{4}$-horse; up to 24 inches, same power, weight $1\frac{1}{2}$ tons; and up to 36 inches, power $\frac{1}{2}$-horse, weight 2 tons. Among the many works and factories where this machine has been introduced, it may suffice to note the most recent, viz., the Royal Arsenal at Woolwich, for the War Department.

Next in importance, and of somewhat earlier date and longer standing, is Messrs. Robinson's Patent Moulding and Planing Machine. A long table or frame is provided with a longitudinal feed-motion, whereby the board, plank, or piece of timber is carried along past sets of revolving blocks carrying cutters, which operate on the top, bottom, and both sides from end to end. The timber

is fed by four calender rollers, with worm and wheel for transmission of motion, and the feed-speeds are so arranged as to give a considerable length of belt. The two upper rollers being made to traverse up and down in curved guides struck from the centre of their geared driving-wheel, the gear will work in at the same depth, whatever be the depth or thickness of the timber. For mere planing, straight cutters are set in the blocks; and boards may be edged, or tongued and grooved, by suitable cutters affixed to the side-blocks. For moulding, the top surface cutters of special shapes are fixed in the upper block, in regard to which there is a speciality meriting particular notice; with bold mouldings, one side being much thinner than the other, the cutters on that side are apt to spring, on account of their extra length and projection beyond the axis, leaving the finished surface rough and ridgy. To obviate this, Messrs. Robinson apply their patent angle-block, by which the axis of the cutters is set at an angle corresponding to the general inclination of the moulded surface, in transverse section, thus as nearly as practicable equalising the lengths of the cutters, and conducing to evenness of work and smoothness of finish. Whatever be the nature of the work, the planing and moulding operations are effected simultaneously on all surfaces. The revolving blocks require to be driven at very high speed, and their bearings are peculiarly and specially arranged that they may so run without getting any play, whereby accuracy of work is secured. The rate at which mouldings and boards may be passed through this machine varies from 10 to 30 feet per minute. The machines are generally made in 4 sizes, from 2-horse power, weight 2 tons, for working timber up to 2 by 5 inches in dimensions, in gradations to the largest, weight 5½ tons, 6-horse power, for any size of timber up to 5 inches by 16 inches. The mouldings wrought thereby are of all kinds, for door-casings, architraves, skirtings, sash-bars, troughs, window-beads, angle-beads, true ogee cauls, base and door mouldings, cornice and bolection mouldings, &c.

In the engraving Fig. 2, is represented Messrs. Robinson's endless-band sawing machine, as exhibited, adapted for cutting out circles and other fancy shapes, fretwork, &c.; in general form resembling the letter G. On the foundation plate there are two short, hollow columns

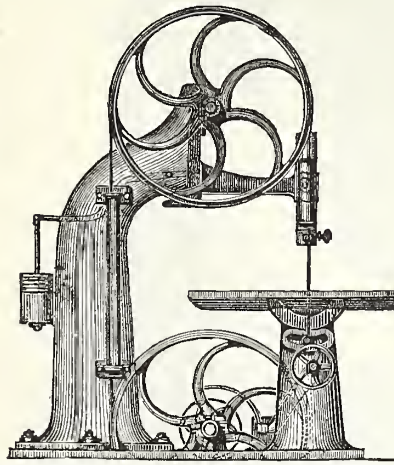

Fig. 2.—Robinson's Endless Band-saw Machine.

(the whole being in one casting), carrying the table on which the wood is placed, also the lower pulley and bearings sunk therein to the depth of its semi-diameter; and a hollow pillar with curved arm, carrying the upper pulley and bearings, is bolted down thereon. The driving belt and pulley are on the shaft of the lower pulley, and both the upper and lower pulleys—round which the endless or band-saw runs—are accurately and truly turned and balanced, the speed being high. The upper pulley and bearing is made adjustable by vertical traverse through a hand-wheel and screw motion, for regulating the tension of the saw, and is also fitted with a bent and counterweighted lever, by which any variation in the tension, through the expansion and contraction of the saw in working, is compensated for. With pulleys from 48 down to 30 inches in diameter, these machines require about 1-horse power to work them, their weight varying from 3 to 1¾ tons. The smallest size, 24 inch pulleys, weighs 1⅓ tons, and requires about ½-horse power. The band-saw between the pulleys passes through a guard-sleeve or tube, bolted to the column, and also through a similar short guard above the table, carried on a short projecting arm from the frame-head. The table is so arranged as to have an angle motion in two directions, at right angles, so as to tilt the board operated on, and admit of bevel-cutting; which is effected by means of toothed sectors, pinions, and hand-wheels.

In the bench for sawing, tongueing, grooving, rebating, and cross-cutting, the frame is in one casting, and fitted with an adjustable spindle, arranged so as to rise and fall, for grooving and rebating. At the inner or saw end of the spindle, a section of the table can be lifted out so that the circular saw may be removed, and a circular block with cutters affixed in lieu thereof for the operations of tongueing and grooving. At the opposite or outer end the spindle is arranged to receive an auger, for boring, and attached to the frame, beneath the auger, a stand with sliding top is placed, to carry the timber to be bored. The parallel fence, for guiding the timber for sawing, is made adjustable so as to cut at any desired angle, and removeable so as to be readily detached for cross-cutting purposes, swivelling for the purpose on the roller at the end of the table. The driving shaft with pulley and belt, and fast and loose pulleys, is carried in separate bearings and frames. A considerable variety of joinery and cabinet work can be effected with one of these machines, of which the largest sizes (provided with two saw-speeds) run circular saws of 36 and 30 inches diameter, cutting 15 and 12 inches deep, and weigh 25 and 20 cwt., respectively, on dimensions 5 feet 6 inches by 2 feet 9 inches, and 4 feet 6 inches by 2 feet 6 inches, requiring 3-horse power to work them. Smaller sizes, requiring 2-horse power, run saws of 24 and 20 inches diameter, cutting 9 and 7 inches deep, and weigh 15 and 16 cwt. on dimensions 4 feet by 2 feet 6 inches, and 4 feet by 2 feet respectively.

All Messrs. Robinson and Sons' exhibits are power-machines.

No. 6,046. Closely adjoining the last-named exhibits is the Improved American Sawing and Drilling Machine of Mr. Richard S. Williams (Room V).

This is a small machine, which may be worked by the foot with a treadle—as shown in the accompanying illustration (Fig. 3)—or by steam-power, as exhibited at South Kensington; and is especially designed and adapted for fret-cutting, cabinet work, pattern shops, as well as for use in amateurs' workshops, and many other industrial processes, such as stereotyping. It is capable of working in various metals, as well as in all kinds of wood, ivory, bone, vulcanite cloth, leather, paper, &c. The speciality of this machine, as a sawing machine, consists in the method of mounting and working the saw, which is a short length of band saw, attached to and strained between the extremities of two long horizontal and parallel lever-arms, which are pivoted on two wooden rollers as fulcra, having a third similar and equal roller placed between them and in contact with both, beyond which the projecting short arms of the levers are joined by the screwed straining rod and nut, whereby the tension of the saw-blade is adjusted and regulated: by this arrangement the saw-blade is made to keep a truly perpendicular position in its vertical vibrations, with

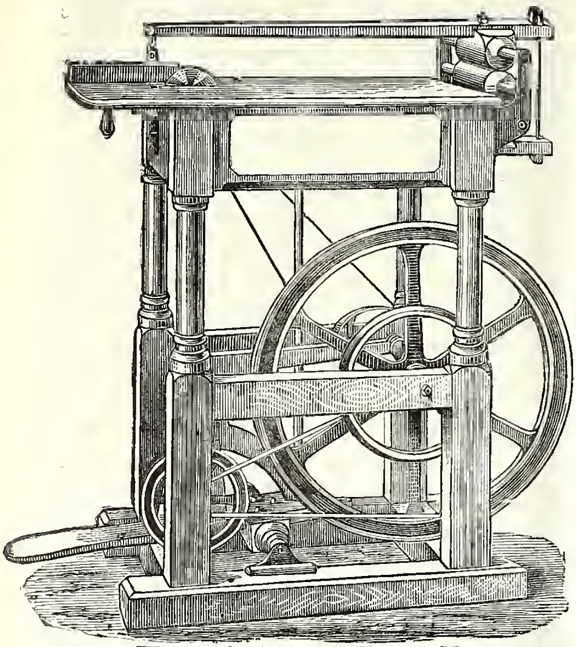

Fig. 3.—Williams's American Sawing Machine.

sufficient play to clear itself in the cut. The running gear is driven at a very high speed, over 1,000 revolutions per minute, and by means of an eccentric or crank-disc and rod works the saw-blade with the same rate of stroke up and down. Working at this speed the cut is smooth and clean, requiring no subsequent finishing off with a file: the construction and action are very simple, and the machine works with very little power, being compact and occupying very little space. The upper lever-arm is made of lance-wood, and is very springy, being also made hollow from the fulcrum to the head of the saw-blade, so that the saw and work may be kept free from sawdust by a slight air-blast, generated by means of a self-acting blowing apparatus and tube connected therewith, affixed beneath the table. There is a useful accessory in the drilling apparatus, which is fitted on the top of the machine, and consists of a long arm through which passes the spindle carrying the drill: by pressing downwards on a knob on the top of the spindle to the required depth, a spring rises and keeps it up for drilling a hole. Another useful appurtenance is a small circular saw, driven by a separate belt and pulley on the driving shaft which is fitted with a fly-wheel. In the engraving this circular saw motion is shown in action; while the belt for working the reciprocating bandsaw is thrown off, but kept by a special contrivance to a certain degree of tension, so as not to hang loose about the gear.

No. 6,041. Opposite the machines previously described, in Room V, are the machines exhibited by Messrs. F. W. Reynolds and Co., namely Hand-power Circular Saw-bench, and Mortising Machines.

These machines are devised and adapted to occupy an intermediate position between the old hand tools, such as handsaws, chisels, &c., and the larger class of modern machines driven by steam-power; being suitable for employment in smaller builders' and joiners' workshops where steam-power is not available, and enabling the work thus to be executed with superior facility by

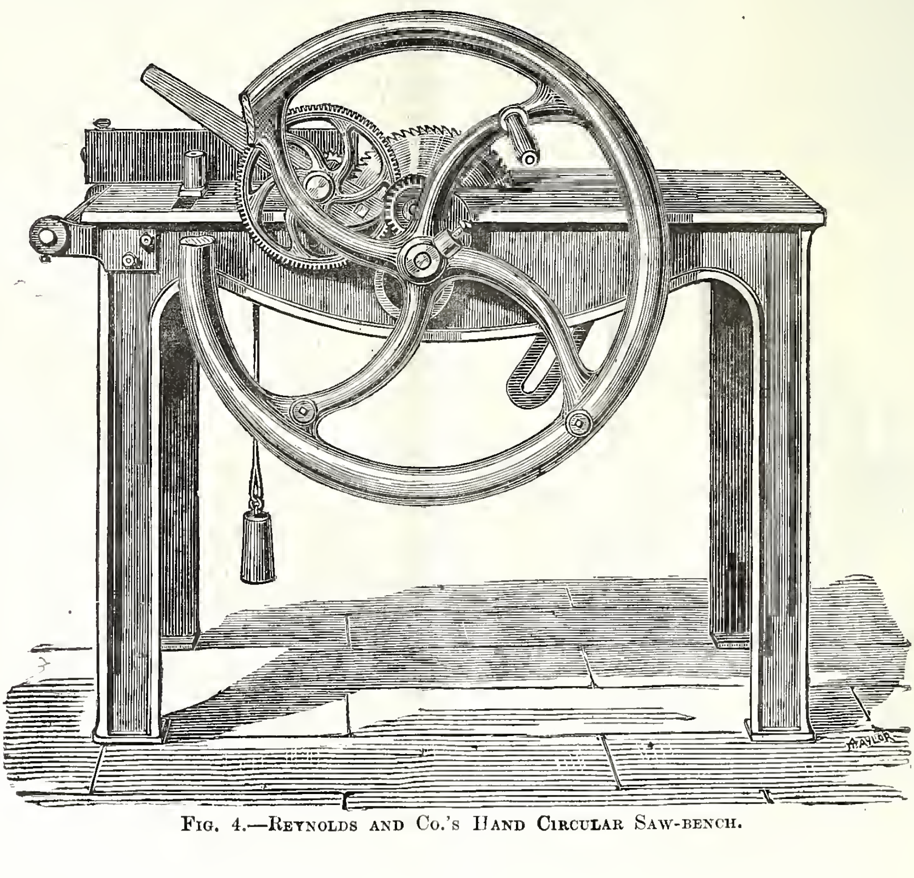

Fig. 4.—Reynolds and Co.'s Hand Circular Saw-bench.

mechanical means, manually operated, approximating to the advantages of power.

The Imperial Hand-power and Self-feeding Circular Saw-bench is illustrated in the annexed woodcut, Fig. 4, and consists of a plane iron table or frame, with a transverse spindle in the centre carrying the circular-saw blade and hand-driving or flywheel. This machine will saw 4½-inch stuff, and is constructed so that it will cut in either direction of revolution, either upwards or downwards; and the saw-spindle is made to rise and fall, for tenoning, grooving, and rebating, being swung by means of a lever and nut, working in a slotted sector-arm below the table. Attached to the driving-shaft is an automatic feed-motion, whereby the wood is fed along against the blade as the saw-cut progresses; a lever-arm is pivoted on the shaft, and carries a spur pinion, gearing into a pinion on the shaft, and driving a spur-wheel carried on the lever-arm, on the axle whereof is mounted a small spiked wheel, which rests on the upper surface of the piece of wood which is being cut; the rotary motion communicated thereby from the driving-shaft through the intermediate gear propels the wood along the table as cut; for long pieces separate rollers and bearings are provided. When the saw is set for cutting, the lever-arm is brought over, so as to depress the spiked wheel on the top of the wood, in which position it may be fixed by means of a wing, nut, and rod, attached to the lever for the purpose; and it is thus adjusted for continuous cutting at the same depth or thickness. Two double-cog change-wheels are provided, whereby the rate of feed-motion may be varied according to the thickness of the timber in cut; for up-cutting the small pinion is to be placed between the feed-wheel with arms on it and the carrier or double cog-wheel; for down-cutting the small pinion is to be taken out, the circular-saw being reversed in position to correspond. There is a fence-plate parallel to the saw, fitted with four small set screws at the back, whereby it can be regulated and adjusted, and it may also be set on the skew for bevel-cutting. A groove on the bench-table serves also to guide a cross-cutting and mitreing fence, whereby that class of work may be done with accuracy and expedition. For tenoning or grooving the feed-motion must be released and shifted over; the nut being taken off the end of the feed-shaft, and the small set screw in the wheel released, the shaft may be drawn out of the way. The timber to be tenoned is passed perpendicularly to the saw, and kept close to the fence. This operation is

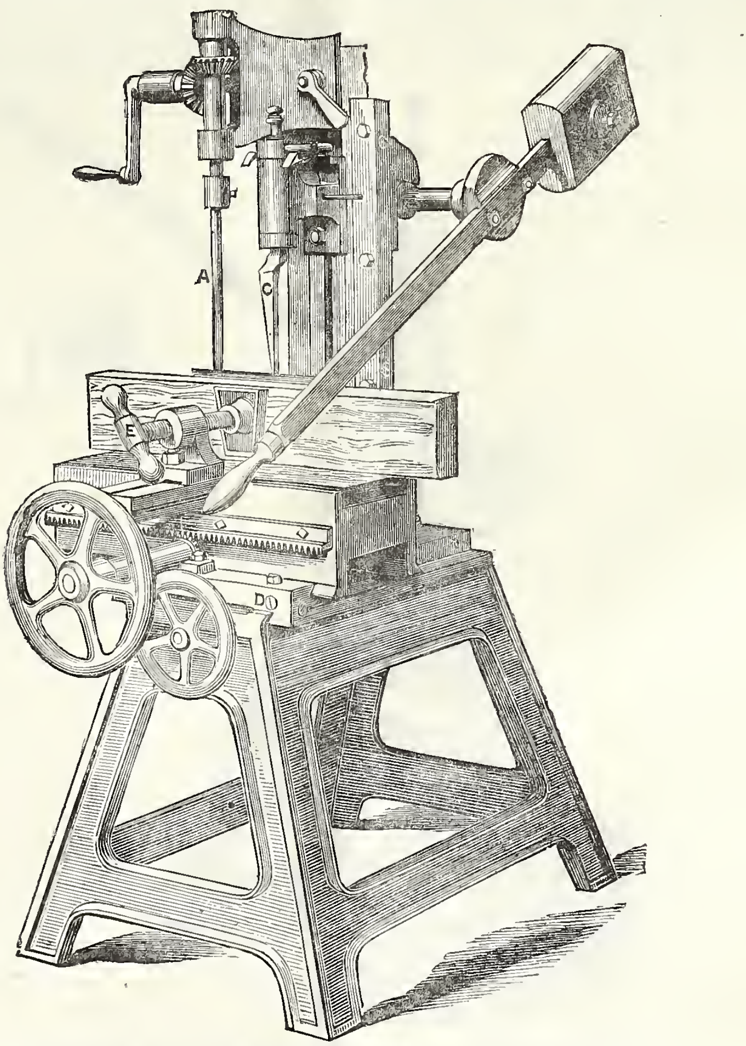

Fig. 5.—Reynolds and Co.'s Imperial Mortising and Boring Machine.

facilitated by attaching a piece of planed timber, standing higher than the fence, by means of four screws and holes provided in the fence-plate for the purpose. For grooving, tenoning, or rebating, the circular saw is to be raised and lowered in position, as requisite, by means of the lever and swing below the bench-table.

The hand-mortising machines exhibited by the firm are of two kinds, viz., the Imperial Mortising and Boring Machine and the Royal Improved Mortising Machine, which are similar in general construction and principle, yet with distinctive differences, as will be seen from the accompanying engravings.

The Imperial Mortising and Boring Machine (Fig. 5) has the boring apparatus carried upon the sliding-block, independent of the mortising chisel. The vertical frame forming the slides is bolted down on to a strong, stout table, and in front of it is carried thereon the slide D for the bed which carries the timber, and which is fitted with a double traversing motion, with racks, pinions, worms, and hand wheels. At the back of the sliding bed is a fence against which the timber to be tenoned is firmly fixed by means of a clamping screw E. In this manner, by means of the lower and smaller hand-wheel, the fence is adjusted, according to the position of the mortise in the timber, which is caused to traverse in front of the mortising chisel, as the mortise is cut. The chisel C is carried in a revolving spindle, mounted in a sleeve on the sliding-block; and the sleeve has a small lever handle at top for giving it a half-turn, to reverse the chisel for the opposite cut. In the back of the sliding-block is fitted a rack, in which works a toothed sector, carried on the driving-shaft, which carries the counter-weighted hand-lever. This handle, being depressed, forces the sliding-block and chisel downwards to effect the cut, when the wood is properly placed in position, and on the elevation of the hand-lever the chisel is withdrawn, leaving the core in the mortise, inasmuch as the action is not sufficiently rapid and powerful to clear out the chipped fragments, as may happen in machines driven by steam power; wherefore core drivers are supplied with the machine for clearing the core out of the mortise when cut and completed. A boring apparatus A, with augers, rimmers, &c., is also fitted to an attachment carried on the sliding-block as shown; the wood being placed suitably, the winch-handle and gear impart the requisite rotary motion to the bit, while the penetration is obtained by the depression of the counterweighted lever-handle. The vertical traverse of the sliding-block is, of course, limited by the extent of movement of the lever-handle; and the depth of cut is farther regulated by means of an adjustment for altering the height in relation to the wood. This machine is very well adapted for general mortising work by hand.

The Royal Improved Patent Mortising Machine, Fig. 6, is of a very compact and powerful construction, especially suitable and adapted for the operation of mortising in hard woods, as from the principles of its make and action the power exerted is applied quite closely and

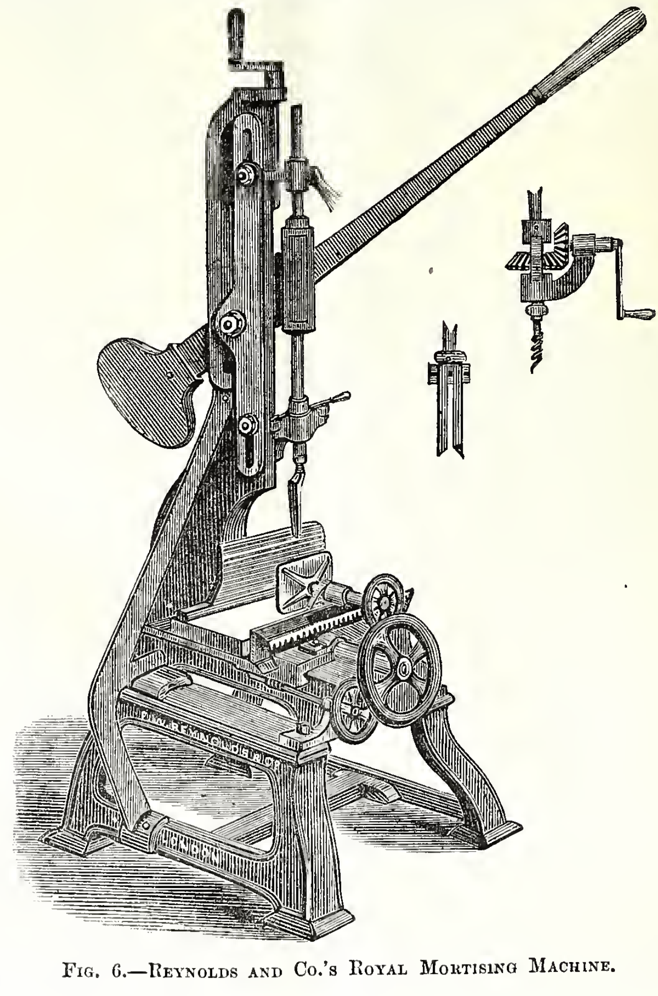

Fig. 6.—Reynolds and Co.'s Royal Mortising Machine.

directly to the operating tool. The lower or table framing, with its sliding bed, double traverse, racks, pinions, worm and hand-wheels, fence and clamping screw, is very similar to the corresponding component structural elements in the machine last described, and the material difference arises in the vertical and cutting parts of the apparatus. The vertical pillar is single instead of double (for the slides), and strongly stayed on one side to the bottom framing; it is also slightly arched forwards, so as to project over the work, somewhat after the manner of a small steam hammer of a particular type. The frame which carries the cutting apparatus and lever-handle is slotted, and attached by screw-bolts and nuts, so that within certain definite limits it is capable of adjustment in height, and being firmly fixed; and similarly the column is slotted to a considerable depth for the variation in the position of the pivot of the lever-handle: the vertical motion is effected by means of a feed-screw and handle. The slotted bar carries an upper and lower collar, or guide, within which the sliding spindle of the boring-tool has its upward and downward movement, which is imparted thereto by means of a rack, into which a large semi-shrouded pinion on the lever-handle engages. At the lower end of the boring spindle a handle is affixed for reversing the chisel according to the direction of the cut; and core-drivers, Gilpin's patent bits, and a patent boring apparatus, with a special tenoning tool, complete the appurtenances of the machine as shown in the engraving. These are not, however, separate adjuncts, as in the "Imperial" mortising and boring machine, Fig. 5, but simply substitutes for the mortising chisel, which must merely be detached and withdrawn from the socket in the bottom of the spindle when such other work has to be done. If for tenoning, the work is effected with the proper tool, by operating the counter-weighted lever-handle; if boring has to be done, the boring bit and tool is inserted, and simultaneously with the action of the lever-handle by one hand, the rotary action of the auger is effected with the winch by the other. More than 3,000 of these hand machines are in use in all parts in the medium builders' workshops and similar industrial works, for which they are particularly designed, and the number of the hand saw-benches exceed 2,000. It may be noted that at a recent agricultural show at Preston, at the beginning of August, a silver medal was awarded to Messrs. F. W. Reynolds and Co. for their hand-power machines for the various purposes of joinery.

(*To be continued.*)

THE ETHNOLOGICAL COLLECTION AT THE INTERNATIONAL EXHIBITION.

By P. L. Simmonds.

After the preliminary introductory remarks respecting the Australian races, &c., published in a recent number of the *Journal*, I proceed now to give more specific details and some descriptive information respecting the aboriginal articles shown in the gallery of the Albert Hall, with the view of directing public attention more prominently to them, and of inviting co-operation in the object aimed at of forming a permanent museum of ethnology and anthropology.

The collection of articles shown from the South Sea Islands, New Zealand, and Australia, is varied and interesting. The principal exhibitors are the London Missionary Society, T. Hughes, P. L. Simmonds, the Rev. Mr. Haweis, and others.

In the South Sea Islands case, two mother-of-pearl ornamented women's girdles or waist belts are worth examination. The care, accuracy, and ingenuity with which these have been uniformly cut, bored, and threaded with rude implements evinces wonderful skill and patience. There are strings of teeth and rings of bone and other ornaments. The carvings are well done. There are two or three curiously ornamented drums on wooden stands, cut out of the solid wood, surrounded with circlets of bone ornaments and carvings round them. Adzes of stone and hard wood are shown. There are feather necklaces and shell necklaces. Necklaces made of plain or polished shells are very common ornaments in the Pacific Islands. Strings of the elenchus shells, polished with great labour by the aborigines of Tasmania, are still to be found in the Bethnal-green Museum, the British Museum, and in private collections. Sections of white cones, sufficiently large to go on the arm as a bracelet, are so much in request in the Pacific Islands that shell dealers in Europe now obtain high prices for them. Very often rare terrestrial or fluviatile shells are obtained from these native necklaces. A necklace was stolen from one of the aboriginal figures at the Crystal Palace a few years ago, because it happened to contain a few rare shells, worth to collectors several pounds.

In full dress, many of the South Sea islanders are decked out with large white *Ovula* shells appended to the waist, elbows, and ankles. Necklaces of *Natica* shells are also common in the Pacific Islands. The orange cowry (*Cyprea aurantia*), which is worn suspended from the neck as an emblem of sovereignty, is so rare that it fetches readily now at public sales of shells here £2 10s. to £3. Among other curious objects shown are some of the hideous idols carved in wood and stone (one or two of these are most grotesque), carved wooden bowls, stools, and handles of official sticks, stone pestles for powdering bread-fruit and other food, fishing nets, fish hooks carved out of mother-of-pearl shell or made of hard wood, decoys for catching cuttle fish made of sections of large cowry shells, fire sticks, a suit of armour or warrior's dress made of coir or cocoanut fibre, head ornaments of teeth and feathers, a warrior's belt made of small bones, and other articles. There are also a model of a canoe with paddle, ornamented with cowries; a curious dancer's cap, formed of feathers and pieces of mother-of-pearl; a fly-flapper of various feathers; and a fan used by the priests for driving away flies from human sacrifices.

There are some elaborately carved paddles and clubs shown, especially a paddle used in high ceremonies; and one of the clubs has a tragic interest, being that with which the Rev. J. Williams was murdered on the 19th November, 1839, on the Island of Erromanga. There are several adze heads, and one adze with a handsomely carved handle; also many singular head-dresses, one of red and black feathers, with some of the *ovula* or "poached-egg" shells suspended, and a head dress of black feathers worn by chief mourners.

There are some wooden weapons with two side pieces, all armed with sharks' teeth, forming a formidable serrated instrument of attack. Also various kinds of basket work, tapa cloth, and carved calabashes.

The Rev. J. O. W. Haweis shows some handles of sacred fans, said to be made of human bones carved, tapa cloth, a bread-fruit mallet, and Tahiti idols, and an image of Tanne, an evil spirit, made of feathers.

All savage nations in some way or other make a convenient use of the natural productions of the country in which they live; but there are great differences in this respect. There are degrees of barbarism as there are degrees of civilisation. Some races are endowed with greater ingenuity than others, and keener perceptions of what is applicable for their various purposes. Some savages know no other adornment or covering than perishable leaves, whilst others have carried the weaver's art to perfection, and placed all those members of the vegetable kingdom under tribute that can yield them a fibre.

There are a variety of interesting articles shown from the Fiji islands. The Fijians, judging from their tools, weapons, and clothing, are but little behind the New Zealanders in skill, whilst in some respects they are in advance of them—in the art of pottery, for instance. There

are many beautiful specimens of the cloth called "tapa" made by macerating and beating out the bark of the paper mulberry. The most simple form of an article of dress, and one much worn in Fiji, is called "Liku," consisting of a number of pieces simply attached to a waist-band. It is made of many different plants, that most esteemed being a black creeper (*Rhizomorpha*) which grows in swamps. Those worn by the women are from the fibrous bark of several *Paritiums*. Dyed mats with which the floors of houses and sleeping places are thickly covered, are made of the leaves of *Pandanus odoratissimus* and *Pandanus caricosus*. Fans, baskets, and the finest mats are made of bleached leaves of the latter. Occasionally neat patterns are worked in by introducing portions of the material dyed black, whilst the borders of highly finished mats are tastefully ornamented with the bright red feathers of the kula, a parroquet. The clubs are very heavy weapons, about five feet long. The spears are long, and pointed with the sting of the ray fish. Girdles of *Hibiscus* fibres, six inches wide and dyed black, brown, and yellow, are worn by the women.

Pillows are made of a thick stick with four legs, and are just put under the neck, so that the frizzled hair of the sleeper may not be damaged. The musical instruments of the Fijians are trumpets of conch shells, flutes made of bamboo, and drums of sonorous wood. Rude pottery, made without a wheel and dried in the sun, is made by the women in some of the islands.

The London Missionary Society shows some musical instruments, patapatus or crushers of basalt and of bone, jade amulets, and other greenstone ornaments, carved models of canoes, clubs, &c., from New Zealand.

T. Hughes and the writer exhibit different kinds of flax and feather mats. The Maories are very successful in the preparation of the fibre of the New Zealand flax plant (*Phormium tenax*), as the beautiful silky texture of their mats shows. There are several kinds of flax mats made. That called *kaitaka* is the softest and most valued; they vary in size, some being as large as twelve feet long and seven feet wide. They are made of close parallel lines of soft twisted flax, with transverse threads at intervals of about an inch. The weft (if I may so call it) is knotted round the warp, six or seven threads of which are taken up in each knot. They generally have borders of about a foot in width, of closely-woven material, beautifully embroidered in ingenious patterns with black or red threads. The weaving of one of these mats sometimes occupies one person eight months. Another description of mat is called *korowai*. It is generally about six feet square, smooth inside, but having outside a number of black strings seven inches long dangling from it. This mat, like the *kaitaka*, has a very open texture. The mat called *taupo* is made of flax leaves, seven inches long and three-quarters of an inch broad, attached to a smooth coarse mat; every third leaf is dyed yellow and the rest black. This mat is perfectly impervious to rain. The *pureki* mat is another waterproof covering, made of roughly prepared flax fibres, eight inches long, attached by one end to a coarse mat. It differs from the *taupo* mat in the flax being more scraped and not dyed. The *kotikoti* is a mat which is so fabricated as to allow close rows of pipe-shaped tassels to hang down. These pipes are made by exposing the green flax leaf to the fire, which causes it to curl round in the form described. This mat rattles when the wearer walks. Several other kinds of flax mats are made. Mats are also formed of dogskin and of the feathers of various birds, especially the kiwi.

The tools employed by the Maori for shaping the hulls of their canoes, felling trees, &c., were made of various kinds of hard stone, shaped into the form of adzes and axes. The stems of their canoes were ornamented with figure heads and carved prows, the execution of which displayed wonderful skill and knowledge of art. These carvings were generally made of very hard wood, stained black. The pattern was always an open-worked design, similar to the Indian and Chinese carvings in ivory—circles and intersecting curvilinear lines tastefully and regularly arranged. The figure-head was generally a rude copy of a human head, the proportions and treatment of which exhibited a surprising degree of artistic skill. The paddles were made of various kinds of wood, those made of manuka (*Leptospermum erincoides*) being much esteemed. Their handles are occasionally carved, and their form is constructed so as to cause them to enter and leave the water easily and smoothly.

For personal conflicts, the New Zealanders had several deadly weapons, and, like all races ignorant of iron, they used hard minerals for making keen-edged weapons. Of these, the greenstone "mere" was the most esteemed. It weighs about six pounds, is usually a foot long, and in shape resembles a powder-flask flattened. Its edges are as sharp as a knife, and in the handle is a hole for a loop of flax or leather, which is twisted round the wrist. Sometimes meres are made of wood or whalebone, and in such instances are fashioned into various shapes and ornamented on their handles with carvings. The meres are deadly weapons at close quarters, and a single blow with one on the head will cause instant death. The Maoris had five sorts of wooden clubs, which were occasionally highly carved and ornamented with feathers and dyed flax. The "toke," or adze, was a favourite weapon. Its handle was made of wood, two feet long, and the blade of greenstone, jade, jasper, or granite.

Like some of their more civilised brethren, the Maories are passionately fond of adorning themselves with trinkets and other ornaments. At the present day many of the decorations formerly used have been discontinued. Ear ornaments are in general use; they are worn by both sexes and are of great variety. Those of greenstone "poenamu," are the most highly prized; and sharks' teeth are also held in high estimation. Sometimes ear ornaments are made of the feathers of the Huia or Tuia birds. The neck ornament is generally of greenstone carved in the resemblance of the human figure. These are called "heitiki"; the image is not unlike a Hindoo idol, having an enormous face and badly shaped legs of disproportionate size. Some heitikis are about the size of shillings, others as large as plates.

The native of New Zealand is not deficient in those arts which are essential to his comfort. His house is constructed with great skill and elegance, his garments are of much beauty, and ornamented with a border of elaborately wrought embroidery.

The collection of aboriginal weapons and utensils shown from Australia is but small compared with the large and fine series belonging to Col. Lane Fox, now on view at Bethnal-green. Still there are many characteristic types of the weapons, palm leaf water vessels, netted dilly bags, &c.

Boomerangs or curved projectiles are widely diffused among the tribes from Western Australia and Victoria to the Richmond River, Billington River, Fort Bourke and Mackay River districts. The boomerang seems to be as much a weapon for treachery as of direct attack. When the eye is diverted by its motions the opportunity is taken to strike with the spear. They are much valued by the natives, and not readily parted with. This weapon offers a faint clue by which the origin of the people might possibly be traced. The use of curved or angular weapons is said to have been known to several nations of remote antiquity.

Thus there is an Egyptian boomerang in the British Museum which is described as an instrument for fowling, for throwing at or knocking down birds. Such a weapon is also used by the wild tribes of India.

From the movement of this simple instrument, Sir Thomas Mitchell introduced the boomerang propeller in maritime steam-engines. The possession of the boomerang by the Australian savages is assumed by some to prove an early communication with a more civilised people, or the enjoyment of a much higher degree of knowledge among themselves before they relapsed into

their present state of utter barbarism. The same might be said of the mero or throwing board of the spear.

Col. Lane Fox, in the full descriptive catalogue of his anthropological collection arranged at the Bethnal-green Museum—a catalogue, I may remark, which, though not yet complete, is a treasury of valuable information on all that relates to savage weapons and implements—disputes this assumption. "It is not an invention," he observes, "as some suppose, which would have required far greater knowledge of the laws of projectiles than is possessed by the people who use it, but simply a weapon accidentally produced and retained, by the selection of the natural forms of the stems of trees and branches suitable for the purpose. When it is considered that the Australians, like the primeval inhabitants of other parts of the globe, had nothing with which to construct their weapons but flints and stones, and the enormous labour of working with these materials, it is easy to understand why all the Australian weapons are formed on the grain of the wood, on account of the great time which it would require to chip them into any other form than that provided by nature. The curves and forms of all the Australian weapons are therefore as infinite as the curves of the branches out of which they are formed, and afford an immense variety of shapes out of which to select those which in practice are found to be best suited to the various purposes of the user. The plain stick, as cut from the tree, would be used for throwing as well as for striking." Waimeras or woomerahs—meros, as they are called in some parts—are throwing-boards, used for launching the spear. They are about two feet long, and four to eight inches broad in the middle, and tapering off at each end.

At one end, which is the handle, is sometimes fixed with resin a kangaroo tooth, or a piece of quartz or glass, to scrape and point spears with. The other end has a small point or hook resting on the flat side, which is slipped in a hole at the end of the spear. This is a lever of great power. These are in use in Western Australia, Fort Bourke, and the Murray River districts. The throwing-stick, a short heavy stick, used by the natives in close war and capturing game, is thrown with great dexterity, and easily breaks a kangaroo's leg. It is made of different woods, according to the district. In the Canning district of Western Australia it is sometimes called "Wang-gou-Dowak," as native characters are marked on it and sent as challenges to another tribe, who cause a reply to be marked on the same, and it eventually brings about either a reconciliation, quarrel, or war. The native carrying it, should he get tired in his own district, gives it over to the first native that he meets of his own tribe, who, under penalty of being speared, must either see it forwarded or carry it himself to its destination, and arrange for its return.

Barbed and plain spears are in general use. Some of these are of reed and others of wood, some have sharp-edged pieces of quartz or glass, either set in a row or at the end, fixed by means of gum or resin. These spears are used as weapons of war. In the northern territory of South Australia double and three headed spears are used as harpoons for fishing.

The heliman, a native weapon, is made in Queensland from *Urtica gigas*. The native spears are made from *Acacia excelsa*. The aborigines make their shields from the soft wood of the native cork tree, *Erythrina vespertilio*, Benth. There is great variety in the form and ornamentation of the shields used by the natives of Australia. Some are used as bucklers against the boomerang, the wider ones as protection for the person against spears. These are usually about 39 inches long by 9 to 12 inches broad. They come from all districts, but the shields differ in size according to the tea tree from which it is made being large or small in the district. In the north it is used by nearly all natives, and forms a good protection when handled quickly.

The Yarra natives use geeaus, or flat shields, gurrecks, or spear throwers, goypims, kangaroo spears, warrawarras, or fighting sticks with broad ends, mulgars or club shields. The peduncle of *Xanthorrhea australis* is used for the lower portions of spears, and *Xerotes longifolia* and *Poa australis* for baskets and net bags.

Axe-headed weapons, stone hammers, or tomahawks, are met with in the Darling River, Barwon River, and Murray River districts. These are now getting scarce. They are used to cut up the kangaroo and other animals, to wound each other in close wars, and to mark their bodies when they are in grief or enraged. The northern knives are called bondgums, in the western districts, Tabba and Dtarh-ras. They are mostly attached to the handles like the spear-heads by the resin or gum of the grass-tree, *Xanthorrhea australis*, and secured with fibre.

Passing now from Australia and the Pacific to Africa, the visitor will find much to inspect that is curious and noteworthy.

The African exhibits are contributed by H. Cole, C.B.; J. A. Skertchley, Col. Harley, Major Britten, Mrs. Harley, Mrs. Clayton, Captain Cooper, Colonel G. Coleman, the writer, and others; but I am surprised to find how little has been contributed by the African trading companies and merchants having dealings with the coasts and rivers, who must necessarily have many curious and interesting articles connected with Africa, illustrative of native manufactures, tools, weapons, and domestic utensils. Looking at what the Society of Arts has already done in former years in diffusing ethnographical knowledge, and its present large African Committee, more might have been expected from the merchants and traders illustrative of this large continent and its numerous races and tribes.

Mr. H. Cole shows some interesting specimens of gold jewellery and personal ornaments from Coomassie, and fragments of bowls and gold beaten work. Mrs. Harley also shows African gold jewellery, brooches, pins, necklets, &c., some with brilliant green beetles set in gold. Major Britten shows a quiver with poisoned arrows. Mr. Skertchley exhibits the state carved stool of an African prince, and there are state umbrellas, message sticks, and other emblems of office and sovereignty.

There are many varieties of African pipes shown from the Gaboon, the Niger, and the West Coast, by Col. Harley, P. L. Simmonds, Mrs. Clayton, and others; also several musical instruments. A curious one made of a gourd, with bridge and strings, is the property of Capt. Cooper. A kind of fiddle is shown by the London Missionary Society, and several carved ivory trumpets.

Of personal ornaments and decorative jewellery (if I may so term it) there is a great variety made and worn by the African races. There are bracelets, armlets, and anklets of ivory, plain and inlaid; of iron, brass, and white metal; of black glass and coloured glass, formed of old bottles or broken glass melted down. The coloured glass armlets are made of the same materials, but with European beads fused in to make the pattern. Thick round ivory armlets, inlaid with lines of dots in metal from the Niger are scarce and much prized, being chiefly worn by women. At Lagos wrought-iron and brass bracelets are worn. Some curious necklaces or waist-bands are worn, made sometimes of the vertebra of a snake, sometimes of dried silkworm cocoons threaded, with small pebbles inserted to rattle; others are made of sections of palm-nuts, or ostrich egg-shells, ground down by hand with infinite labour, and afterwards strung together, it taking months to make one of sufficient length. The weapons, implements, &c., exhibited over the African case and on the shelves, are interesting and curious, and would form the subject for ample description did space permit.

Among most of the coast tribes the use of the common trade guns has superseded the original weapons, and flint guns and pistols are now used all along the

coast. These are of various kinds, and are known by the trade names of carbines, long and short danes, fusees, buccaneers, &c. The natives are often particular in their choice of these, and the kinds that will sell at one part of the coast are often rejected at another. For instance, at Porto Novo the large heavy red guns, with a capacious barrel, known as "buccaneers," are most in favour, while in the Nun the guns with a long thin barrel, called "fusees," are preferred. Guns with brass mounts are much liked also. In Porto Novo and Yoruba pieces of iron pots broken rather small serve for bullets, but the native blacksmiths in Porto Novo also make very good bullets by beating thin strips of iron into a spherical form. They put very heavy charges of powder in their guns, and as the guns are not of the best make or material they often explode. The weapons generally used in the interior are the sword, spear, dagger, and various axes or war knives. Most persons of importance carry a sword, not as we should wear it, attached to a belt at the waist, but slung over the shoulder by a cord and tassels made of silk and cotton. The sword is large and heavy, about four feet long, with a fine two-edged blade of good steel, sharp-pointed, set in a metal cross hilt. The blades are, I think, obtained from the Arabs, who come across the desert to trade with the Houssas, as they bear the Morocco mark, two half-moons. The sheaths are made of coloured leather and brass, sometimes ornamented with silver, and are decorated in the Moorish style with various metals, velvet, and Morocco leather. They often use brass or iron overlaid or plated with silver, but by what process this is done I do not know. They have a very handsome appearance when new, but of course in a climate like that of Africa soon get tarnished and dirty, and then look anything but nice. As instances of the skill and taste displayed in carving and decoration, the numerous ornamented calabashes may be instanced, a carved wooden fire-bowl, with figures smoking, as a base or support, shown by Mr. Clayton, and also some carved wooden fetish figures, stools, and spoons, by the writer.

In leather-work the Africans are equally skilful, and some good examples are shown, both in the galleries of the Leather Court of the Exhibition and the Ethnological Department, in slippers, saddlecloths, and ornamental quivers. The Houssas, especially, are very skilful in the art of making Morocco leather. There is a Mandingo purse of striped leather shown by Colonel G. Colman.

Iron and bone needles, bead-work bracelets, aprons, and a Hottentot head-dress ornamented with cowries and round copper ear-plates, are shown by the London Missionary Society. Hide shields, powder-flasks, a model of a Bechuna hut, models of canoes, and other objects, will be examined with interest.

Of pottery and earthenware there are several examples, in milk pans, large and small pipe-heads, lamps and lamp stands of red pottery ornamented with colours on the Niger. Lamps of black pottery are made at Lukoja; small red earthenware jars with lids at Porto Novo; ornamented water jars, pitchers, large round pots of brown pattern, for shea butter and palm oil, at Ibo on the Niger. Milk pails of solid wood are also used in the southern parts of Africa.

Of extemporised domestic utensils, gourds and calabashes are the principal in use, taking the place of the more brittle crockery and glass of civilised nations. These calabashes, the husk or shell of the fruit of the *Crescente cujite*, are plain, beautifully carved, dyed, &c. Some of the smallest of these and little gourds are used for holding pepper, salt, snuff, &c. The most ornamented calabashes are those which come from Gheybe. They are used as dippers, dishes, drinking cups, spoons, &c. The bottle gourd is also much used.

The matting and basket work of African manufacture shown is curious. At Lagos, strong white mats are made of the fan palm leaf. At Porto Novo, soft rush mats, occasionally ornamented with dyed leaf fibre; at the Gaboon, small narrow palm leaf mats of fine plait, which are sometimes coloured by the Mandingoes. At Lagos mats are made of split mid-ribs of the *Rhapia vinifera* palm, and these are occasionally ornamented with the dyed fibre of the leaves. In the towns, &c., of the Niger river, they excel in the beauty of the mats made; some are called "guva" or elephant mats; some fine coloured ones are made from the fibre of the leaves of *Phœnix spinosa*, and at Nuphe there are oval ones of superior make in use by the chiefs. The coloured patterns of these are frequently very tasteful. Some strong reed mats are made of the stalks of a species of *Sorghum*, or millet. Plaited grass trays or strainers are also in general use. Many specimens of ornamental mats, basket work, fans, strainers, hats, &c., of African manufacture are exhibited.

The whole field of description of savage life, manufactures, weapons, and utensils is so extensive and suggestive, that even a mere enumeration and brief detail of Australian, Pacific, and African exhibits has carried me beyond the due limits of of a single article, leaving Dr. Leitner's collection, the Indian articles, and those of some other countries untouched.

THE CULTURE OF THE SILKWORM IN MACCLESFIELD.

The *Macclesfield Courier* gives an account of a recent attempt at silkworm culture near that town. It says that Mr. John Draper, of Hurdsfield, has for the past four or five years been engaged rearing silkworms, and has met with decided success. In the garden adjoining his house are planted no fewer than sixty mulberry plants, all of which appear quite healthy, and require little more care than ordinary plants. Mr. Draper has reared at least one brood of worms every season for the last four years; and this season has successfully reared two broods. The cocoons spun are of a yellowish-green hue, which has been pronounced by several practical authorities, who have visited Mr. Draper and seen his specimens of silk, to be as valuable as that produced in continental countries. Mr. Draper states that, so far from its being impossible to rear the silkworm in England in less than 56 days (as has been repeatedly stated by authorities on the culture of the silkworm), he has reared them in much less time, and does so regularly, as the following will show:—"The birth of my silkworms was on the 18th of May, and the first age (that is the first moulting or change of the skin) was on the 22nd of May; the second age on the 26th of May, and the third age on the 1st of June, the fourth age on the 7th of June, and the fifth age on the 14th of June. On this day they began to rise (that is to say, to spin their cocoons), 28 days after their birth. On the first day of July they became perfect fly, on the 2nd day of July deposited eggs, and on the 17th of July these eggs hatched for the second crop of cocoons in this year." Mr. Draper, as may be inferred, has already been visited by many who are interested in the silk trade, and will be glad to exhibit his productions and his valuable collection of caterpillars to any who may take an interest in their culture.

A company has been formed to work the sulphur deposits at White Island, a marine volcano 140 miles from Auckland. It is estimated that 100,000 tons of sulphur in an almost pure state are lying on the island ready for shipment. Chemical works are likely to be established soon, and the island leased.

It is stated that the effort in the Southern States to promote manufacturing industry has resulted in the establishment of large cotton manufactories at Augusta and Columbus, Georgia, and other cities. Chattanooga, Tennessee, has three large manufacturing establishments. Memphis is also about to establish cotton mills.

THE COAL-FIELDS AND MINING INDUSTRIES OF RUSSIA.*

A recent visit to Russia enabled the author to collect information and statistics relative to the mining industry of that great country of which but little have hitherto been published. As far back as 1848 a geological survey of Russia was made under the auspices of the Government, and since then more complete investigation of the different districts had been made. From the geological map it was seen that the carboniferous limestone formation has a very extensive range. Thin bands of it appear to flank both sides of the Ural mountains, and they occur again over an extensive area in the Donetz district near the Black Sea. The coal-field of Russia was divided into three districts—the Tula coal-field, extending over an area of 13,000 square miles, at present but little worked, only sending up about 140,000 tons of coal per annum. This was to some extent owing to the great distance of the railway, but a new railroad was being laid down to reach this coal-field, which included two seams of coal, respectively 3 feet and 7 feet in thickness. The next field in point of extent was that known as the Demity, situated in the country of the Don Cossacks, on the shores of the Sea of Azoff. That field was 11,000 square miles in extent, and embraced a vast thickness of coal, many of the seams being brought within easy reach from the surface through the dislocation of the rocks of the country. It was both bituminous and anthracite in quality, and the same seams were found bituminous in one place, while they were anthracite in another—in that respect, as Sir R. Murchison had pointed out, resembling in a remarkable manner the analogous special feature of the South Wales coal-field. In this district 60 seams had been discovered, of which it is believed 44, having an aggregate thickness of 114 feet, were workable. The chief seams were 3 feet, 2 feet 7 inches, and 5 feet 7 inches in thickness, and the average depth of the pits was from 50 to 80 yards. The percentage of carbon was 89. Coal 30 inches in thickness had been found at 36 fathoms from the surface, and 36 inches at 48 fathoms. In the Ural district there was a long narrow coal-field at the base of that range of mountains in which seams of coal 30 and 40 feet thick were found and worked. It was of a soft and friable nature, but threw out a great heat. The peculiarity of all these coal fields was that they belonged to a distinct formation altogether from the true carboniferous series; and the only coal-field of Russia which belongs to the true coal formation was a small tract of some 80 square miles in Poland, which contained seams varying in thickness from 3 feet 8 inches to 21 feet, this last being a magnificent vein of coal without the slightest clod between it. There was 60 feet of workable coal in the centre of this district, but there was a marked absence of some of the rocks invariably present in the English coal-field, and the coal there rested upon the Devonian. Of the total quantity of 817,000 tons of coal worked in Russia in 1872 one third was wrought in this small Polish basin. The writer then described the operations at one of the collieries sending up 50,000 tons per annum. Here they were not much troubled with water or fire-damp. The coal produced was often raised by horses or small steam-engines of 8 or 10-horse power. The system of working the coal was that known as the block system. The shafts were fitted with cages, and wire ropes were used for raising the load. Altogether, the arrangements were better than could have been expected, but in the method of hewing and putting there was much room for improvement. Three men generally worked at the same place, and the coal was forced from its place, not with picks and by blasting, but by means of a crowbar moved by two men, who drive it into the mass of coal, and by driving it rapidly at the same spot, they manage to bring down large blocks of coal, which are tipped into the waggon, and the third man draws it to the bottom of the shaft, whatever the distance might be. The men work from 6 a.m. to 6 p.m., with an interval in the middle of the day of one hour, when they come to the bank for dinner. The wages for hewers are 10d. per ton, including putting to the shaft. The average wages are 1s. 8d.; smiths, 1s. 4d. to 1s. 7d. per day; carpenters, 1s. 1d. to 1s. 7d. per day; firemen, 1s. 5d.; labourers, 9½d. to 1s. 1d. per day. These wages are rather like those paid in the Newcastle district in olden times, when an old chronicler states that horses were worth from £6 to £7 10s., or 1s. being paid for a 15 peck corve, shift-work 1s. per day, overmen's wages 8s. per week, the viewers 15s. or 16s. per week. The men in the Russian collieries generally live a long way from their homes, to which they go once in a year, where they remain for a fortnight, generally at Easter. Large lodging-houses are provided for them at the pit's bank, where 100 men lodge together. The Donetz coal-fields extend about 11,000 square miles, and the Ural coal-fields 10,000 square miles. The quantity of coals raised in Russia in 1871 was 817,008 tons, being double that of 1868. The quantity of coals imported into Russia from England in 1855 was 213,553 tons; the quantity in 1871 was 872,588 tons. In 1872 Russia exported 4,400 tons of coal. The quality of the Russian coal-field varied very much, but in the Donetz coal-field it was of a very superior quality. In some parts of Russia for locomotives and for factories coal was being used now, but at present, wherever wood can be obtained, which cost the same money, it was preferred; but as the wood diminished the coal would become more and more used. Various other items of information of great interest to Englishmen were supplied with reference to the trade of Russia in other minerals, such as iron, lead, zinc, cobalt, and gold, from which it was inferred that the country was eminently rich in mineral wealth, and it could only be a question of time, and the educational development of her inhabitants, before she would be rendered quite independent of foreign support. In gold mining alone there were 40,000 people at work, and the workings were as extensive as anything in California or Australia. There were now 8,500 miles of railway open —1,000 sanctioned by the Goverment, and many more projected—and the necessities of locomotion alone would lead to a more rapid and extensive development of their coal-fields than the Russians had hitherto shown.

* A Paper read by Mr. J. B. Simpson, of Blaydon-on-Tyne, before the Institute of Mining Engineers at Cardiff.

The Angora goat gives about one oka, or 44 oz. avoirdupois, of wool; the quantity supplied throughout the wool region is estimated at from 350,000 to 400,000 okas, *i.e.*, 962,500 lbs. to 1,100,000 lbs. 40,000 okas (110,000 lbs.) are expended in thread manufacture in Asia Minor itself, of which more than half is sent to Holland, and 8,000 to 10,000 okas (17,500 lbs.) are converted into home-made shawls and stuffs.

The *Golos* states that during the year 1873 the total mileage of Russian railways increased from 13,217 to 15,191 versts, or in the ratio of about 15 per cent. The number of passengers conveyed in 1873 amounted to 22,800,000, showing an increase of about 11 per cent. over the previous year's numbers, and the gross receipts were 122,877,000 roubles, or upwards of 20 per cent. over those of 1872.

Jarrah Timber, the valuable product of Western Australia, is said to be growing in appreciation in the neighbouring Australian colonies, and also in New Zealand. The Western Australian Timber Company recently received an order for as many as 100,000 railway sleepers. Further supplies for New Zealand are also being arranged for.

The business of the United States Patent Office continues to grow. The receipts for every month this year are thus far larger than those of the corresponding months for any previous year.

An attempt to develope, mathematically, the general theory of duplex telegraphy has been made by Mr. L. Schwendler, by whom a paper on this subject appears in the *Philosophical Magazine*.

JUTE FIBRE.

A report on "The Chemical Composition of Jute Fibre," was read by Dr. Hodges, on Friday, the 20th inst., before the Chemical Section of the British Association. Dr. Hodges said:—"At a meeting of the Association held twenty-two years ago, I had the honour of reading before this section a report on the composition of the flax plant, the fibre of which supplies the raw material of the staple industry of this part of Ireland. In that and subsequent reports I gave an account of a series of investigations which had been undertaken by me at the request of the Association, and in which the composition of the fibre and the changes which it undergoes in its technical preparation were for the first time completely examined. Fifty years ago the fibre of the jute plant was to be found only in our museums, now the quantity of it introduced into the United Kingdom almost equals that of the flax which we import, and exceeds the annual importation of hemp, and, owing to the improvements which have been effected in the processes for its preparation, and especially in the methods of bleaching, it is, I believe, destined to occupy in future a far more important place among the raw material of our textile manufactures. The plant which yields the fibre known in commerce as jute, a name which is supposed to be derived from a corruption of the Bengali name of the plant, is a member of the family *Tiliaceæ*, the linden or lime tree family, which from remote periods has been cultivated by the natives of Southern Asia for textile purposes. The treatment of the plant for the separation of the fibre is precisely like the ordinary methods used by farmers in this country in the preparation of the flax fibre. The products of jute far exceeds that of flax, being, it is stated, five times as great as that which flax affords. Though India is the great seat of jute cultivation, and supplies the fibre used in this country, yet the jute plants, especially *Corchorus olitorius* have been long cultivated in China and other eastern countries. Attempts have been made to grow the plants for textile purposes in the Southern States of America, on the banks of the lower Mississippi, and also in Algiers, and it is said the results are encouraging. For some time after the introduction of jute, the opinion prevailed that it could not be bleached, and was, therefore, of little value as a textile material. Experiments made at several times proved that this was a mistake, but until lately scarcely any progress has been made in improving the qualities of the fibre, or giving it the whiteness of linen fabrics. The difficulties, however, which retarded the success of jute bleaching have, during the present year, been completely removed, by the application of methods which have been patented by my son, and which are at present in operation, at works erected for the purpose by Mr. W. Sibbald Johnston, of this town, at Mile Cross, near Newtownards, in the neighbouring County of Down. The length of the fibre of the jute of commerce is frequently no less than twelve feet, usually the lower end near the ground is dark coloured and woody. I had hoped to be able to give an analysis of the jute plant, in the condition in which it is removed from the field; but, unfortunately, a specimen which had been forwarded from Calcutta arrived only a few days ago, and I must therefore defer its investigation until some other opportunity. With respect to the magnitude of the jute manufacture, I may state that in the present year one hundred thousand tons of the fibre were imported into Dundee alone, by direct shipment from Calcutta, while London, Liverpool, and Glasgow received probably half as much more. The rapidity with which, by means of improved machinery, it can be manufactured may be judged from the fact that, since the opening of the Suez Canal, the fibre has been delivered in Dundee, spun and woven, and the goods shipped back, and paid for—viz., within six months from the date of the bill of lading. At the present time jute is used for the manufacture of a great variety of fabrics. In fact, it will serve for the production of every kind of coarse textile material. It is used as a substitute for hair, and can be formed into admirable chignons. The dust from the mills is employed to make silk hats, and the waste fibre yields an excellent pulp for the manufacture. Stair carpets of jute, with bright colours, can be sold at three pence per yard, and woven into what are known as carpet bed covers, a fabric is produced at not more than one third the price of wool.

THE EXPORT TRADE OF THE UNITED KINGDOM.

The declared value of the exports from the United Kingdom during the year 1873, although less than the amount of the year 1872 by some four millions sterling, was still largely in excess of all previous years, and it is worthy of note, as a proof of our increased trade with foreign countries, that whereas in 1859 their custom brought us a hundred and fifty-five millions it now brings us exactly double that amount. Some of the articles in which our trade has been most largely developed are:—Alkali, of which the sales increased by about £400,000 on 1872; apparel and "slops" by £300,000; empty bags by £300,000; beer and ale by £400,000; railway carriages by more then £100,000; coals, cinder, and fuel by nearly three millions sterling; wheat by £300,000, and flour by £10,000; herrings by £200,000; furniture by £70,000; plate glass by £90,000; bottles by £90,000; steam engines by £300,000; mixed copper or yellow metal by £130,000; iron and steel manufactures generally by nearly two millions, and telegraphic wire nearly another two millions. The decrease in the value of some of our exports was very marked as compared with 1872. In gunpowder our sales fell by about £43,000; butter by £40,000; cotton manufactures by the large sum of two millions; leather by more than £200,000; linen manufactures by nearly a million; copper, in its unwrought state, by £200,000; painters' colours by £100,000; silk manufactures by more than £300,000; soap by about £60,000; British spirits, as merchandise, exclusive of those shipped as stores, by £16,000; woollen and worsted yarn by nearly £800,000; and woollen and worsted manufactures generally by nearly seven millions; in fact, the exports in this branch of trade fell below the value of 1871 as well as 1872. Our exports of foreign and colonial merchandise also showed a considerable decrease, amounting to about two millions and a half, the principal articles in which there was a great decrease being in raw cotton, amounting to more than two millions, and tea, equal to six hundred thousand pounds sterling. Our largest customers during the year were France, Germany, Holland, Belgium, the United States, Russia, Sweden, and Norway, and Italy, with whom our trade in all cases was above a million sterling. It reached with France the enormous sum of nearly thirteen millions, and with Germany nine and a half millions. Our trade with France, though it is recovering, is still below the amount of the year 1871, but as compared with 1870, when it had fallen to ten thousand, it shows a great rise. It is, however, now only where it was in 1862, and is very far from the amount of 1865, when it reached its largest value of sixteen millions. With Germany the fluctuations of our dealings have been very similar, and the value of the German purchases is almost where it was ten years ago. In 1870 it fell to seven millions and a half, then in the two following years it arose above eleven millions, and now again it has dropped to nine and a half. The Dutch, who stand third on our list in the value of their purchases, bought goods to the amount of nearly eight millions, this being slightly below the previous year, but considerably above the average of the last ten years. The Belgians bought to the value of nearly half a million more in 1873 than in 1872, and their trade with us shows a steady rise. The United States purchases were

nearly two millions less than in 1871, when our trade with them reached the highest value it has yet attained of about five millions, the average range of the last ten years being about two millions. The purchases made by the British possessions amounted to £4,809,236, being two hundred thousand below the amount of the previous year, which exceeded five millions.

REPORT OF THE COMMISSION ON THE FRENCH MERCANTILE MARINE.

When, in July last year, the National Assembly voted the abolition of the surcharge on foreign flags entering French ports, and placed all on the same footing, it expressed its sympathy with the mercantile navy of France, and appointed a special Commission to inquire into its condition, and study the methods which would best aid its prosperity.

The Commission was nominated by decree in October last, with the Minister of Commerce as President; MM. Ancel and Duval; Admirals Bourgois, Lapelin, and Ozenne; and a number of eminent men, heads of departments, members of chambers of commerce, shipowners and builders, merchants and others.

M. Dupuy de Lôme, Chief Constructor of the Navy under the Empire, was named reporter at the first meeting of the Commission, and after twenty-eight meetings, the report of the Commission is before us.

The Commissioners are unanimous respecting the distressed condition of the shipping interest, and equally of opinion that the existing laws and regulations contributed to paralyse it. It appointed three sub-commissions to divide the labours, the first to deal with the existing laws which regulate the merchant service; the second with laws and regulations respecting naval construction, the service of maritime companies subventioned by the State; and the third to consider the laws respecting societies of credit, and the organisation of maritime hypothèque.

The report is drawn up under twenty-nine heads, including:—Revision of the Commercial Code, Organisation of Mortgage (hypothèque), Duties of Registration on Sale of Vessels, Organisation of a Maritime Credit Society, Shipowners' Patent Tax, Pilot Dues, Examination of Shipping Tonnage, Quay and other Dues, Consular Tariffs, Foreign Chambers of Commerce, Shipwrecks in or at the Mouths of Ports, Cost of Sick Sailors and sending them Home, Shipwrecked Seamen's Wages, Certificates of Captains of Vessels, Maritime Inscription, Volunteers, Proportion of Foreign Sailors to be allowed on board ships, Strikes of Seamen, Steam Companies, State Freights, and the two important points of Compensation due to French Shipbuilders on account of the free admission of metals, &c., for construction, and Subvention to Shipowners on account of the navigation being thrown open.

Those who are specially interested in the subject of merchant shipping will naturally consult this important document for themselves. The limits of this *Journal* will only allow of reference to the most generally interesting points of the report.

The 28th clause of the report says that when the Government abolished the surcharge on foreign flags, it also allowed of the importation of foreign vessels, and thus gave a heavy blow to two industries which had been the sources of great wealth to the country, and it proposes that compensation shall be given to French shipbuilders; and, supposing that the free admission in bond of materials for naval construction should be maintained, it proposes that the following compensating allowances should be made:—10 to 55 francs per 100 kilogrammes, net weight, for all steam or other motive engines placed on board ship; 40 francs per ton, gross, on all steam or iron vessels; 14 francs per ton on wooden vessels of 200 tons and upwards; and 7 francs on those under 200 tons. These compensations are estimated to cost the Government 1,689,000 francs per annum.

In clause 29 the Commission asks for a credit of 6,600,000 francs, for the purpose of allowing to every shipowner a subvention at the rate of one franc per day for every seaman subject to the naval conscription; fishing-boats, those of the home-coasting trade, and engaged in the mail service excepted.

This proposition is, in fact, only the extension to vessels engaged in long voyages and the outer coasting trade, of the premiums now paid by the Government to vessels fitted for the great fisheries.

A premium of seven francs per ton on wooden and sailing vessels, and of fifteen francs on iron and steam ships per annum, says M. Dupuy de Lôme, represents the economy which a shipowner makes by being allowed to import ships at two francs per ton (and consequently a protection of the French shipbuilder to that amount). But such economy does not compensate for the reductions he is compelled to make in his charge for freight consequent upon the abolition of the surcharge on foreign flags. This suppression is at the present moment the principal cause of the suffering of the mercantile marine, an industry which is of vital importance to the prosperity and safety of the country. The development of the foreign trade of France called perhaps for the abolition of the surcharge on foreign vessels, but the Commission is of opinion that it should be replaced, not only by maintaining the advantages resulting from the suppression of the dues on the registration of vessels as French, but also by a subvention from the Government to shipowners on account of the rivalry of foreign ships.

The report will be presented to the Assembly immediately after the vacation.

THE PRODUCTION OF PEAT IN GERMANY.

A branch of industry which is gradually increasing in importance has arisen in late years in the barren moorlands of north western Germany, by the preparation of peat or turf, the material most in use in the northern part of Europe as fuel for private dwelling-houses, and in some cases even for larger establishments. Two companies have lately been formed in Oldenburg for the purpose of manufacturing peat on a large scale, and of supplying it to the inhabitants of Bremen, Oldenburg, and other towns around at a far cheaper price than that now paid to the peasants, who have hitherto almost had a monopoly of the trade in this article. The companies mentioned cut the peat out of the soil of the marshy moors or bogs extending from Bremen to the Dutch frontier by machinery, and by this process not only obtain the material in question, but at the same time construct a net of canals, which are of use for conveying the peat itself to market, and which form new and permanent channels of communication, available likewise for all other purposes.

The peat-cutting machine consists of a large flat-bottomed steam-vessel, which, when set to work, is able to cut a canal twenty German feet in breadth and six feet in depth whilst proceeding at the rate of from ten to twelve feet per hour. The soil thus cut out by this floating peat manufactory is lifted into the vessel by steam-power, and after being thoroughly ground, is deposited, by means of a long pipe running out of the side of the vessel, alongside of the bank of the canal, where it is subsequently cut into the shape of bricks, and dried. It is stated that by this method about 1,000 centimes (55 English tons) of a very good kind of peat may be manufactured per day. "In view of the present high prices of coals, particularly in Great Britain," remarks Consul Ward, "and of the great importance which attaches to the question of obtaining a cheap kind of fuel at all times, it might perhaps be well worth while to consider whether this system of peat manufacture could not be introduced in many other parts of Europe, where the soil is doubtless as well suited for the purpose as in Oldenburg."

GENERAL NOTES.

Ornamenting Metal Surfacas.—A new process for ornamenting metal surfaces has been recently invented in America. It consists in plating, electro-plating, or otherwise covering a plate, bar, or ingot of soft metal with a thin film of harder metal, and then rolling out or pressing the ingot into a sheet; whereby the coating is broken into irregular forms, and a marbleized appearance produced on the surface of the sheet.

The Channel Tunnel.—The French Minister of Public Works (M. Caillaux) has received the report of a commission charged with the consideration of the question of a proposed great tunnel between France and England. The commissioners report in favour of taking the project into consideration, subject to the accomplishment of certain formalities. MM. Michel Chevalier and Léon Say are at the head of a French company which has, for the present, assumed the charge of this gigantic enterprise; the engineers engaged are MM. Charles Bergeron and Alphonse Lavalley. The last named gentleman was associated with the execution of the Suez Canal.

Mechanics of Ancient Warfare.—An interesting experiment, says *Nature*, was recently made by MM. Bertrand and Mortillet, directors of the St. Germains Museum, in the Champ de Manœuvre. The war implements constructed from designs of Trajan's Column were tested, when it was found that the catapult threw arrows a distance of 300 yards. The mark was hit regularly each time up to 180 yards. The same can be said of the *onager*, which sends stones to a distance of 180 yards with astonishing precision, although weighing 1½ lbs. The initial velocity was calculated to be more than fifty metres per second, as the time taken to reach the mark is not more than seven seconds, and sometimes less than five. All these apparatus are to be tried at a public exhibition to be given in the beginning of next October.

Births and Deaths in Paris.—M. Husson has laid a statement before the Academy of Moral and Political Science of Paris, showing the gradual decrease in the number of births amongst the population. During the period commencing with 1817 and ending with 1830, the births amounted to 1 for 26·91 inhabitants; in that of 1860 to 1865, it was 1 in 31·99; from 1866 to 1872, including the time of the war, it only reached 1 in 34·39. The number of illegitimate children born annually during the last-named period was 14,613, out of a total of 52,065, but it is mentioned that out of the former number 10,453 were legitimised, either completely by the marriage of their parents, or by legal recognition. The number of marriages has slightly increased during the century; it amounted to 1 in 104 inhabitants during the period of 1866 to 1872, but the number of children has slightly declined relatively. On the other hand, the proportion of deaths has declined; in the past century it amounted to about 1 in 30 inhabitants; between 1817 and 1830, it was 1 in 32·59; in 1860 to 1865, 1 in 39·04, rising again in 1866 to 1872, war time included, to 33·61.

Guano.—A report by Commander Cookson upon the guano deposits on the islands of Lobos de Tierra, Lobos de Afuera, Macabi, and Guanape (in continuation of reports to the Admiralty relative to the deposits in Peru), has just been printed. At the time of the visit of H.M.S. *Petrel* to the first-named island there were no inhabitants, except a few Indian fishermen, from whom no information could be gained. The island is six miles long and in some parts three broad; the beds of guano there are a considerable distance apart, and are estimated to amount to 600,000 tons. The working of the guano there will shortly be commenced by the Guano Shipping Company at Macabi, and 100 Chinese labourers have already been sent to make piers and erect the necessary buildings. The same company has undertaken the working of the beds upon the island of Lobos de Afuera, under a contract with the Peruvian Government, by which the company receives 85 cents. per ton shipped, and defrays the expense of all the necessary works, such as building piers, laying tramways, making shoots, &c. The estimated quantity here 500,000 tons. The labour employed by the Shipping Company is all Chinese.

Phylloxera in France.—The Board of Trade has received from the Secretary of State for Foreign Affairs, a copy of a French law, promulgated on the 25th ult., instituting a prize of 300,000 francs (about £12,000), to which may be added subscriptions from other sources, for the discovery of an efficacious and economical means of destroying the phylloxera, or of preventing its ravages. A commission, nominated by the Minister of Agriculture and Commerce, will determine the condition of compensation and the award of the prize.

New Javanese Resin.—Among the natural products collected by Dr. T. E. de Vrij during his stay in the Isle of Java was a crystalline resin produced from the *Podocarpus cupressina*, or *P. imbricata*, a tree common in the forests of Java, and known locally by its Malay name of Djamoudjou. This resin, when treated with alcohol, yields a white crystalline acid substance, which has been called Podocarpic acid. The last number of the *Journal fur praktische Chimie* contains a long paper by Herr A. C. Oudemans, jun., in which he describes the results of his studies of this acid, and of several of its salts and derivatives.

Tierra del Fuego.—M. Pertuiset, who was recently commissioned by the Chilian Government to explore the group of islands composing the Tierra del Fuego, has forwarded his report to the French Geographical Society. From it there would seem to be a remarkable field for agricultural development in the country, virgin forests and prairies occupying a large extent of ground. Coal, copper, and iron —all of good quality—were found by M. Pertuiset to exist in great abundance, and the mean temperature at midday was between 60° and 68° Fahr. Those of our readers who are interested in this little-known country, which, however, the Chilians seem bent on turning to account by their quiet and systematic method of occupying, colonising, and exploring it, will find a concise article on the subject, entitled "The Straits of Magellan," in the *Ocean Highways* for last December.

Straw a Protection against Lightning.—An extraordinary account has appeared in a French agricultural journal, to the effect that straw forms admirable lightning conductors. It had been observed that straw had the property of discharging Leyden jars without spark or explosion, and some one in the neighbourhood of Tarbes had the idea of constructing straw lightning conductors, which were formed by fastening a wisp or rope of straw to a deal stick by means of brass wire, and capping the conductor with a copper point. It is asserted that the experiment has been tried on a large scale around Tarbes, eighteen communes having been provided with such straw conductors, only one being erected for every sixty arpents, or 750 acres, and that the whole neighbourhood has thus been preserved from the effects, not only of lightning, but of hail also. The statement comes from a respectable source, and the apparatus being extremely simple and inexpensive, it is at any rate worth a trial. Copper conductors are out of the question in ninety-nine cases out of a hundred, but every cottager almost could set up a straw one.

Wood-pulp for Paper Making.—One of the processes employed for preparing wood for paper-making, that of M. Keegan, is thus described in the *Revue de Chimie*:—The wood used is soft deal or pine, and it is sawn up into pieces six to twelve inches long and half an inch thick. The pieces should be all of the same size, but the smaller they are the more rapid is the operation. The pieces of wood are placed in a cylindrical boiler, which turns upon its horizontal axis during the maceration. In another boiler close at hand is prepared a solution of caustic soda, of about 20° strength; and this solution is introduced through a tube into the first boiler, which is presently closed hermetically, and the soda forced into the pores of the wood by means of a pump. A pressure of fifty pounds on the square inch is sufficient when the wood is not more than half an inch thick, and the injection is completed in about half an hour. When this is effected, the superabundant solution is pumped back into the second boiler for the next operation. When this excess of the solution has been pumped off from the wood, steam is let in between the double sides of the first boiler and the wood thus heated to about 310° to 370° Fahr. The wood is then washed in the ordinary way till the water runs off perfectly limpid. The half-stuff may then be converted into pulp either before or after bleaching, according to the quality or colour of the paper to be made from it.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

MACHINERY, ENGINEERING, AND CONSTRUCTION.

(*Continued from page* 857.)

III.—Wood-working Machinery.

No. 6047. Occupying the greater part of the space in Room II. of the Western Annexe of Machinery in Motion, the firm of Samuel Worssam and Co. exhibit an important selection of their specialities in wood-working machinery, comprising a Patent Roller-feed Circular Saw-bench, a Patent General Joiner, an Improved Trying-up Machine, a small 4-roller Moulding Machine, a Patent Parquetry Facing Machine, a large Hand Mortising Machine, a Patent Mitreing Machine, a Band-saw Machine, and an improved Saw-sharpener. The various uses of these several machines, and the manifold operations and work for which they are adapted are respectively illustrated by artisans who are daily engaged in the practical work of joinery in regular course. For example—their labours are directed to the manufacture of large advertising frames, and also of special lattice-work, employed in a patent process of concrete construction, exemplified in the grounds adjacent.

As might readily be surmised, the cutting up of large pieces of timber into smaller scantlings can only be carried out at this exhibition on the smallest, and not upon the largest scale; thus in the class of sawing machines Messrs. Worssam show merely a circular and a band-sawing machine. Their improved Patent Roller-feed Circular Saw-bench is characterised mainly by the self-acting mechanism of the feed-motion. A fluted or grooved feed-roller of considerable diameter and suitable length is fitted in a recess in the flat surface of the iron table, so as to project slightly; and its axis is set a little askew, so as to form a slight angle of deviation from the perpendicular to the saw and the fence, thus acting continually, in conjunction with the downward cutting action of the circular saw, to feed the timber forward, and press close up against the face of the fence; this automatic feed-motion is made variable by means of 3 cone pulleys, within the limits of a feed of from 20 to 40 feet per minute, according to the nature of the work to be done, while the circular saw makes over 1,000 revolutions per minute. The main standard or frame of the machine is all in one casting: the fence is carried on a socket on an axis fixed to the end of the table whereon it slides and swivels, being fixed with a screw; thus it is easily removeable and adjustable, a scale being marked on the table for the regulation of the width of cut; by means of slotted sectors the fence can also be adjusted to an angle for cutting at a bevel. Another special feature of this machine is that the saw revolves between wooden guides with a packing of spun-yarn, adjusted by screws. When the timber to be cut is long, carriages, which run on rails at each end, may be employed to support the projecting and overhanging end of the wood. The diameter of the circular saw is 36 inches, the depth of cut being 14 inches, diameter of pulleys 14 inches, and the average power requisite is 6-horse; the weight is about 25 cwt. upon dimensions 5½ by 3 feet. Two sizes larger are made, up to a maximum diameter of 48-inch saw, making 700 revolutions, with an average power of 8-horse, 18-inch pulleys, 20-inch cut, weight 33 cwt., and dimensions 7 by 3½ feet.

Differing from the foregoing straight cut, the sawing of curvilinear work of almost any kind is effected by the plain band-saw machine. In this particular machine (Fig. 1) the columns which carry the upper pulley and the table are cast in one piece with the foundation or bed-plate carrying the lower pulley in bearings suitably bolted down. The upper pulley is in bearings on a sliding block having a vertical traverse in slides by means of a screw and handwheel carried on a suitably pivoted and counterweighted lever: by this means the tension of the band-saw is regulated and maintained, in compensation for the effects of contraction or expansion. The endless serrated steel ribbon or band-saw (Perin's) passes between guards or guides, to prevent buckling, and the material to be operated upon is manipulated in various directions about the saw, according to the configuration desired. For sawing bevelled work, the table is made adjustable, with a motion in one direction only, by means of slotted segments, &c.

A machine which presents a marked improvement on preceding and existing manual processes, is the Saw-sharpener (Figs. 2, 3), whereby the use of a file is superseded. A rapidly rotating disc or wheel of consolidated emery is carried upon a counterbalanced arm, so that it may be raised and lowered as needed by the operator, and angle adjustments are provided whereby the disc can be presented and brought into contact with the saw-teeth to be sharpened at any desired angle according to the forms of tooth, and for bevelling, topping, gulleting, &c. Circular saws are carried upon a suitable vice, and a different vice is employed to hold mill-saws or straight blades. This is a long vice with compound table affixed to the forepart of the machine, and capable of adjustment in position as requisite. The emery wheels or discs are not costly, and may last on the average about two months in full work. The machine requires about half a horse-power to work it, at a speed of 450 revolutions per minute, the pulleys being eight inches in diameter; total weight about half a ton. It is estimated that the saving of labour thereby is five-sixths. It may be noted that for the band-saws a special sharpening-frame and vice is required, with pulleys and screw adjustment for manual setting, this machine being inapplicable.

In the Improved Trying-up Machine, scantlings of hard or soft wood are placed for trying or trueing up, so that the finished surfaces may be perfectly smooth and truly parallel planes, however much twisted or warped the scantling may have been. This machine has a travelling cast-iron table, whereof the surface is perfectly level and true, supported on suitable slides on a fixed frame or standard, and caused to reciprocate to and fro beneath the cutting apparatus on fixed slides in the frame, whereof one is plain and the other only is V-shaped. The table is fitted with screw-clamps at intervals of 3 feet, and the material to be worked is thereby clamped down on to the table, small wedges being inserted to fix it wherever the lower rough surface may be untrue or "in winding," so as not to be in close contact with the surface of the table. The feed-motion is self-acting, and consists of a step-rack on the underside of the travelling table, with duplicate pinions engaging therein; by this arrangement, the rack being in two parts set side by side with the teeth of one against the intervals of the other, a very regular and uniform motion is obtained. The

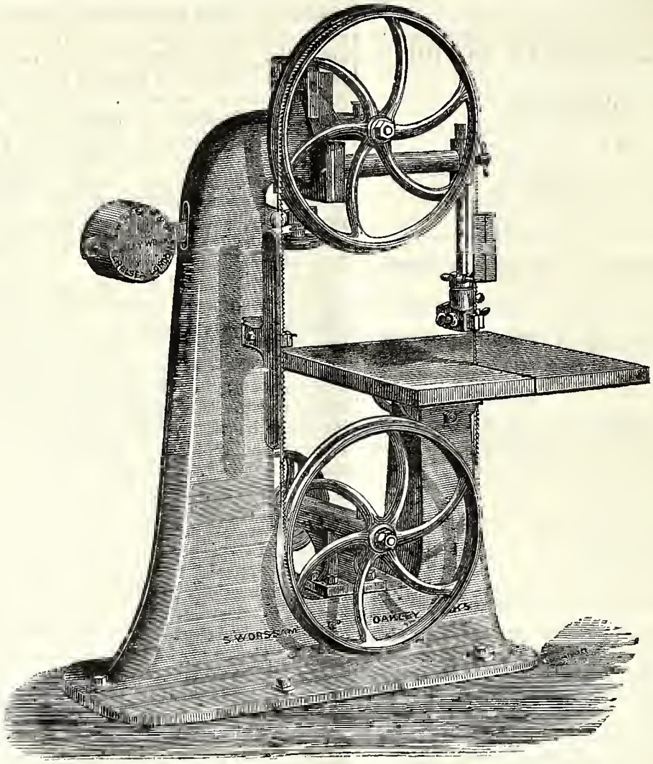


FIG. 1.—WORSSAM AND CO.'S BAND-SAWING MACHINE.

feed-speed is about 15 feet per minute for the forward motion during cutting, while there is a quick return motion of about double, or 30 feet per minute. The trying-up is effected by the rapid revolution of four cutters affixed to an adze-block, the cutter-edges being plain and straight throughout their length, which is transverse to the table; the cutter-block is borne in a carriage having a vertical traverse on slides slightly inclined in the side-frames; and the carriage is adjustable by means of a handle worked in connection with two side screws, whereby the height of the adze-block above the bed may be regulated to suit the thickness of the scantling. The cutter-block carriage is also provided with two pressure rollers, for keeping down the stuff when the cramps are not needed. The cutters work in conical centres, which keep true, are adjustable to take up wear, and work very easy. The smallest size is to work scantlings up to 1 foot in width, the length of the table being 12 feet, diameter of pulleys 12 inches, and the speed of the countershaft 650 revolutions per minute. The machine weighs about 2 tons, and requires 2-horse power. The largest size weighs

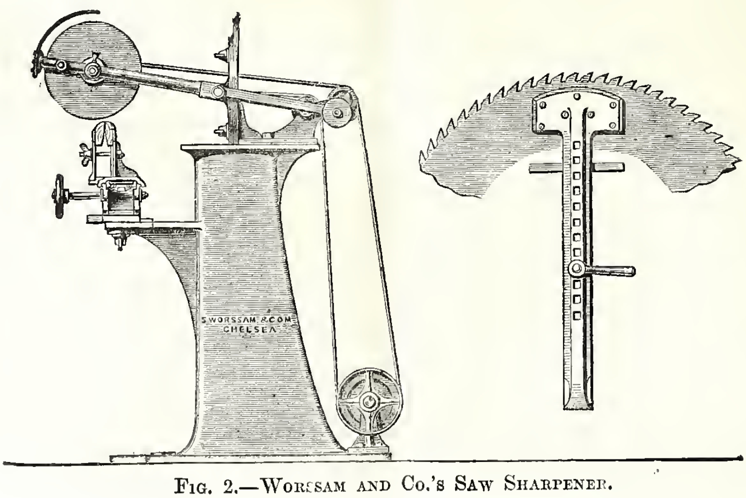


FIG. 2.—WORSSAM AND CO.'S SAW SHARPENER.

6 tons, requiring 5-horse power, speed 600 revolutions, 16-inch pulleys, the length of table being 15 feet, and adapted to work scantlings up to 2 feet in width.

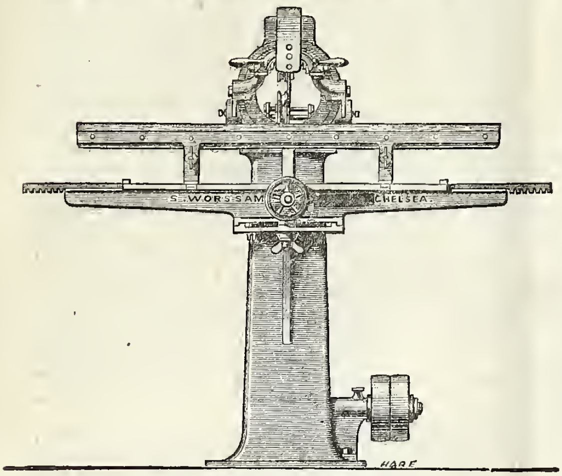
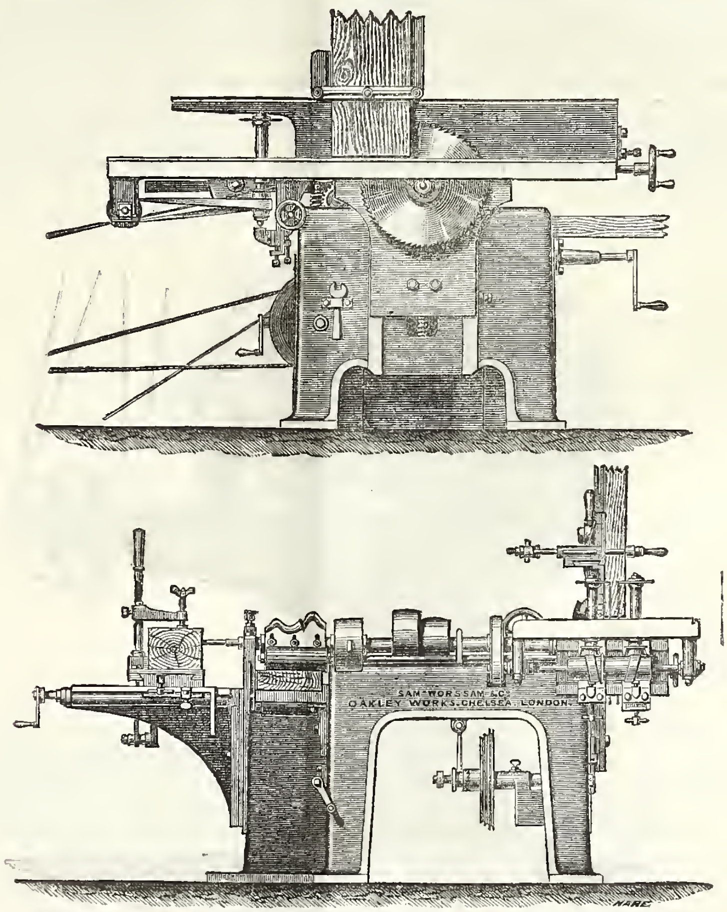


Fig. 3.—Worssam and Co.'s Saw Sharpener.

Messrs. Worssam's Patent General Joiner, as illustrated in the accompanying engravings (Figs. 4 and 5), is devised to supersede six separate machines, namely, saw-bench, tenoning, moulding, mortising, boring, and curvilinear machines, all these operations being effected by this single machine, without necessity for alteration, and, so to speak, simultaneously. All the varieties of work usually done by manual labour in a joiner's shop may thus be performed mechanically, such as sawing, with or across the grain, wedge-cutting, chamfering, mitreing, single or double tenoning, planing, straight or curved moulding, beading, rebating, grooving, tongueing, mortising, boring, &c. It is compact and self-contained, the frame requiring simply to be bolted down or otherwise secured to the floor. Its weight is about 35 cwt., the driving pulleys are 12 inches in diameter, the countershaft has a speed of 600 revolutions, and the power requisite is 6-horse. There are two motions for varying speeds of saw-spindle, and high-speed motion for mortising and boring. The saws are circular, varying from five to 26 inches in diameter. The fence is, for various purposes, so arranged as to be capable of adjustment to almost any desired angle, and is worked parallel to the saw by means of square-threaded screws, in gun-metal nuts. It can be readily removed when cross-cutting is required. In the operation of tenoning the tenons are completed at one operation, by two vertical and two horizontal saws. The tenoning spindles receive motion direct from the main saw-spindle, without a separate intermediate, and they may be fitted with saws, or cutter-blocks and cutters. The stuff which is to be tenoned is held vertically instead of horizontally, and the tenoning clamp is so fitted



Figs. 4 and 5.—Worssam and Co.'s Patent General Joiner.

and arranged that the material can be quickly secured or released, and readily gauged. The planing and moulding apparatus is adapted to work up to dimensions of 9 by 3 inches, with automatic feed, at the rate of about 25 feet per minute, which is capable of being graduated and adjusted to a rate suitable to the material operated upon. This planing and moulding is effected at an independent table. For circular mouldings there is a vertical spindle fitted with suitable cutters and a guide-pin. The mortising apparatus is fed up to the cutter by means of a hand-lever, the table being provided with suitable stops for regulating the dimensions and depth of the mortises, which are chased, *i.e.*, made by a boring tool, and not with a chisel. All the needful appliances for the foregoing are provided, namely, mortising tools, moulding and planing irons, cutter-block for curvilinear work, tenon-shoulder apparatus, false fence, tenoning slide and gauge, cross-cutting plate, feed-rollers, &c.

For the operation of grooving a special appliance is provided, viz., the "drunken-saw" apparatus, whereby grooves of from 1-8th of an inch to $1\frac{1}{4}$ inch in width can be cut. The circular saw is simply set slightly out of the perpendicular, whereby, when in rapid revolution, a "wobbling" motion is generated. For this purpose it is fitted with two cylindrical shoulders at the axis, a kind of roller bearing, and is adjusted and set by screws. The table is raised and lowered by means of a screw-motion and handle, whereby the depth of the saw-cut for the groove is varied and regulated as may be requisite.

The small 4-cutter Moulding Machine is adapted for cutting mouldings, and for light work; or with suitable cutters it can be made available for planing stuff of various kinds. The material to be operated upon is fed through the machine at a rate which may be varied from 12 to 40 feet per minute. The machine is fitted with top and bottom and two side cutters. Side-springs on the surface of the table are arranged to press against the stuff, and keep it in position, while a reverse moulding may be fitted on the top as a saddle, and being kept down by a spiral spring prevents the wood from springing. The smallest size is a 4-horse power machine, about 15 cwt. in weight, adapted for working stuff up to dimensions of 4 inches in width by 2 inches in thickness, the diameter of the pulleys being 10 inches, and the speed of the countershaft 900 revolutions per minute. A 3-horse power machine, for material up to 7 inches wide by 3 inches thick, weighs 20 cwt., and has pulleys 12 inches in diameter. For material up to 9 inches by 3, the pulleys are 13 inches in diameter, the speed of the countershaft remaining the same, viz., 900 revolutions per minute, the total weight of the machine being 25 cwt., and requiring about 4-horse power. The feed-rollers, as will be seen, are carried on a weighted lever, so as to exercise an adequate pressure, while being adjustable in height. The larger machines of this class are of a special construction, adapted to cut single or double mouldings of various patterns, either in hard or in soft wood; also to plane, groove, tongue, edge, thickness, and bead, match-boarding or flooring; the rate of feed and revolutions of countershaft being as above stated, capacity up to 12 by 4 inch stuff with about 6-horse power.

The machine for surfacing Parquetry work for flooring, &c., is shown in the accompanying engravings (Figs. 6 and 7). The parquetry work is firmly attached to the face of a large flat metal disc, which is caused to rotate at a sufficiently high speed; while the cutting apparatus is traversed in front thereof, from the periphery to the centre, by means of a screw-motion; the feed is automatic and provided with stops. The cutting tools are carried on slide-rests aligned with the centre of the disc, with appliances for adjustment, so that they may be caused to approach to or recede from the parquet surface. The tools consist of a gouge, which makes the first cut, and a diagonal serrated chisel or cutter, which completes the surface with a high degree of finish.

All the foregoing machines are power machines. Messrs. Worssam also exhibit two hand-machines, as

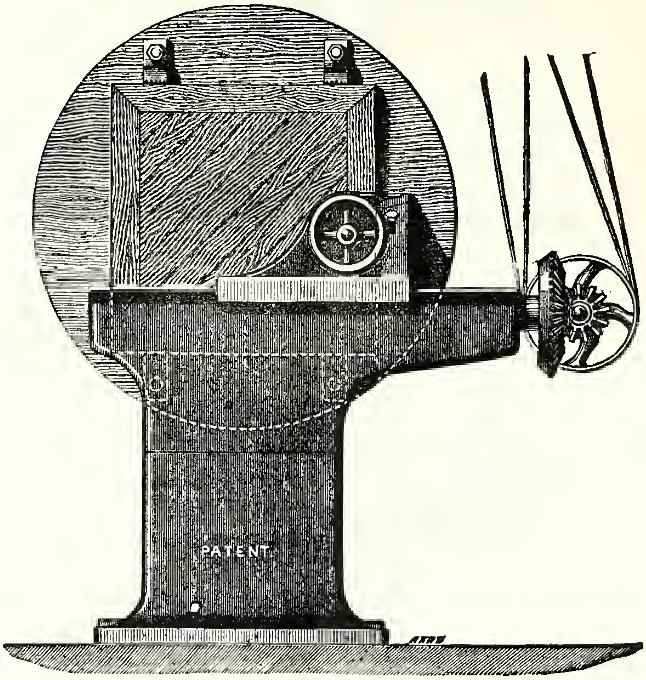


Fig. 6.—Worssam and Co.'s Parquetry Machine.

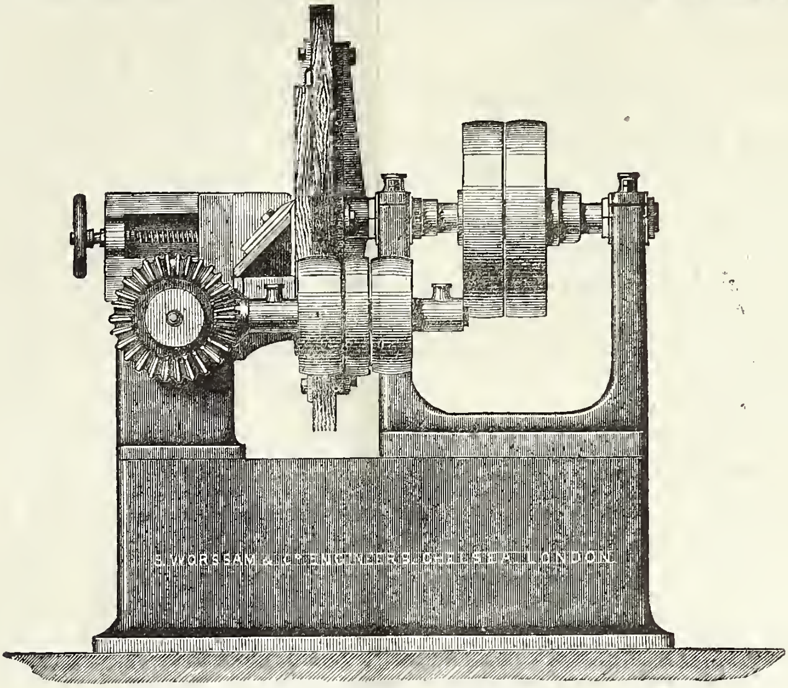


Fig. 7.—Worssam and Co.'s Parquetry Surfacing Machine.

follows:—In the Hand Mortising Machine the material is clamped in position on a moveable table, with double traversing motions, whereby the mortises may be adjusted in position and regulated in dimensions according to the requirements of the work. The power is applied to the sliding-bar and mortising chisel by means of a counterbalanced lever, pivoted on the vertical standard, and connected therewith by a link, giving it a parallel motion. In addition to the set of mortising chisels, the machine is fitted with a core-driver, a tenoning tool, an auger, a boring apparatus, with hand-wheel and bevel gear, whereby the rotary motion is generated and

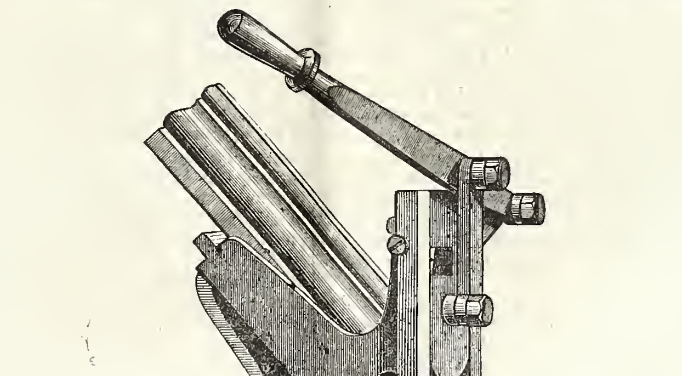


Fig. 8.—Worssam and Co.'s Hand Mitreing Machine.

applied, simultaneously with the downward pressure which gives penetration. The larger sized machine weighs about 6½ cwt., and is constructed to work with chisels up to two inches in width; the smaller sized machine weighs only 4 cwt., and of course is less powerful.

Messrs. Worssam's Patent Hand Mitreing Machine is shown in Fig. 8. The material to be mitred is placed in the frame on an inclined shoot or bed, at an angle of 45 degrees from the vertical, below the cutting knife, which has a square or round edge, and works in vertical slides. The power is applied to actuate the knife by means of a hand-lever, set across the machine, pivoted on the standard, and connected with the cutter by an intermediate link, giving a parallel motion, similar to that described in the hand-mortising machine. The machine, as will be seen, is quite portable, and can be removed and taken wherever it may be required for work. It is adapted for the use of joiners, picture-frame manufacturers, and others, for mitreing panel and frame mouldings, and the like.

In reference to Messrs. Worssam and Co.'s exhibited machines as above described, it may be noted that the visitors to the Exhibition are enabled to see them in action, and examine their construction and operation, exactly as in use for joinery and building works; the room being, for the time, a joiner's shop, and the work done being actually utilised for various frames, doors, panels, &c.; more than 12 tons of timber having been thus cut up and wrought to correct dimensions, and so converted into first-class building material intended for future employment in construction.

Mr. William Tighe Hamilton has a single woodworking machine in the Exhibition, of recent introduction, which presents some novel and remarkable mechanical features. This is a Patent Dovetailing Machine, combining a new reciprocating movement. In it a single rotating circular saw is applied to the cutting of wedge-shaped pieces in wood or other materials, the saw being peculiarly mounted, so that in rotation it swings to and fro in planes which have a common line of intersection in one diameter of the saw. This diameter, in the case of cutting dovetails, is vertical, but horizontal for cutting the pins to correspond; and the mode of mounting the saw constitutes such an arrangement of parts as is tantamount to an universal joint of a special kind. The sizes of the wedge-shaped pieces are controlled and regulated by a particular device for generating a reciprocal motion, whereby the planes of the saw are caused to intersect in other lines than those that pass through the centre of the axle; and further there is a special contrivance for the purpose of maintaining the plane of the saw in its proper and desired position, consisting of a guide-plate, fitted with a back-block which works in a slot, or its equivalents, two lugs pivoted over the centre of motion, or wings working in slotted appendages attached to the head-stock.

As in all machines of this class, the operating tool—in this case the saw—duly mounted on a frame or standard, is fixed in position, and the material to be operated on is carried, and, if requisite, fixed on a moveable table, provided with feed-motions in three directions, having suitable vertical and horizontal traversing mechanism.

The axle, which carries the saw, is horizontal and mounted in bearings, but has a limited range of reciprocal or endwise motion while rotating. The outer end of this axle is fitted with driving gear, belt with fast and loose pulleys, or toothed wheels; and the inner end, whereon the saw is carried, is slightly bent or cranked at an angle to its axial line corresponding to the obliquity of the dovetails: the central line of the axle intersects that of the cranked part, or crank-pin, at its middle point. A sleeve-shaft, kept in position by two collars, is mounted on the crank-pin, so as to be free to revolve thereon, and has two exterior opposite sides flattened, and the other two bevelled off from its centre to both ends, so that one section is rectangular and the other that of a truncated double cone. A circular boss, having a central axial orifice corresponding to the flattened section, is mounted on the sleeve by pivots or gimbals, or by trunnions cast on the sleeve-piece, so that it may swivel freely on the double cone, *i.e.*, in one direction only; and the line of the pivots passes through the centre of the crank-pin, and is coincident with the central lines of the crank-pin and the main axle. Mounted on and revolving with the boss, is a flanged hoop or strap, carrying the saw, and kept in place by the flange, and by a plate, carrying an arm projecting beyond the edge of the saw, so as to act as a guide-bar, and terminating in a guide-block at right angles to the plate, working in a slot in a fixed frame or arm, which is mounted on a head close to the inner axle-bearing, concentric with the axle; the slot is thus always parallel to the axle, and the frame can be made to describe a quarter turn on the axle, against a slotted quadrant affixed to the bearing, being secured by a set screw thereto, so that the plane passing through the axle and slot is either vertical or horizontal; in the former case, the plane being vertical, the action of the guide-block in the slotted arm will maintain the rotating saw in planes intersecting in a horizontal line, and *vice versa;* in the latter case the intersection of the planes will be vertical. Thus, as the axle rotates, the crank-pin, turning in the sleeve, compels the saw-hoop and saw to swing to and fro in their revolutions in intersecting planes, as described. If the plane of slot and axle be placed horizontal, a mortise or dovetail will be cut in the end of any board to which a vertical traverse is given up the face of the saw opposite to the slot; the plane of slot and axle being placed vertical, and the board traversed horizontally endwise towards the saw, the recess cut will become the interval between two pins or tenons—with a certain modification effected by the reciprocator. This modification is to be attained by imparting to the rotating axle a reciprocating motion in the direction of its length; and, at the same time, this expedient is available for controlling and regulating the cut so as to obtain dovetails or pins of any required dimensions.

The reciprocator is a sleeve with a projecting arm, mounted on the axle at such an inclination as may be required to give sufficient motion to the slotted arm to generate the required amount of throw; but it is to be noted that, in its extreme position, this inclination must be in the opposite direction to that of the plane of the saw in its extreme position, *i.e.*, the saw and reciprocator must incline to or from each other in their swing or variation. The throw thus imparted to the axle will thus proportionally counteract the sweep of the front or cutting portion of the saw; whereby in effect the intersection of the varying planes of the saw will no longer be a line passing through the axle, but will be shifted forward to a parallel line at any desired part of the saw-blade towards its preriphery, which, when cutting dovetails, will be in front of the axle, and when cutting pins, above or below the axle, as the case may be. By a suitable alteration in the adjusting screws of the reciprocator, its deviation from the vertical may be varied, and therewith is obtained a power of regulating the cut, and of mutual adjustment for dovetails and the corresponding pins of any required size.

By a modification of the apparatus, the mode of cutting dovetails or mortises may be combined with and effected by a horizontal feed or traverse of the feed-table and the material to be operated upon, affixed thereto, *i.e.*, towards the saw. As the reciprocator acts upon the sliding slotted arm, which guides the block attached to the saw, by means of a stud thereon through which the projecting arm of the reciprocator passes, it is obvious that the lateral motion of the axle may be effected not only by a fixed stud and a variable inclination of the reciprocator, but also by a fixed inclination and a stud made variable in its distance from the axle, by the provision of

suitable sliding and gearing mechanism, acting upon the stud, which, at the same time, may be made automatic by connection with the feed-motion of the table. Thus the stud will approach the axle *pro rata* as the table and board approach the saw; and, the cutting operation being commenced when the line of intersection of the saw-plane is about where the saw enters the wood, *i.e.*, with the reciprocator at its extreme throw, the effect will be that the cutting parts of the saw, or rather its range of cut, will be made to expand, as it were, with the forward motion of the object operated on, and contract with its retrogression, leaving the dovetail-mortise cut to a corresponding depth. The stud in this case is connected, not directly to the slotted arm or frame, but to an intermediate slide moving in guides on the frame, the reciprocator being permanently fixed in its extreme angular position. Then, as the distance of the stud from the axle is diminished, the range of endwise movement of the axle is correspondingly contracted; the action of the saw on the cranked end of the axle will thereby be varied, so that, whereas on entering the wood the saw-edge passes always through the line of entry, or nearly so, it would have a reciprocating motion at the bottom of the cut, the line of intersection of the saw-planes having receded thus far on the saw-blade from its edge. The stud may also be located in front, in lieu of at the back of the axle, being fed along with the table, with the same effects, provided that the reciprocator and the saw have similar instead of opposite inclinations, *i.e.*, are parallel. Under all circumstances the quarter-revolution of the saw and saw-planes must be accompanied by a similar change in the position of the reciprocator, which may be effected by mounting the stud or reciprocator, so as that they may be carried round through a like quadrant, being fixed in the two extreme positions by means of set-screws; the principle being that the saw and reciprocator must assume their extreme inclinations, like or opposite, simultaneously.

There are various equivalent forms of construction, claimed by Mr. Hamilton, producing like results. For instance, the reciprocator may consist of a strap and rod, revolving on a crank-pin (similar to that above described, carrying the sleeve-piece and saw), whereon a shank passes into a collet-hole at the outer extremity of the axle so as to revolve within it, and being fixed by set-screws and a quadrant, as convenient. Also in lieu of a crank at the saw, the axle-end may be straight and carry a boss, pierced diagonally; at the proper angle for the shaft revolves a a strap, kept in place by end-plates, in lieu of the sleeve and gimbals, or trunnions upon the diagonal boss, the other parts remaining the same. Or the saw may be mounted on a ball and socket or universal joint, and the back-plate and block connected by a link with another reciprocator mounted on the axle, so that the swinging or "wobbling" motion and action are generated thereby.

The peculiarity and effect of this variety of motion and mechanical action, though singular, is simple enough to look at, but requires to be seen to be properly appreciated.

(*To be continued.*)

To induce artisans and others to visit the Exhibition for the purpose of gaining technical instruction, the charge of admission has been reduced to 3d. each person on Mondays, Tuesdays, and Saturdays, being the free days of the South Kensington Museum. The Exhibition will close on the 31st of October.

The following is the return of admissions for the week ending Monday, August 29th:—Season tickets, 975; payment, 7,251; total, 8,226.

One of the American railway journals has calculated that in the year 1880 there will be 100,000 miles of railroad in the Republic. The total has already reached 70,000 miles

EXHIBITIONS.

PARIS EXHIBITION OF FINE ARTS APPLIED TO INDUSTRY.

The *Academy* for last week contains two articles on the exhibition recently opened under the auspices of the "Union Centrale des Beaux Arts appliqués a l'Industrie," by M. P. Burty and Mrs. Bury Palliser. As these may serve to supplement the notice in last week's *Journal*, some extracts are given:—

This exhibition may be divided into four parts: in the nave are shown the highest class of art manufactures, such as porcelain, furniture, bronzes, stuffs, &c.; in the galleries on the first floor are exhibited the productions of the schools of design throughout France; next to these, illustrations of costume from the earliest period up to the end of the eighteenth century; on the opposite side the State manufactories of Sèvres, of Gobelins, and of Beauvais, exhibit their most recent productions in china, carpets, and tapestry.

The only part as yet entirely finished is the room containing the productions of the national manufactories.

After the International Exhibition of 1851, and the report written thereupon by M. de Laborde, a general conviction was felt that art must henceforth be regarded as the greatest power in the service of industry; every nation therefore determined to master these sources of our own long established pre-eminence.

After the second International Exhibition in 1862, Prosper Mérimée, the reporter of the French section of the International Jury, published an appeal which originated the project formed by a few independent citizens of organising, in place of the Government, this association for the application of fine arts to industry.

In 1863, a few of the principal manufacturers of lace, bronzes, paper-hangings, carpets, furniture, and jewellery met together, chose for their president M. E. Guichard, and subscribed the amount necessary for setting the scheme afloat.

The association set up its library and its germ of a museum at No. 15, Place Royale. It was soon joined by many artists, critics, and amateurs, who, in exchange for their subscription of 100 francs per annum, received the title of co-founders, and the permission to use for three years the collections and library of the institution. The museum received contributions of but trifling value, and want of funds prevented its increase. The library was more successful. Critics presented it with books on art, manufacturers with patterns, reviews with series of numbers, the Ministers of Public Instruction and of the Fine Arts with their great official publications.

Evening lectures by distinguished men on special subjects attracted a small audience, chiefly composed of the middle classes. When the subjects were of general interest, and treated in a popular manner, as in the lectures by M. Charles Blanc on Æsthetics, they were received with great applause. When the courses were technical they were delivered to empty benches.

The great success of the association, the means by which it has acquired its real importance, was in the establishment of exhibitions.

When first invited by the association to contribute, the specimens of the schools of design from all parts of France were so feeble, so ridiculous, they outraged to such an extent every rule of art, that there was a general cry of horror. It was then that for the first time the depth was measured of the abyss into which we had fallen since the end of the eighteenth century. The great Revolution, when it broke up the old guilds on the ground that they interfered with individual liberty, instituted a new order of things which the tyranny of the First Empire prevented from assuming a definite form. Art when it became a part of the official administration

no longer reached the mass of the people, its models lost all originality, and were satisfied with following the last fashion and the last book. First came the style of the Empire with its consular fasces, then that of the Restoration with its imitations of knights and troubadours, followed by the style of Louis Philippe with its Romantic mouldings. In this deplorable confusion there was lost the tradition of thorough professional teaching, which constituted our strength in former times.

Our exhibitions of works from the schools of design have not as yet solved this great problem of modern time, but they have encouraged its study by demonstrating its urgency. They have roused the old teachers. They have occasioned the foundation of new or the radical reformation of old schools of design in the great industrial centres, such as Lyons, Limoges, &c. They have stimulated a demand for new models less feeble than those which the scholars were made to copy literally, just as they were forced to learn by heart antiquated maxims without life or spirit. The progress made has been evident and marvellous. The difference between the specimens of this year and those of 1869 is really wonderful.

The committee has also instituted competitions. Prizes are given to the artists or manufacturers who have best solved certain difficulties. Practically, no great results have been obtained.

Although the chief attraction for the public consists in the retrospective exhibitions of this society, its real benefit is derived from the exhibitions of contemporary productions. In these we see the effects of the direct impulse which has been given.

The society has been joined this year by some important members in a social point of view. M. Barbédienne, whose beautiful bronze reproductions are well known, and M. Denière, President of the Chamber of Commerce in Paris, have each hired a large space, which they intend to adorn with their finest works. This practical adhesion of the higher commerce needs no commentary.

Another great fact is the reception of the productions of many artistic tradesmen who did not choose to send their works to the International Exhibition at Vienna. Among them are M. Froment Meurice, a jeweller whose reputation is European, and the brothers Fasinières, bronze-workers of the first-class.

A great proportion of the cases are filled with pottery. Here, too, a great progress is perceptible. It is a pity that we cannot compare the beautiful productions of the brothers Deck, for instance, with those of Minton. But the brothers Deck have at the present moment formidable rivals in France. Lastly, our State manufactories exhibit their produce side by side with that of private firms.

Mrs. Palliser deals with the retrospective exhibition of costumes, with regard to which she gives the following particulars:—

The classification employed is geographical: Japan, China, and the extreme East being placed in the rooms on the right, the American peninsula on the left, Europe in the centre. Six rooms are assigned to France, corresponding to the different historical periods. The Gauls, Franks, and Carlovingians are in one room; then follow the different centuries to the Renaissance, and the Valois Kings to the Bourbons, Louis XIII. to Louis XVI. All the rooms are hung with tapestries illustrative of the various epochs. In the room devoted to the sixteenth century there are few contemporary vestments, but an admirable collection of paintings and embroideries with costumes. Two curious oval pictures in needlework represent, one a stag hunt, the other bear-baiting, in which latter Diane de Poitiers is to be seen extending her staff, desiring that an unfortunate dog should be rescued from the hug of the bear. Another, already exhibited by M. Jubinal in the South Kensington Exhibition of Art Needlework, has for subject the visit of Henry III. and his queen to a lady for whose infant she is to stand sponsor. In this, and two others of similar date the costumes are perfect, as also in the needlework back and seat of a large sofa in its original plainly turned wooden frame, the ladies wearing enormous Medicean collarettes, the men the padded hose. A curious doublet is here shown, of steel plates, covered with brown velvet, evidently used for protection against assassination. A charming terra-cotta statuette, the dress heightened with gold, gives the costume of an Italian lady of the Renaissance. The ecclesiastical vestments in this room are very rich. A crimson velvet cope, embroidered with seraphim, fleurs-de-lys, and eagles; one of black and gold, of similar design and a kind of green velvet; one of blue satin, with rich Italian scroll border, the pattern cut out and applied in yellow and white satin. In the centre of the room is a group of armour, and the cases are filled with smaller objects of jewellery, enamels, and metal work.

The room of Louis XIII. is again remarkable for the costumes, pictures, and busts illustrative of the period: among others a series of paintings, with subjects resembling the engravings of Abraham Bosse, but totally devoid of the costumes themselves. Here, too, is a most splendid set of furniture for a bed, of the richest tapestry, partly executed on the frame, partly by the needle. In the scalloped vallance, figures are introduced into the pattern.

The Louis XIV. room is hung with tapestry, representing the appropriate subject of the King's visit to the manufactories of the Gobelins, conducted by Colbert Other tapestries on the top of the stairs, representing various incidents of his reign, are admirable for the costumes; but it is much to be regretted that so few of the actual garments have been forthcoming. There are none earlier than the eighteenth century, and none of historic interest.

The eighteenth century brings us to the time of Louis XV. and Louis XVI., when the extravagance of dress was at its climax. This is the only period which is not scantily represented, and nothing can surpass the magnificence of the men's dresses, of the richest velvets, flounced silks and satins, embroidered with massive gold and silver, pearls, and tinsel (clinquant) of brilliant metallic hues, or of the ladies' sacs of equally rich satins and silks. It is a pity some "dummies" could not have been dressed, to exhibit these coats, waistcoats, &c., to full advantage; but the difficulty has been in procuring the head-dresses corresponding to dates, and the unwillingness to exhibit in order to complete the costume of any vestment not in its original state.

Supplementary to this series is a room assigned to the collection of ancient textiles, formed by M. Dupont Auberville, whose fine historical collection of lace calls forth so much interest in our International Exhibition of this year. His textiles range from the tenth to the eighteenth century. In those of the tenth and eleventh the patterns are so effaced by age that a tracing is given by the side of each. Next follow the Italian tissues of the thirteenth and fourteenth centuries, of Asiatic type, the patterns consisting of animals opposite each other (affronted) in silk and gold. The fifteenth still preserves the Oriental style, velvets woven with gold and silver, silk brocatetta copied from the looms of Constantinople. The beginning of the sixteenth century exhibits a magnificent cope of cloth of gold—such a tissue as may have been worn by Henry and Francis on the field of Ardres. Then, with Henry II., a transition takes place; the patterns are small and geometric, silks for female costume, striped velvet for the padded hose. M. Dupont exhibits a short velvet mantle of the time of Henry III., *à crevés*, as it was called, from the perforated holes which formed the pattern and showed the doublet of silk underneath, and a fragment of the dress of Margaret of Valois, sister of Francis I. In the seventeenth century the manufactures of Lyons and the "gros de Tours" appear, creations of Colbert; large patterns of trees, pomegranates, &c. With Louis XV., the Chinese taste came in, pagodas, bridges, boats, China men and China women. Then follow the ribbon or

"rivière" patterns, succeeded by medallions, which continue on to the Consulate and the Empire.

In the centre of this room is part of the vast collection of shoes formed by M. Jules Jaquemart, so well known by his brilliant aquafortis engravings, the "poulaines" and square toes of the sixteenth century, the raised "patins" of the Venetian ladies, "talons rouges" of the eighteenth—shoes in every variety. The series is continued in the Oriental room, and here the shoes of the Empress of China figure among the most diminutive. M. Jubinal contributes a collection of gloves.

The Oriental room is highly interesting. The Chinese dresses mostly bear the imperial insignia of the five-clawed dragon, yet cannot all have belonged to the emperor himself, the yellow always excepted—probably the members of the imperial household are allowed to wear this distinctive pattern. The Japanese costumes are even more splendid and also of the richest colours, some of them bearing the armorial insignia of the nobles of Japan. One of blue satin has the sacred "tailed" tortoise embroidered all over in gold. A white dress has the imperial insignia of the "guikmon" or chrysanthemum; another, black, is covered with the bat and other fantastic animals; and a yellow satin is sprinkled with fans. There are some fine pieces of Chinese embroidering on satin of the time of Louis XIV., one representing Pousa, the god of contentment, with the peach of longevity in his hand. Another Chinese divinity has the avis deer, also emblematic of long life, by her side. The central case is filled with curious objects from China and Japan; a series of Japanese theatrical wooden masks of extraordinary lightness, the different expressions of the countenances wonderfully given, Japanese dolls, armour, grotesque helmets, and various other curious objects of Oriental workmanship.

Another room contains the costumes of Greece, with the leathern embroidered jacket of Wallachia, Hungary, Egypt, &c.; another the costumes of Spain and Mexico, rich in gold and silver, but these divisions are not completed, and it will be yet some time before the whole is finally arranged and ready for the catalogue of its contents.

It is a most novel and interesting exhibition, and reflects great credit on its originators and on the exertions of the members of the Union Centrale in bringing the collection together, and in having turned to the best advantage the resources at their disposal.

CHANNEL PASSAGE.

The project to construct a tunnel between France and England, says *Iron*, is assuming a practical phase. The capitalists and engineers embarked in this gigantic enterprise demand a concession of thirty years instead of the ninety-nine usually accorded to railway companies, and ask for neither guarantee nor grant. Further, they are ready to advance a sum of four millions for preliminary investigations. The project in question consists in the immerging of a duct on the English and French coasts, and the boring of two long galleries from each side. The soul of the enterprise, with MM. Michel Chevalier, Leon Say, and Rothschild, is M. Lavalley, an engineer who has surmounted the greatest difficulties in the construction of the Suez Canal, and without whom this gigantic enterprise could not have been accomplished. M. Lavalley estimates the cost of the work at 150,000,000 francs. The English engineers think it will amount to 250,000,000 francs. He suggests that this work should be done partly by France and partly by England, and that to induce the two countries to press on this undertaking energetically there should be a bonus for the one which works the fastest. The 4,000,000 francs forming the preliminary capital are nearly all, it is said, subscribed.

WASTE WATER METERS.

As the question of constant water supply is one that has now been for some time before the Society, and as the provision of some means of measuring the waste of water is an important requirement under any system of constant supply, the following report, submitted to the Liverpool Town Council by Mr. F. J. Bramwell, C.E., F.R.S., and having for its subject Mr. Deacon's Waste Water Meter, may prove interesting to many members of the Society:—

Sir,—In accordance with a resolution passed on the 9th March last at a meeting of the Water Committee I have examined into the matters thereby submitted to me, and I now beg leave to report to you as follows:—

The subject under consideration—"the prevention of the waste of water"—is one to which I have paid much attention (especially in reference to the regulations for the water fittings of the metropolis), and I have always looked upon it, and I still look upon it, as one of a very important character, and also one which is surrounded by many and varied difficulties.

Even in the rare case where a town has a practically unlimited supply of water it is most undesirable that it should be wantonly wasted, not only because the habit of waste is bad in itself, but also because the consumption of such a town is referred to as a sort of standard in the case of other towns where waste is going on, and where, in all probability, it cannot be so well afforded, and the authorities of these towns seek to justify themselves by showing that the expenditure of water cannot be very bad, because, after all, their consumption per head is far below that of the particular town where an almost illimitable supply has engendered the practice of gross waste.

In the generality of towns there is not this practically unrestricted supply of water, or, even if there be, it has to be distributed at the cost of engine power, and thus, as a rule, waste is a most serious matter. It stints the supply for the fair and reasonable wants of the consumers —as well the honestly careful as the wickedly careless. increases the cost, and thus either adds to the rates, where the water supply is in the hands of the Corporaation, or diminishes the profits where it is vested in a company; under such circumstances waste is felt to be an evil that cannot be allowed to continue, but must be put a stop to by some means.

One means—and a means which only too readily occurs to the mind of the engineer in the case of a town using the constant supply—is the doing away with that constant supply, and the reverting to the intermittent service.

The intermittent service can be speedily reverted to; it costs nothing in original outlay (although it is a source of current expense), and it goes a long way towards attaining the end sought, viz., that of preventing the waste of water.

But this mode of attaining the end is, in my judgment, a greater evil than is the waste itself.

I believe a constant supply to be, on sanitary grounds, a necessity; and on the grounds of economy and simplicity of management I believe it to be the most desirable.

With the intermittent service the water must be stored in cisterns. These, even in houses of considerable rental value, are very frequently placed in positions where it is difficult to obtain access to them for the purpose of cleaning, and they are also frequently so arranged that the foulest gases from closets and drains are brought into contact with the water. The constant supply does away with all these objections, and the water may be obtained for all drinking and culinary purposes direct form the mains, cool, fresh, and uncontaminated.

While many cities and towns (including places of such importance as Manchester and Sheffield) are in the full enjoyment of a constant supply, I look upon it as a

perfect disgrace to the metropolis that it is still, with but rare exceptions, suffering under the evils of an intermittent service; and I fear that the fact of Liverpool having, on account of the waste of water, changed from the constant supply to the intermittent service, has afforded considerable aid to those who in the metropolis advocate that service.

But although the reverting to the intermittent service is the (unhappily) obvious way of preventing waste, it is not the only way, and it is not the way that would be adopted by those who fully appreciate the full benefits of an uncontaminated water supply, and who are prepared to encounter much vexatious labour to set right that which is wrong. Such persons prevent waste by getting rid of defective fittings, and by putting an end to all grossly negligent manners of dealing with the water.

But, under ordinary circumstances, this method of putting a stop to waste is a most difficult and arduous one. It involves a "house to house" visitation—a tedious work, and a work attended with great cost. Moreover the careful man, who keeps his fittings in good order, and deals with the water fairly, is annoyed at having an inquisitorial visit paid to him, and he is apt to feel that his care and attention have been bestowed in vain; for they have not saved him from being an object of suspicion, and from incurring the same treatment as is applied to his reckless neighbour. It is, therefore, on the score of expedition and cheapness, and, above all, on the ground of not offending the careful consumer, most desirable that there should be some means by which it may be determined whether or not a visit of inspection is necessary.

It has been sought to obtain preliminary knowledge in Liverpool and elsewhere by applying some kind of ordinary water meter to the service main of a district, so as to judge from the registration of the meter whether the consumption of this particular district was above or below the average; but such meters, although they record the total quantity of water passed through them, do not record the hour of the day in which it passes, and thus they fail to afford that most valuable information in the case of bad fittings or negligent use, namely, what is the nocturnal rate of expenditure, it being well known that an habitually large expenditure during the night must be due to waste. The only way of obtaining the nocturnal rate of expenditure with ordinary meters is to visit them at any desired hour, and to note the rate of movement. This is a possible process, and has, in fact, been used in your town; but it is a very troublesome one, there is liability to mistake in the reading, and, as there is no self-registration, there is nothing by which any error may afterwards be rectified.

Your engineer, Mr. Deacon, has set himself to devise a meter which shall leave a permanent record of the rate of expenditure of the water passing through it, and thus enable the engineer to see, on reference to these records, what was the quantity of water per hour passing through at each and every hour (in fact at every moment) of the day and night, and it is this waste-water meter which you have asked me to make the subject of examination and report.

The meter proper consists of nothing more than a vertical truncated hollow cone, having its small end upwards, and containing within it a disc of the same diameter as the small end of the truncated cone; a central stalk on the upper surface of this disc is suspended from a fine German silver wire, which passes, practically watertight, through a small hole in the upper part of the chamber above the cone, and is attached to a guided cross-head, carrying a pencil or tracer, and having above it a band passing over a pulley, and supporting on the other side of the pulley a weight, which is a determinate amount heavier than the cross-head and disc, when the disc is weighed in water, so that the weight always tends to draw the disc up to the top of the truncated cone. The inlet for water is in the chamber above the cone, the outlet proceeds from a chamber below its base.

In the upper chamber there is a diaphragm, with openings to equalise the flow of the water.

Assume that water is supplied to the meter, but that none is passing through it, because all the outlets are closed, then the weight will have raised the disc to the extreme point of its travel, and so that the disc fills up the aperture at the top of the cone. If now a cock in the outlet be opened, say to a small extent, water will seek to flow, but in endeavouring to do so it must press upon the disc, and send it downward to a larger part of the cone, and the point where the descent of the disc will cease will be that at which the annular area between the edge of the disc and the interior of the cone is sufficient, under the difference of pressure between the upper and the under side of the disc, to enable the required quantity of water to pass; and this pressure will obviously be, for the whole surface of the disc, exactly that which will balance the excess of the weight above the weight of the disc, weighed in water, and the cross-head weighed in air. If the pressure were less than this the weight would cause the disc to rise until the annular area was so much diminished that the required pressure to balance the surplus weight was just adequate to drive through this annular opening the quantity of water being drawn from the outlet; on the other hand, if the pressure were greater than the surplus weight the disc would descend until the increase of annular area would be such that at the pressure equal to the surplus weight the quantity of water demanded would flow through. In this manner the point of rest for the disc, with the supposed quantity being drawn, would be self-found; and, similarly, if a less quantity or a greater quantity (within the limits of capacity of the meter) were drawn off, the disc would find its appropriate position of rest in the truncated cone, a position corresponding to the particular quantity passing through. But the tracer rises and falls with the disc, and if this tracer have a piece of paper presented to it it will draw a vertical line on that paper, the length of which will indicate the rate at which the water is passing through the meter; and, if this paper be printed with horizontal lines representing hundreds and thousands of gallons per hour, then an inspection would show at which of these lines the tracer were standing, and would enable an observer at once to say—"Water is now passing through the meter at a velocity equal to 1,000 gallons or 3,000 gallons per hour," as the case may be.

The foregoing is the construction of the meter proper; but if no further provision were made there would not be left any other record than this, viz., that since the paper was put on the rate of consumption had at some time attained a point indicated by the length of the vertical line on the paper; but it would be impossible to say when the maximum recorded rate of consumption was reached, or for how long it endured. Such an apparatus would give a record analogous to that of a self-registering thermometer, as from this implement all that can be ascertained is that at some time since the index was last set the maximum temperature has been a certain number of degrees, but when this happened, or for how long it continued, there is no means of ascertaining.

But if a further provision be made by which, as in the steam-engine indicator, the paper presented to the tracer can be caused to move sideways, then the tracer will no longer describe a mere vertical line, but it will describe a line compounded of the lateral movement of the paper, and of the rise and fall of the tracer. In practice, Mr. Deacon causes the paper to move sideways in the manner employed in apparatus for automatically recording the pressure of the wind, and other similar phenomena; and in the manner in which the "pressure papers" of the governors of gas works are actuated, viz.; by wrapping the paper round a vertical cylinder to which motion is given by a common clock movement, so that the cylinder

makes exactly one revolution in the 24 hours. The paper is divided vertically by 24 "hour lines," representing the hours of the day and the night, and as has already been said, is divided horizontally by lines indicating the rate of flow in gallons per hour, and thus an examination of the line made by the tracer shows what was the rate of flow at any time of the day or night.

Water meters, such as are used for registering the quantity of water as taken by a consumer, are ordinarily divided into two classes, namely, positive meters and inferential meters. The positive meters are those in which a measuring chamber is alternately filled or emptied, and the number of those fillings is recorded. An inferential meter is one in which, by the velocity of the current passing through the meter, movement is given to indicating apparatus. Meters of this latter class have the merit of simplicity and of cheapness; but they do not, as a rule, record small quantities with the same accuracy as such quantities are recorded by meters of the positive class. They are, however, in received and very general use for gauging the quantity of water supplied to those who pay by meter.

Mr. Deacon's waste-water meter, now under consideration, is of the inferential class, and, like such meters, although its indications are very close to the truth, is not absolutely accurate; but it must be borne in mind that for the purposes for which Mr. Deacon has devised his meter absolute accuracy in the registration of small quantities is not essential. That which is wanted is to indicate, and to put on record, whether there is an unreasonable amount of water being used in a district at particular times of the night and day, and this Mr. Deacon's meter indicates with great fidelity. I have made very careful experiments with his meter, under pressures varying as much as five to one, and with the meter in proper order, and also with it purposely put out of order by blocking up several of the inlet orifices so as to endeavour to get irregular action, and I have satisfied myself that the records given by the meter may be thoroughly relied on for the purpose for which it is intended.

The meter, with its clock, is contained in a neat cast-iron box with a hinged lip at top; this box is let into the ground below the footway, the lid is padlocked, and is covered by another lid, carried in a frame in the flag stones.

When it is intended to introduce one of these meters into a district, the service main is cut, and a curved pipe is jointed to it to lead the water to the meter inlet, and another curved pipe is supplied to convey the water from the outlet to the main again.

In this manner all the water delivered by that particular service main is compelled to go through the meter, and the paper being put on the vertical cylinder, a daily record is got of the behaviour of the district as a whole; and not only is the rate of flow at any moment known, but a very good estimate can be made as to the total number of gallons which have been delivered to the district in the twenty-four hours.

If, on an examination of the record paper, it appears that the district has taken an improperly large quantity of water, and especially if it is discovered that there has been a heavy consumption throughout the night, then there is strong reason to suspect waste; and it becomes necessary to make an investigation into the condition of the service mains and services, into the state of the fittings, and into the amount of care which is exercised in the district in the use of the water.

I spent several hours on each of two nights in the streets of Liverpool for the purpose of making myself thoroughly acquainted with the manner in which your officers avail themselves, in practice, of Mr. Deacon's meter to guide them in this investigation; and I will give an account of one of the night's proceedings.

On reaching the meter between eleven o'clock and midnight, we found there was a consumption going on at the rate of nearly 3,000 gallons per hour; this was clearly a consumption that could not arise from any proper use of the water at that time of night, We then proceeded through the district to ascertain at which of the houses the waste was taking place, and the manner of doing so was as follows:—Outside each house, or other place supplied with water, there is in the service pipe a stopcock, which can be turned off in the street by the inspector.

As each house is reached the inspector applies the turning key to the plug of the cock, and then applies his ear to the top of the key, and by the sound can ascertain whether water is passing through. The turning key acts as a stethoscope, and those who are accustomed to its use can readily detect the passage of even small quantities of water, and if they are in doubt the partial closing of the cock generally sets the question at rest, as the diminution of the aperture adds to the velocity and increases the sound. If water is heard to pass the cock is shut off, and the number of the house and the extent of the noise are noted in the inspector's book.

When every cock through which the passage of water can be detected has been closed the meter is revisited. On the particular occasion of which I am speaking the result of the closing of the cocks where noise was heard was to diminish the rate of expenditure from 3,000 gallons per hour to 720 gallons per hour.

By the before-described examination the inspector is enabled to ascertain at which of the houses in the district waste has been going on; and thus, on the following day, only these houses need be entered, and in this manner the labour and loss of time of a house-to-house visitation throughout the district is rendered unnecessary, and the offence of such a visit to persons whose fittings are in good order and who do not waste water is avoided.

I had abundant opportunity of satisfying myself as to the sensitiveness of the meter. One instance was very striking. At about half-past one in the morning we had reached a place where a great rush of water was heard. This was found to proceed from the leaving open of a tap which supplied a public trough closet in a court. This tap we closed, and noted the exact time. On examining the meter a distinct vertical line was found to have been drawn at this very hour, indicating the reduction of a large number of gallons per hour. I had caused standpipes to be fixed in different places on the service main, so that I could make waste wherever I desired, and I found that the meter was as alive to the opening of cocks at distant parts of the service as it was to the opening of cocks close at hand. The meter also enables the condition of the service mains and pipes to be ascertained. If, for example, on shutting off all the cocks in a district through which the flow of water can be detected, there should still appear a large nocturnal consumption, then it must arise either from the passage of water through the stop-cocks, but at too slow a rate through each to be detected, or it must arise from the imperfect condition of the pipes. To test this all that is necessary is to close every stop-cock in the district, and then to re-observe the meter. If the expenditure has been stopped, or diminished, then it is clear that there was a passage of water past the stop-cocks not detectable by the ear; but if the expenditure continues, then it is evident that it arises from defects in the service mains or in the service pipes.

I have already said I believe Mr. Deacon's meter to be thoroughly effective for the purpose for which it is intended; and I will now add that I believe it is not at all likely to get out of order, and that its first cost should be, when manufactured in quantities, extremely moderate. Having regard to these considerations, I have no hesitation in advising the Water Committee of the Town Council of Liverpool to employ Mr. Deacon's waste-water meter in all their districts; and I have no doubt that if this be done, not only will the average expenditure per head be materially diminished, but that that diminution will be accompanied by all the benefits and all the simplicities in service attendant upon a constant supply.—I have the honour to be, sir, your obedient servant, (Signed) F. J. BRAMWELL.

CORRESPONDENCE.

THE THAMES AT RICHMOND.

Sir,—The present condition of the Thames at the upper part of its tidal course is now attracting considerable public attention, while the best way of abating an undeniable nuisance is being discussed somewhat hotly in the columns of your daily contemporaries. There is no manner of doubt that the river above London is being rapidly silted up, and that the material with which its bed is being filled is neither more nor less than sewage. That some means must rapidly be adopted to prevent what must be the inevitable end of the process now going on, if it is allowed to continue, is certain, but it is of the greatest importance that we should ascertain once for all what method is most likely to produce the required effect. On this point it seems to me the Society of Arts might well lend its powerful aid towards the collection of such evidence and such statements of opinion from experts as may throw light on the subject. It is now a purely technical question, a matter of hydraulic engineering. Is it probable that the construction of a lock below Richmond would injuriously affect the river below, and if so, what other remedy can be suggested? It is only in a scientific and technical journal that the question can be properly discussed, and I am sure that if it were known that your columns were open for the purpose, many of the authorities in such matters would gladly come forward to lend us the light of their practical experience. As a sanitary and as an engineering question the subject is of the highest importance, and well worthy the attention of a body so catholic in its aims as the Society of Arts. May I therefore suggest that you should take it up by means of your *Journal*, and endeavour to elicit the opinions of those whose experience alone can help us to solve this difficult question?
—I am, &c., Fluviatilis.

NOTES ON BOOKS.

Linear Drawing. By G. C. Mast. (*C. Bean.*) 1874.

The object of this manual is to provide a text-book by which young pupils can be instructed in the art of *linear* drawing, at the same time as *freehand*. The book is accompanied by a series of plates arranged in a graduated scale of progressive difficulty, commencing with straight lines, then giving curves and simple patterns, and leading up by patterns of greater complexity to the delineation of objects. Full directions for the execution of the various designs are given in the text.

Dictionnaire des Falsifications des Aliments, &c. By Leon Soubeiran. (Baillière et Cie., Paris, 1874.)

Dr. Leon Soubeiran, Professor at the Ecole Supérieure de Pharmacie at Montpellier, well known as the author of many valuable scientific works, has just published a useful book on the adulteration of foods, medicines, &c. The public, it is said, does not object to adulterated articles, and even prefers them for some reasons to pure products exempt from all mixture. Manufacturers urge that mixtures often improve the quality of the articles, and add as another argument for adulteration that it makes them cheaper. These points are discussed in the work, and, although many works have already been published during the last twenty-five years on this subject, both in England and in foreign countries, there is no one which supplies us with information down to the present time as to what science has accomplished. Professor Soubeiran's book supplies this want, and his name is a sufficient guarantee for its being well done. Besides bringing chemistry to his aid he has made use of his knowledge of natural and physical science, and has followed out his researches by the aid of the miscroscope. The learned professor has treated not only what may be termed adulterations proper in connection with alimentary and medical substances, but he has touched on other matter of great importance more or less allied, such as bottles, short measure, cartes de visite, coal, lace, gilding, silvering, manures, guano, charcoal, stuffs, money, paper, animal black, perfumes, soaps, &c. He has collected information with the minutest care from both French and other publications, and at the end he gives a bibliographical index, so that his readers can refer to the publications themselves. Two hundred and eighteen illustrations are incorporated in the text. An appendix is added, which gives a complete account of French legislation on adulteration, besides touching on the laws of other countries on the same subject.

GENERAL NOTES.

Signalling at Sea.—A commission has recently been appointed in France to conduct a series of experiments on a steam organ, called "The Calliope," for signalling, the sound of which, it is stated, may be heard from a distance of fifteen leagues in fine weather, and from a minimum distance of three leagues in foul weather. The period of the autumnal equinoxial gales as a crucial test will be chosen for experiments.

The Creusot Iron Works.—It appears from a report that the iron works of Creusot, the first mechanical establishment in France, produced last year 550,000 tons of pig iron, 80,592 tons of rolled iron, 40,597 tons of rolled steel, and 90 locomotives, without taking into consideration bridges, machinery, and miscellaneous apparatus. The consumption of coal during the last twelve months exceeded 550,000 tons. The production especially increased last year, Creusot having attained a high reputation for its steel rails. Creusot sold steel rails last year to the extent of 38,085 tons, whilst, on the other hand, the make of iron rails declined, and did not exceed 26,900 tons.

Population of large Cities.—A report from the Bureau of Statistics, Washington, gives an account of the population of the various countries of the world. Among other details, it gives the following as the populations of the 25 largest cities of the world:—London, 3,254,260; Sutchan (China), 2,000,000; Paris, 1,851,792; Pekin, 1,300,000; Tschantschau-fu, 1,000,000; Hangtschau-fu, 1,500,000; Siangtan, 1,000,000; Singnan-fu, 1,000,000; Canton, 1,000,000; New York, 942,292; Tientsin, 900,000; Vienna, 834,284; Berlin, 826,341; Hangkau, 800,000; Tschingtu-fu, 800,000; Calcutta, 794,645; Tokio (Yeddo), 674,477; Philadelphia, 674,022; St. Petersburg, 667,963; Bombay, 644,405; Moscow, 611,970; Constantinople, 600,000; Liverpool, 493,405; and Rio de Janeiro, 420,000.

Arsenical Wall-paper.—Dr. Hamberg, of Stockholm, has made some investigations relating to the character of the atmosphere in apartments having the walls covered with papers which contain arsenical pigments. The results of these researches are published in a recent number of the *Pharmaceutical Journal.* The paper of the room in which the experiments were conducted had a light green ground, with an ornamental pattern of brownish-yellow colour; this yellow was probably derived from an ochre, but the green resembled Schweinfurt green, and was strongly arsenical. An arrangement was made for drawing a current of air through a series of U-shaped and bulbed tubes, suspended on the wall. The passage of air was continued from July 16 to August 16, 1873; and it was calculated that during this time about 2,160,000 cubic centimètres of air had traversed the system of tubes. Some of the tubes had been plugged with cotton wool, while others contained a solution of nitrate of silver, and at the termination of the experiment the contents of the tubes were separately examined. The results showed that there had been an arsenical exhalation.

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FRIDAY, SEPTEMBER 11, 1874.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

GENERAL EXAMINATIONS, 1875.

The Programme for next year is now ready, and may be had on application to the Secretary.

RESULTS OF TECHNOLOGICAL EXAMINATIONS, 1874.

The following candidates having passed in the prescribed subjects at the Examinations of the Science and Art Department, and having been reported by the Society's Examiners as having passed in Technology, the Council have awarded them Certificates as follows:—

Steel Manufacture.

*71,573–Fowler, William H., 20, Oldham Science and Art School—1st Honours, with the Prize of £10.
71,576—Lees, John T., 17, Oldham Science and Art School—1st Elementary.
71,579—Preston, Henry, 21, Nottingham Mechanics' Institution—1st Elementary.
68,198—Strachan, Thomas, 27, Crewe—1st Elementary.
71,577—Sugden, Thomas, 24, Oldham Science and Art School—1st Elementary, with the Prize of £5.
71,574—Thompson, Thomas T., 35, Oldham Science and Art School—2nd Elementary.
71,581—Webster, George E., 20, Nottingham Mechanics' Institution—1st Honours.

Cotton Manufacture.

71,563—Baxter, James, 24, Stockport Mechanics' Institution and Stockport Sunday School Young Men's Improvement Society — 2nd Elementary.
71,590—Clay, John, 20, Hebden Bridge Mechanics' Institution—1st Elementary.
71,572—Harrison, John E., 16, Oldham Science and Art School—2nd Elementary.
71,567—Mills, Thomas G., 23, Manchester Mechanics' Institution—1st Advanced, with the Prize of £7.
71,591—Parker, John, 20, Hebden Bridge Mechanics' Institution—2nd Elementary.
71,589—Redman, James, 22, Hebden Bridge Mechanics' Institution—1st Elementary.
71,570—Rye, Charles W., 19, Oldham Science and Art School—1st Elementary, with the Prize of £5.

Carriage Building.

71,594—Mullins, Jeremiah F., 25, Cork School of Art—1st Elementary, with the Prize of £5.
71,595—Mullins, Mathew, 20, Cork School of Art—2nd Advanced.

* The numbers are those given at the Science and Art Examinations of the present year.

Gas Manufacture.

71,584—Bryan, Eli, 29, Wedgwood Institute, Burslem—2nd Elementary.
71,586—Hepworth, Reuben A., 20, Elland Science School—2nd Elementary.

Cloth Manufacture.

68,210—Heywood, John, 23, Preston—2nd Honours.
71,585—Sykes, Edmund, 31, Elland Science School—1st Elementary, with the Prize of £5.

The following have been reported by the Society's Examiners as having passed in Technology, but not having passed the required Examinations of the Science and Art Department, no Certificates have been awarded to them:—

Steel Manufacture.

71,568—Davenport, Frank, 21, Manchester Mechanics' Institution—1st Elementary.
71,596—Fleming, Thomas, 18, Cork School of Art—2nd Elementary.
71,564—Grey, John, 38, St. Nicholas Science Classes, Deptford—2nd Advanced.
71,582—Hollis, Charles W., 20, Nottingham Mechanics' Institute—1st Elementary.
71,575—Lees, Kay, 20, Oldham Lyceum—2nd Elementary.
71,597—Pulvertaft, James, 20, Cork School of Art—2nd Elementary.
71,580—Westmoreland, John W. H., 20, Nottingham Mechanics' Institute—1st Elementary.

Cotton Manufacture.

71,565—Riley, Charles E., 22, Burnley Mechanics' Institution—2nd Elementary.
71,571—Warrenner, Albert, 17, Oldham Science and Art School—2nd Elementary.

Carriage Building.

71,562—Mead, Benjamin, 27, Aylesbury Science School—1st Elementary.

Gas Manufacture.

71,593—Gilcriest, Thomas, 51, Sligo Science School—2nd Elementary.

The above candidates by passing the required Science Examination in a future year can obtain Certificates.

IMPROVED RAILWAY LAMP.

The Society's Gold Medal, or Twenty Guineas, is offered for an improved lamp or means of illumination, suitable for railway passenger-carriages, that shall produce a good, clear, steady, durable, and safe light.

It must be simple in construction, and capable of being readily cleaned and repaired.

In judging the merits, cost will be taken into consideration.

Specimens, in a condition suitable for trial, to be sent in to the Society's House not later than the 1st of November, 1874.

The Council reserve to themselves the right of withholding the medal or premium offered, if, in the opinion of the judges, none of the articles sent in competition are deserving of reward.

EXHIBITIONS.

Chili International Exhibition.—Foreign-office, Sept. 3.—The Secretary of State for Foreign Affairs has received a note from the Chilian Minister accredited to this court, inviting the co-operation of her Majesty's Government in an International Exhibition, to be opened at Santiago de Chili on the 16th of September, 1875; and announcing that the following gentlemen have been nominated by the Government of Chili as Commissioners in this country for the Exhibition in question:—Thomas Kynaston Weir, Chilian Consul, Gresham-house, Old Broad-street, London, Chairman; Stephen Williamson, 19, James-street, Liverpool; James Sawers, 16, Manchester-buildings, Liverpool; Thomas Cockbain, 19, James-street, Liverpool; Edward Edmondson, Gunston, Sons, and Co., 16, Castle-street, Liverpool; Henry James Bath, Swansea; John Head, Allington-house, Ipswich; Thomas Bland Garland, Hillfields, Reading. Applications for space should be made as soon as possible; and if enclosed to the Chairman of the Commission, will be forwarded by him, in due course, to the proper quarter.—*Gazette.*

Exhibition of Insects in Paris.—The Paris correspondent of the *Daily News* gives an account of the exhibition of useful and noxious insects in the Tuileries Gardens, which has just been opened. On the occasion of the opening a lunch was served as a preliminary to the inaugural speech of the Minister of Commerce and Agriculture. About thirty persons sat down to table. They included M. Ducuing, the deputy, M. Mene, a naturalist and promoter of the exhibition, the Professors of Natural History of the Jardin des Plantes and University, some great gentlemen farmers, and three journalists, whose special function it is to write articles for Paris and provincial papers on rural economy, cattle shows, and the like. One of the great gentlemen farmers was the Vicomte Benoist d'Azy, the younger, who cultivates an estate in the department of the Nièvre worth about 300,000f. year. It was M. Ducuing who did the honours of the Orangery, where the insects are on view. These creatures are divided into two great classes. The beneficent are on one side and the maleficent on the other. The bee and the silkworm have a prominent place in the exhibition. I was glad, says the writer, to see the spider's claims to human gratitude allowed. Crickets, beetles, and other familiar insects which we treat as enemies are placed among the auxiliaries. The direct and indirect utility of the ant are lectured upon by an aged savant, who has spent his life in studying the ways of insects in the woods and vineyards of the Jura, and seeking to penetrate the mysteries of their nervous system. Insect intellect is scarcely less wondrous in its way than the human. The terrible phyloxera is an object of peculiar interest to Parisian families, because of the rise this mischievous little insect has caused in the price of ordinary wines produced on the alluvial soils, where it most multiplies. Each insect is pinned to a card, stating briefly its natural enemies, habits, appetites, capacities of increase, uses (direct or indirect), or the ravages it commits in accomplishing its destiny. Exhibitions of this kind would be more useful, the writer thinks, in market towns on market days than in Paris. Savants are not yet agreed as to what bird or other creature has received nature's commission to keep the phyloxera from multiplying prodigiously. The improved beehives on sale at the Insect Exhibition enable the agriculturists to take away the superfluous honey without danger to the bees. In an annexe there is a collection of insectivorous birds. Each bird has round its neck the bill of fare which its palate and necessities dictate. The correspondent remarks that he was never in an exhibition which more interested him than this. One comes away with the impression that, if man is at the head of created beings, nature has a care for her more insignificant children, and will not suffer them to be stamped out of existence with impunity.

PUBLIC MUSEUMS AND LIBRARIES.

The following returns of the numbers of visitors for August have been received up to the present date:—

	Number of Visitors.
British Museum	(no return)
National Gallery (Trafalgar-square)	91,809
Kew Gardens and Museum	
South Kensington Museum	98,256
Bethnal-green Museum	59,914
Geological Museum, Jermyn-street	
Patent-office Museum	33,317
Edinburgh National Gallery	21,984
Edinburgh Museum of Antiquities	20,861
Edinburgh Museum of Science and Art	40,284
Royal Dublin Society:—	
Natural History Museum	
Botanic Gardens, Glasnevin	
Dublin National Gallery	
Zoological Society, Dublin	13,846
Museum of Irish Society, Dublin	
Tower of London	21,094
Royal Naval College, including Greenwich Painted Hall	

PATENT OFFICE REPORT.

The report of the Patent-office has just been issued for 1873. It contains the usual details of the number of patents applied for, granted, &c., and accounts of income and out-going expenses. It appears that during 1873 there were in all 4,294 applications, of which 1,388 were only provisionally specified; of these 68 applicants obtained grants of letters patent, but neglected to file final specifications, and 1,320 did not proceed after the six months provisional protection had expired; 2,906 completed their specifications and obtained letters patent. In the preceding year, 1872, there were 3,970 applications, and 2,745 completed patents. Of the specifications sent in, 216 were filed complete at once without any prior provisional specification. During the year 737 patents paid the £50 stamp duty due at the end of three years (these were patents taken out during the year 1870, in which there were 3,405 applications, and 2,146 completed patents.) There were also 232 patents, on which the duty of £100, due at the end of the seventh year, was paid (these were patents taken out in 1866, in which year there were 3,453 applications, and 2,106 complete patents; the £50 duty on them was paid in 1869, when 578 paid that duty). There were 14 patentees who required duplicate copies of lost original patents. There were 3 new patents granted under the special provisions for extension made in the Act of 1852.

The total revenue of the office during the year was £144,761, of which £2,290 was derived from the sale of specifications, &c., and the remainder from the fees on patents. Against this are to be set costs and charges to the amount of £49,477, leaving a surplus paid to the Treasury of £95,284. The corresponding amount last year was £85,611; and the total amount from 1852 is £1,108,204.

The main items of charge are—printing, £17,416; salaries, £11,430; current expenses, £6,565 (including payments for preparing abridgments, £1,651); compensation to Irish Law Officers, Scotch Lord Advocate and their clerks, £3,413; fees to English Law Officers (hereafter abolished), £6,321; paper for printing specifications, &c., £2,100. The rest are rent and office charges.

THE MANUFACTURE OF CAOUTCHOUC AND ITS INDUSTRIAL USES.*

By Eugene Pavoux,

(Director of the General India-rubber Manufactory at Brussels.)

The multifarious uses of india-rubber, and the numerous industries in which it is employed, are such as to give an interest to the consideration of the properties of this material and of the means employed to give it the appearance and the forms under which it is rendered useful.

Its principal quality is its elasticity in an ordinary temperature. This special quality, to which it owes its repute, disappears almost entirely under a temperature approaching to that of melting ice, and only reappears when the india-rubber is subjected to a heat of from 30° to 40° (Cent.), when it again becomes supple. It softens in proportion as the temperature rises, becomes viscous, and ends by taking the consistency of treacle. This sensibility to the influence of the temperature must have prevented its being used in industrial pursuits, if means had not been found of neutralising it by a special manufacturing operation. Above 200° it is decomposed, and passes off in a volatile form.

Its density varies between 0·925 and 0·950.

According to Faraday, it is composed of 87·2 of carbon and 12·8 of hydrogen.

India-rubber is a sap which flows from various sorts of trees which grow in abundance in the regions near to the equator, notably the *Ficus elastica*, the *Siphonia cahucha*, &c. Its qualities are distinguished by the places where it is grown, and sometimes, though rarely, by some external characteristic. The terms most frequently used in the manufacture are: Para, Madagascar, Carthagena, Guyaquil, Borneo, West India, Assam, &c.

It is obtained as follows:

The trunk of the tree is pierced, and the sap (which contains about 40 per cent. of india-rubber) is allowed to run off into a vessel, but more frequently into a hole dug at the foot of the tree. Balls of dried clay made in the shape of pears are plunged into the liquid, and afterwards passed over a fire made of the branches of trees, in order that the layer of india-rubber which has been deposited on the clay may be made to coagulate rapidly. This operation is repeated until a certain thickness has been acquired. The balls are then plunged into water, and the clay, thus softened, is easily got rid of by simple pressure.

Sometimes a thin board is used as a nucleus, on which the sap is deposited and agglomerated; in this case, the mass of india-rubber thus collected is cut on three sides to admit of the board being drawn out, and in this way double sheets are obtained, which open almost in the same way as a book. The purest india-rubbers are those which are gathered in this way; such as Para and Madagascar, the simple aspect of which reveals the almost total absence of extraneous matter.

When the sap is allowed to run out on the ground, it collects in irregular strips, mixing with the impurities of the soil. These strips are put into sacks and sent off to the various places of consumption. When they are very thin they are rolled up like a skein of thread, and the appearance of the india-rubber in balls serves to remind one of a clue of worsted.

In these different states india-rubber comes to Europe. It is indispensable to rid it of every kind of detritus, sand, wood, pebbles, bark, &c., which have become mixed with the gum whilst running from the tree. This is the object of the first process in the manufacture. The raw material, after being softened by immersion in a large tub of hot water, is cut up with a saw into cubic pieces of about an inch and a-half, then flattened between two cylinders, placed horizontally, the distance between which is regulated at will by set screws. These cylinders are of different velocities; it follows, therefore, that, independently of the pressure which the india-rubber is made to undergo, it is hacked and torn to such an extent that all extraneous matters are removed, and under the continuous action of a stream of water, they are easily carried off. Under this process, which is repeated eight or ten times, every time bringing the two cylinders nearer together, all the impurities vanish, and the rubber assumes the form of an irregular sheet, grained, and pierced through with innumerable holes. This sheet, when hung up to dry in a place where the air circulates freely, thanks to its texture, very soon loses the water with which it is impregnated.

It is important that the material should be kneaded, in order to bring together in a single piece the scattered elements of the sheet, and impart to it perfect homogeneity. This is done by means of a kneader called a "devil," which consists of a cylinder fixed horizontally, divided or not into separate compartments by partitions perpendicular to the axis. Over the total length of this cylinder, and a quarter of its circumference, there is an opening by a sort of door on hinges, through which the dried rubber is introduced. A shaft, provided with a series of sharp pointed teeth disposed in rows alternating one with another, runs through the whole length of it. This shaft, which makes seven or eight revolutions a minute, carries along with it the grained sheet of which I have spoken, and causes it to traverse the entire free space of the cylinder. In doing this the mass of caoutchouc takes a rotating motion, produced by the teeth, which successively take it up and draw it towards them. There results from this a perfect process of trituration, which forms the sheet of rubber into a compact mass, all the parts of which are thoroughly mixed.

In order that this operation may be effected under proper conditions, it is necessary that the roll of caoutchouc which has to be put into the cylinder should be a little wider than the cylinder itself, in order that it may press against the sides, and, consequently, be regularly drawn in by the motion of the shaft. This proceeding lasts, on an average, a couple of hours; the longer it is continued, the less time is required for the process which has to follow, by reason of the thorough homogeneity into which the material has been brought.

The devil, as it is called, is usually formed with a double casing, which is heated by means of a steam jet.

I have been induced to abolish this, because I find that the heat developed by the work itself is sufficient to facilitate the kneading of the material, whilst if it is increased by that arising from the steam, the temperature is such as to cause the rubber to become soft and viscous, and this deteriorates its quality and interferes with the following operations.

On leaving the devil, the material passes to the compressing cylinders, which are placed in couples on a horizontal plane, and may be brought to any distance from each other by means of screws worked by a crank placed within the reach of the workman.

These cylinders are hollow, and are heated internally with steam by a pipe running through a packed box. Two pipes running into one serve to discharge the steam, the ingress and egress of which are regulated, according to the necessities of the work, by taps. The rubber is thus thoroughly compressed until it presents the aspect of a rolled-up sheet, of firm texture, close, and exceedingly smooth. This gives the finish to the preceding operations.

Pure india-rubber is only used for certain special purposes. The requirements of industry demand various qualities of products, possessing properties suitable to the different uses to which they are to be applied; it is the mixture of blocks of compressed rubber with foreign matters in certain proportions which enables the manufacturer to produce qualities answering to the variable conditions under which they have to be used. Rolling forms a

* Translated from "La Revue des Mines" for the English edition of that work.

mixture of these several substances, which is regular and uniform throughout; it is also during this operation that the colouring matter is added, which gives to india-rubber its various shades of gray, black, red, &c., in which it so frequently appears. It is in the form of powder that all these matters are mixed with it. At every passage between the cylinders a portion of it escapes, and falls on a slightly inclined table, which is gathered up by the workman and thrown again into the mass, which, becoming wider by the pressure, is rolled up by the workman as it issues from the cylinders, between which he puts it in afterwards lengthwise. It is, therefore, rolled in every possible way, which tends to give to the texture a greater degree of homogeneity.

The india-rubber paste obtained by this process is afterwards worked up either by rolling or moulding.

In the first case sheets are made of any length and thickness that may be required, whilst in the second it is cast in any mould the manufacturer may desire.

As regards the rolling, the paste is made to pass between the two cylinders of a calender, by which it is spread out into a sheet of the same dimensions as the cylinders; these sheets may be made to any length, of course, by feeding the calender continually with one block of material after the other. The adhesive tendency of india-rubber is so strong that when the finished sheet has to be wound on to a roller, it can only be done by the interposition of a piece of cloth, which serves to separate the different windings of the sheet. It is then placed on a table and unrolled, in order to be worked up into the form and dimensions required. The same calender serves for coating cloth, which is used for many purposes, amongst others, for making tubes and straps; the paste, which passes through the cylinders at the same time as the cloth, is spread upon it in a layer, the thickness of which is regulated by the distance, and the tenacity with which it sticks is in proportion to its adhesive qualities.

Certain pieces are suitable for special forms, which they can only be made to take by moulding. In order to manufacture these, the india-rubber paste is put into a mould, which is filled more or less exactly. The exposure of this mould to a temperature varying between 125° and 150° causes the material to expand and penetrate into every part of the mould, and to take the exact form that is wanted. If a hollow article is required, a little water is introduced, which, being changed into vapour by the heat, compresses the paste, and makes it adhere to the sides of the mould, of which it takes the exact outline.

There is one remark which it is important to make: it is that the paste adheres easily by simple contact, as long as the material has not undergone the process of vulcanisation. The shape then (with the exception of the cutting of certain objects from sheets) should always be given previous to vulcanising, which is the last process of manufacture.

Raw india-rubber seems to consist of two parts, each possessing distinct properties: the one compact and elastic, the other heavy and semi-liquid. It is to the presence of the latter element that is to be attributed the extreme facility of adhesion by which it is characterised, and it serves to explain the way it is affected by the action of the cold, and the modification it undergoes under the influence of a high temperature. The transformation of the viscous part, which is most sensitive to the variations of heat, has the effect of preventing those grave inconveniences arising out of it, and of making india-rubber a substance that can be utilised under any conceivable circumstances. That is the object attained by vulcanisation.

The agent employed for vulcanising is sulphur. Its action on india-rubber is analogous to that with which it acts on fatty substances which, when mixed with it in the proportion of one to five, and heated by a temperature of about 200°, produce a substance offering a good deal of resistance, and presenting almost the aspect of india-rubber. The result is that vulcanised rubber does not harden with the cold, neither does it soften with the heat; it preserves its elasticity, resists acids, and can no longer be made either to dissolve or to adhere.

The incorporation of sulphur is effected either in the solid state or in a state of fusion, according to the nature of the articles that have to be vulcanised. The first method, which is the most in use, consists in mixing flowers of sulphur with the rubber at the same time as the other matters which are added in rolling; it thus becomes uniformly mixed with the mass, but as the reaction to which it must give rise can only be produced at a high temperature, it does not so far modify the properties of the india-rubber paste, which still continues adhesive. The article which is being made is put into a boiler made of sheet iron, capable of supporting a pressure equal to from four to five atmospheres, and closed by a bolted lid; a jet of steam is let in, the tension being measured by a steam gauge, and the length of time during which the operation continues varies according to the number of pieces, but it is estimated at a couple of hours on an average. The necessary temperature is about 150°. When it is required to put several objects one on the top of the other, they are sprinkled all over with silicate of magnesia to prevent them from adhering to their supports.

The articles manufactured in moulds with an open surface are vulcanised in presses composed of two hollow, horizontal plates, the uppermost of which is moveable, and worked by screws which allow it to work up and down. The moulds are placed between these two plates, and in this manner the paste is compressed. The necessary temperature is produced by the steam which circulates in them from pipes placed at one of the extremities, and passing at the other end through outlet pipes.

I have had fixed up in my manufactory a large press of this kind, by which I am enabled to vulcanise sheets, with great economy of time; the plates are about 7 ft. long by 4 ft. wide; their internal surface being carefully planed and dressed they give to the sheets a glossy appearance, with remarkable uniformity of character.

To produce vulcanisation by the liquid method, the sulphur is put, in a state of fusion, into large boilers, underneath which are large fire-places; the articles already made are plunged into these boilers, care being taken to keep them covered with the liquid by means of weights. This precaution is indispensable, in consequence of the difference in density of the sulphur and the rubber. The absorption of the metalloid takes place, and is gradually completed until the combination is effected, which takes from two to three hours. Experience will be the best guide as to the time when the operation has been accomplished. Care must be taken that it is not continued too long, because in this case the rubber becomes hard and loses its elasticity. As soon as the articles are taken from the boiler, they should be plunged into cold water; this causes the layer of sulphur deposited on the surface to crack, after which it is easily removed by scraping.

It is as well to remark that only small objects admit of this method of vulcanisation; those of larger size must undergo the first process.

There are also other methods of vulcanisation which, although less applicable to industrial products, nevertheless deserve to be mentioned. Chloride of sulphur mixed with sulphuret of carbon, in the proportion of one to fifty, will produce this result. When immersed in this compound, the rubber becomes impregnated in a few minutes, after which it is plunged into a reservoir of cold water: the object of this is to neutralise the effect which a too prolonged immersion would have upon the surface, which would be to vulcanise it too much. During the immersion, the mixture penetrates into the centre of the mass. It is only articles that are not very thick that can be subjected to this process.

It is exactly the same as regards the process which

consists in the use of alkaline sulphurets; the operation lasts about four hours. In consequence of the restricted application of this method, it may be regarded as more theoretical than practical.

After vulcanisation, the surface of the rubber sometimes presents slight efflorescences of sulphur; these are easily removed by washing with an alkaline solution.

To dissolve india-rubber, no better agent can be employed than sulphuret of carbon, to which must be added 5 per cent. of anhydrous alcohol; a product is thus formed which, when subjected to evaporation, leaves a residuum of rubber possessing all its primitive qualities. It may also be dissolved by any of the essential oils, but the material which results from their evaporation is oily and viscous, so that their use has been entirely abandoned.

Before proceeding to treat of the industrial uses of india-rubber, it will be interesting to say a few words respecting indurated rubber, which constitutes a special branch of manufacture; independent of its restricted application to great industrial purposes, it is applied to the manufacture of a large number of objects of all shapes and dimensions, adapted to ordinary daily wants. The manufacture of indurated rubber may be disposed of in two words. The quantity of sulphur which is mixed with the paste is larger, and amounts, according to circumstances, to from 35 to 40 per cent., and the vulcanisation is prolonged beyond the ordinary limits, the maximum being from six to seven hours. For great thicknesses, a longer time may be necessary, but this is an exception. The operation is a very delicate one, and demands a great deal of care to prevent the article being burnt, as it in that case would become worthless.

Indurated india-rubber is worked with the file, the saw, and the lathe, exactly like metals and other hard substances.

The applications of india-rubber to industrial purposes are exceedingly numerous, and are increasing daily. "Its elasticity, its tenacity, added to which, the property it possesses of being completely homogeneous and impermeable, recommend it for a vast number of uses in which it would be difficult to find a substitute." *

The various kinds of joints which are used for water pipes, gas pipes, and steam pipes, may be classed in several categories, and india-rubber is used in all of them. The flat washers for flange joints are made in various qualities of material, but most frequently by means of one or several cloths dipped in the paste, and intended to prevent the lateral extension which would take place in pressing the surfaces together, as well as by the heat, in the case of joints with steam at high pressure; the number of cloths depends upon the thickness of the washer. Instead of being parallel at the surface, the cloths are frequently disposed concentrically, and are placed at a distance from each other of from two to three millimetres. The same result may be obtained with felted india-rubber, that is to say, mixed with fibrous matter, such as woollen or cotton waste, &c., which by their resistance admit of greater tenacity, and cause the lateral extension to be less felt.

In laying the flange pipes, it often happens that, through the negligence of the workman, the centre of the washer does not coincide with the axis of the pipe, and causes a projection in the inside. When this defect presents itself at the lower part of a steam pipe, it prevents the waste water from running off; it is better, therefore, to adopt the system in which the washer is kept in its place by a flange at one of the ends of the pipe; the play left between the two pipes admits of expansion, without causing any danger.

The washers with circular section which are used for joining the pipes are especially employed in the ingenious system of which M. Leon Somzé is the inventor. The washer is introduced by being rolled into the annular space between the two ends, called male and female, of the jointing pipes, and is kept by the conical form of the male end in a perfect state of compression.

In making Delperdanges' joints it is necessary to use a ring forming a band, which, placed on the flanges, which are close to each other, of two pipes, is compressed and kept in its place by an iron bridle, terminated with two claws, which are pressed and brought together by a bolt. A copper sheet keeps the rubber against the pipe, where the claws are. This system has been at work in the water distribution of Lille and Valenciennes. Lastly, certain joints are made by means of a cord, either round or square, made of india-rubber alone or of felted rubber, which is placed in a groove in the two surfaces which have to be joined. The compression of this cord hermetically closes the two ends of the pipes.

India-rubber is also largely employed in transport. On the railways, the buffers are furnished with a series of washers of rectangular shape about 2 in. in thickness, separated from each by sheet-iron plates, which allow each washer to be compressed singly, so that every advantage is derived from the characteristic property of the material. To allow the passage of the buffer rod, these washers are pierced in the centre with a hole, the diameter of which is larger than that of the plates, in order that the depression of the washer may not drive back the rubber against the rod. For the same reason, the sheet-iron plates are of larger diameter to prevent the rubber from being pressed back beyond their outer edge.

In the construction of passenger carriages, arched pieces are used, which, being fixed in the inside of the wainscoting of the doors, receive the shock of the glass windows as they are lowered, and preserve them from the breakage to which they would be exposed without this precaution.

In tramways, the springs are replaced by buffers, taking the form of two truncated cones, united by their bases; these buffers, placed between the box and the axles, weaken, by their elasticity, the jolting of the cars, and render the motion exceedingly smooth and gentle. The tenacity, strength, and duration of the springs depend on the proportion of foreign matter which the material contains; there ought to be only a small proportion, but a certain quantity is essential, in order to give them the requisite body and solidity. The use of these springs in the wagons belonging to mines and quarries would, undoubtedly, diminish the deterioration in the rolling stock by preventing the violent shocks which are frequently caused by the dilapidation of the roads.

India-rubber is also used for the outer rim of wheels for vehicles used in railway stations, large manufactories, entrepôts, &c. In this case the metallic rim of the wheel takes the shape of a groove, in which the elastic band is embedded; the diameter of the latter is ordinarily calculated at four-fifths of that of the wheel.

Road locomotives appear to have acquired an increase of tractive power by the application of similar bandages. There is no vehicle, even down to the velocipede, which does not make use of this material, endowed as it is with so many precious qualities.

It enters largely into the construction of machines, and especially of pumps. The valves vary in form as well as in thickness; some are round, others are square or rectangular. The seat on which they rest has several apertures, they are thus supported otherwise than on their edges, which preserves them against the pressure. The metallic breastwork which forms the seat ought to present no projecting edge, which would enter into the material, and cause speedy deterioration. These valves are, for the most part, made of simple india-rubber, but sometimes cloth is put between to give them greater tenacity. The special circumstances under which they have to be employed will guide the maker in the selection.

Certain valves are composed of a simple metallic

* A. Stevart: "Results of Experiments in the Elasticity of Vulcanised India-rubber."

sphere, covered with india-rubber, which, being raised by the liquid, falls down again as the piston descends, on the orifice it is intended to close. In order that these valves may retain sufficient suppleness to admit of their hermetically closing the orifice, it is better that they should consist of a hollow india-rubber sphere, filled almost entirely with small shot.

An ingenious application of india-rubber is that which has been made by M. Field, in respect to a valve composed of two india-rubber discs slightly conical, and placed face to face. These discs are flat and pierced with a hole in the centre, but they are compressed, and made to assume a conical shape by metallic pieces in the interior. Their external edges are in contact with each other, and maintained thus by the pressure which is exercised on their outer faces. The principal merit of these valves is their perfect resistance to the strongest pressure; in fact, their action being exerted in every part at the same time, the lips of the valve are forced against each other, with an energy which is greatest when the pressure is strongest. Messrs. Whitley, of Leeds, have applied this valve to all kinds of pumps, for pumping either cold or warm water or other liquids at pressures rising as high as ten and even thirteen atmospheres.

The Perreaux valve is exclusively composed of india-rubber. The side gets gradually thinner until it comes to the sharp edge, which is split, and opens out a little under the pressure of the liquid; it closes again as soon as the piston begins to descend.

As regards pumps which are intended to pump acids, an india-rubber bucket is used, in which the rod of the piston is placed; these pieces are moulded.

Hydraulic press rings made of india-rubber replace advantageously those covered with leather, which are high in price. These rings are moulded in exactly the form required, and they are much more flexible than leather ones, even of the very best quality.

India-rubber pipes, by reason of the multiplicity of their uses, and the diversity of their composition, form an important branch of manufacture. Those that are used for gas, acids, &c., and have to bear only a feeble pressure, are made of pure rubber by simply rolling a strip of paste round a mandrel; the soldering is easily effected by contact merely, and is consolidated by the pressure of two small blades, worked by hand. To prevent the paste from adhering to the mandrel, care is to dust it over first with powdered talc. Sometimes several strips are placed on the top of the other, the number being determined by the thickness of the pipe which is being made.

When the tubes are intended to be subjected to a certain pressure, they are consolidated by the insertion of one or more layers of cloth, the cohesion of which prevents the swelling of the pipe, the wearing away of the sides, or their rupture under extraordinary pressure. These pipes are generally formed as follows:—A round of india-rubber on the mandrel forms the first tube, over which a strip of cloth is rolled, done over with india-rubber by a calender; a fresh round of pure paste is followed by a second covering of cloth, and the operation is repeated according to the number of folds the pipe is intended to have: this number of folds depends on the diameter, and increases generally with it. The outer envelope is india-rubber. By increasing the rounds of cloth, we obtain pipes capable of resisting the strongest pressure.

When a liquid has to be pumped up, it is necessary to guard against the crushing of the pipe, which the atmospheric pressure would inevitably cause. For this purpose a spiral is used, made of galvanised iron or copper, which is either simply placed in the interior of the tube, or imbedded in the thick part of the rubber. Generally, the outer part of the tube is formed of coarse cloth, which serves as a protecting envelope, as these pipes are nearly always intended to be trailed on the ground; they are much used for fire engines and pumping engines.

All these kinds of tubes can only be vulcanised after they have been finished. They are placed on a vehicle which runs on rails, and run into a boiler 20 yards long, specially prepared for them.

I manufacture a particular kind of pipe, for which I have taken out a patent. It is made of tanned hemp, with an inside casing of india-rubber, and can be advantageously applied to a great number of uses. Being tanned, it is enabled to resist moisture, which has not the slightest effect upon it. It is much lighter than leather, consequently, in case of fire, a man can carry a much greater length, and can mount a ladder with it much more easily. The application of india-rubber sheets to the interior of these tubes prevents the infiltration of water into the pores of the tissue; it also prevents any loss of liquid, and protects them from injury. The resistance is very considerable; a diameter of $1\frac{3}{4}$ in. will bear a pressure of fifteen atmospheres, and one of $\frac{3}{4}$ in. will bear twice the amount of pressure. They are used for fire engines, for brewery funnels, water pipes, steam pipes, &c.

The ropes used for packing, which are made of cloth, done over with india-rubber, are made without core, that is to say, without any inner nucleus in pure rubber; they are generally used concurrently with hemp for furnishing stuffing boxes, and with the best results; the flexibility of the hemp admits of the expansion of the rubber, and this, in its turn, corrects the want of compactness presented by textile fabrics.

Straps merit special notice. They are composed of a certain number of folds of cloth done over with rubber, alternating with layers of pure rubber. The number of folds, and, consequently, the thickness of the strap, is in proportion to its width: for this reason, when the width is above 10 centimetres, there are at least three folds; above 15 centimetres, four folds; and above 25 centimetres they have from five to seven folds. They are made of all lengths in a single piece, and are joined exactly like those in leather. They work as well in water as in places heated to a high temperature. Their use is becoming very general, for besides being less costly than those in leather, they adhere much better. It is important that the several cloths of which they are made should not slip one over the other, and they should be made to adhere firmly by the intermediate layers of rubber. This object is attained by their being vulcanised in the press.

India-rubber has been used for some time in covering metal rollers employed for sizeing and finishing cloth; wooden rollers are replaced by metal ones, which prevent the necessity for using paper or cotton for stuffing the inside of the dressing cylinder; it also does away with the use of linen or woollen cloth for the external covering of the roller, one or more sheets of india-rubber being now used instead. Manufacturers find great advantage in this. The size, whether coloured or not, adheres sufficiently to the rubber to admit of either threads or tissues being well sized without any absorption of the material by the rubber; the size, therefore, as well as the colouring matter can be taken off the roller by simply washing it with water, which permits the immediate use of the same apparatus for sizeing in the other colours. The india-rubber covering, by adhering thoroughly to the metal, and having none of these protuberances caused by the crossing of linen or woollen covers, presents a perfectly smooth and regular surface, and gives greater uniformity to the sizeing.

The thickness of the covering varies from 12 to 15 millimetres, according to the diameter of the cylinder. To have it in good order, the surface of the cylinder should be perfectly smooth.

Billiard makers secure great elasticity for their side cushions by using india-rubber, to which they give various shapes at discretion. The material used for this purpose ought to have rather greater density than the raw rubber.

The other industrial uses to which it is applied are

innumerable; I need only mention the buckets and funnels used for acids, plugs with and without holes, rings and flanges for the joints of washing machines, rollers for twisting frames, sets of pulleys for ribbon saws, guide straps and aprons for paper-making machines, joints for filter presses used in sugar manufactories, moulds for hat manufacturers, aprons for sugar works, &c., &c.

As regards the application of indurated rubber, we may mention the rollers for spinning frames, made in two parts of different composition and colour, the vulcanisation of which is effected gradually, by means of a slow and progressive elevation of temperature, and lasts about four hours.

In telegraphy, insulating bells are used, suspended on hooks of galvanised iron. The outer surface is polished all over, and presents a thickness of 2½ millimetres, so as to cut off the electric current.

If I were to point out all the applications of india-rubber to surgery and ordinary uses, I should become involved in an endless nomenclature utterly at variance with the object of this brief memoir.

CHANNEL PASSAGE.—THE "CASTALIA," AND "BESSEMER" STEAMER.

These two steamers are now approaching completion. The *Castalia* is launched, and the *Bessemer* is nearly ready for launching. The *Castalia* will have the lead, as she is nearly ready for a Board of Trade trial.* Neither ship will be permitted to carry passengers without a preliminary sea-going trial, with the Board of Trade officers on board. This implies no want of confidence in either ship, but in the usual and invariable custom of any ship of novel construction before the Board of Trade issue their certificate that she is safe for the passenger trade. As far as we are able to ascertain both ships are well and faithfully built. To our mind the only advantage they will possess over existing Channel steamers is in their size. The Dicey boat, *Castalia*, cannot possibly get nearly so much power out of two paddle-wheels between two hulls as out of two paddle-wheels for one hull. Everyone of the slightest experience knows that for speed alone, one large hull is better thon two of half the size, each having half the power of engines. And in two hulls there is twice the rubbing surface of water, whilst the back wash from the paddles between the two hulls must seriously retard the speed. One mistake appears to us to be serious, and that is, hanging the two paddles on a continuous shaft. The hulls may work slightly, and this may endanger the shaft.

As regards the *Bessemer* boat, being a long one and broad, she is sure to be comparatively steady in the short Channel seas; but the placing of one paddle-wheel on each side before the other is an important experiment.

The one motion that chiefly causes sea-sickness is the vertical rising and falling of the ship. The rolling and pitching are of less but of some consequence; and if persons given to sea-sickness are not sea-sick in crossing the Channel in these two steamers, the reason will, we think, be chiefly on account of the length and breadth of the ships preventing so great a vertical rise and fall in the short choppy Channel seas, and we are led to the conclusion that a large and broad single-hulled steamer of the ordinary type would be just as successful as either, and would be much preferable to the *Castalia* on account of speed. The *Castalia* will, we predict, certainly not be as fast as some of the present steamers, and will probably burn more fuel. The following are descriptions of these steamers abridged from the *Times* :—

The Dicey steamer was launched at the Thames Iron Works yard about two months ago, and is now being fitted in Victoria Docks.

The idea of this ship was suggested to Captain Dicey by the outrigger boats of the Eastern seas. The *Castalia* may be roughly described as the two halves of a longitudinally divided hull 290ft. long, placed 26ft. apart, bound together by girders, upon which is built a raised deck, enclosing cabin space. Under this deck in the water-way dividing the halves of the hull, work a pair of paddle-wheels, hung side by side upon a single axis driven by two pair of engines, one in each half of the vessel. The *Castalia* has a beam of 60ft. Fore and aft of the engine space are state saloons, running the whole width of the vessel, covered in by the hurricane deck. The top of the hurricane deck affords a promenade. The lower deck runs forward and aft to within a few feet of the bow and stern. A double-hulled paddle-steamer, called the *Gemini*, was constructed years ago and failed, as have other ships of the sort. The *Castalia* is different in some respects from her predecessors. The inner side of each half of the Dicey steamer is built up in a perfectly flat or "wall" side, and is expected to offer less resistance to the water than if each rounded hull had been made complete. The bows of the steamer are 26ft. apart. The paddle-wheels are in the centre of the vessel instead of the sides, and as they work, the water behind them must press against the inner sides of the steamer towards the stern; 12½ knots is the speed reckoned on. Twelve knots will be the least that will be useful for the passage between Dover and Calais. She draws 6ft.; has no paddle-boxes, and can lie close alongside. She need not turn, as she steers from either end. The *Castalia* has no masts.

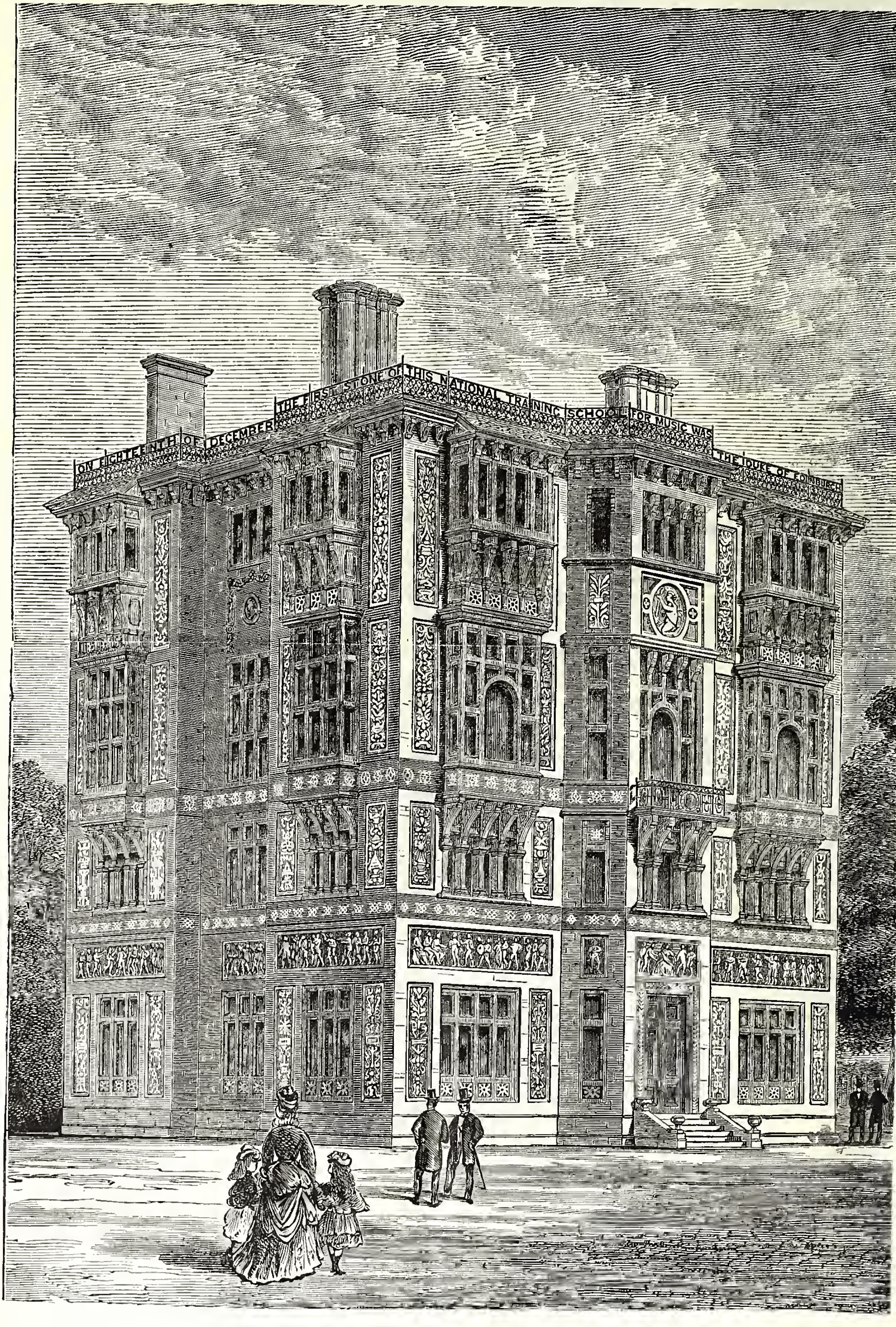
The *Bessemer* saloon steamer is more ambitious, being 350ft. long, with an estimated speed of 20 miles an hour; her intended draught is 7ft. 6in. The Calais mud will not allow her another inch. She will be driven by two pairs of engines, exerting a power of 4,600 horses and four paddle-wheels. The width of her deck is 40ft. She can steam either way, being shaped alike at each end. For 48ft. from each end she has comparatively no freeboard, and the centre portion, which is 252ft. long, is so shaped and raised as to act as a breakwater, throwing off water which will wash freely over the lower deck at each end. The *Bessemer* swinging saloon is in the centre of the vessel, and is 70ft. long, 35ft. wide, and 20ft. high. The mechanical appliances are intended to counteract the rolling motion. The axis and the controlling hydraulic apparatus are to be under the command of one man, who by moving a handle will keep the floor of the saloon in line with a spirit level. The supports of the axis, on which the saloon is hung, rest upon beds of india-rubber. The deck over the saloon will be a promenade. Luggage will not be treated as now, but at the point of departure will be loaded into the railway vans in crates, which will be swung into the hold of the steamer. The Channel passage is not expected to take more than 70 minutes. There is, besides the swing-cabin, a fixed cabin at one end between decks, 52ft. long, and a line of small cabins on each side, for a length of 150ft., between the paddle-boxes. Above there is the deck, 252ft. long. Her construction has been very costly.—*Nautical Magazine.*

* The trial trip of the *Castalia* was successfully made on the 8th instant, since the above was written.

It appears that in 1871 there were in Saxony 469 mines, embracing 36,095 hectares, and in 1872 there were 630 mines in 39,100 hectares. Of the latter 312 were metalliferous and some other mines, 101 were collieries, and 217 were lignite mines.

The *Golos* states that during the year 1873 the total mileage of Russian railways increased from 13,217 to 15,191 versts, or in the ratio of about 15 per cent., the new branches being confined to the basins of the Dnieper, the Vistula, and the Duna, in the south-west portion of the empire. Out of the forty-five different lines one alone, the Livny (length 57 versts), is a State railway, all the others being the property of companies.

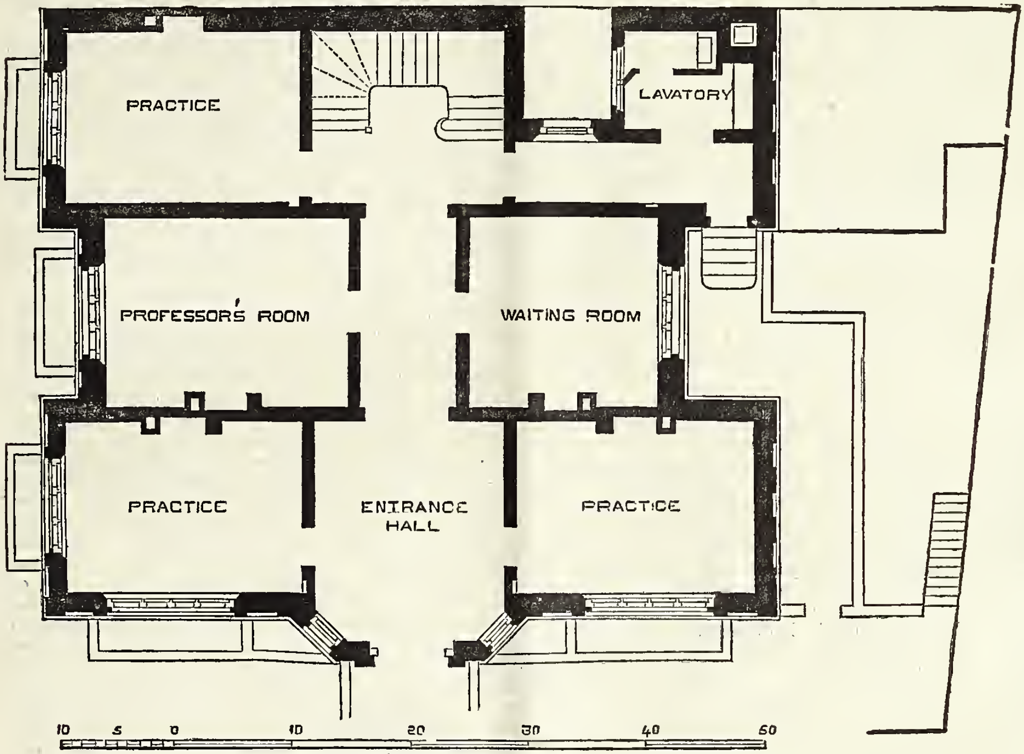
NATIONAL TRAINING SCHOOL FOR MUSIC, SOUTH KENSINGTON.



NATIONAL TRAINING SCHOOL FOR MUSIC.

The accompanying view and ground plan of the building for the National Training School for Music, now in course of erection at South Kensington, close to the Albert Hall, is taken from the *Builder*, in which they have already appeared, by kind permission of the proprietors of that journal.

As the scheme, so far as it has yet been decided on, for the management of the school, has already appeared in former numbers of the *Journal*, there is nothing to be added at present to the information already published. The building is progressing steadily to completion, and when it is in a condition to render further description possible, a full account of it will be given in the *Journal*.



NATIONAL TRAINING SCHOOL FOR MUSIC.—GROUND PLAN.

GLASS MOSAICS.

A new method of ornamenting glass is thus described by the *Architect*:—The patentee uses ground or obscured glass to paint upon. One side of the glass is ground or roughened with emery powder in the usual manner. The rough surface gives a key to bind the painting, and also enables the artist to produce any colour, tint, or tone of colour, with power to blend and graduate the tints, also to glaze upon the tints of colour so as to bring out the richest effect of which each colour is capable. Another advantage of the ground surface is that it destroys the crude appearance of the paint as it appears when done upon the smooth glass; in fact, the artist may paint as he would upon canvas. The design or picture is first sketched in outline upon paper, and then traced on to the glass. It is then either outlined or painted direct upon the ground side of the glass. All those portions of the design which are to appear as gold in the finished painting are washed over with a transparent or semi-transparent yellow in distemper or water-colour, and, when dry, varnished with a clear transparent varnish. Those parts which are to appear as silver are simply varnished with clear varnish. If a rich blue is required the colour is laid on in distemper and varnished, and so on with red, amber, &c. If a tint of colour is required the parts are painted over with oil-colours, and then wiped off again, leaving as much or as little as is requisite to get the tone or tint required. However clear the glass may be wiped with a dry cloth, the glass will retain a certain portion of colour, and the shadows may be put in and blended while the colour is wet, the varnished parts being shaded when the varnish is dry. By this method the artist will be enabled to blend in the most delicate tints, with a softness of effect and variety of tone not hitherto attained in painting on glass. The painting being now complete is subjected to about 190° of Fahrenheit, which hardens the paint and varnish. The whole of the painting is now covered with leaf silver, which produces on the yellow parts gold, and silver on those parts which are simply varnished on the glass, and any portions of the glass left uncovered will appear as frosted or dead silver. Its effect upon the painted portions is to cause them to have a luminous appearance, keeping them equal with the gold and silver when viewed from any position. The silvering being complete, the work is then varnished and backed with a suitable paint, and again stoved. The painted glass is then secured to a thick slab of glass by a suitable cement, and is then ready for use, the edges of both being ground so as to fit perfectly square. By a peculiar process the surface of the glass may have a bright polish, a semi-gloss, or a perfectly dead surface.

IRISH FLAX CULTURE.

Mr. W. Charley read the following paper "On Occasional Errors Prevalent in the Management of Flax Fibre in the Early Stages," on Tuesday, August 25, before the Chemical Section of the British Association:—

The cultivation of the flax plant in the field is not a matter of extraordinary difficulty. Any careful agriculturist who will take the trouble of reading the printed instructions circulated by the North-East Agricultural Society and the Belfast Flax Supply Association will be able to master the details necessary for the growing of the crop. It is the after management that generally embarrasses the farmer, and particularly in those districts where the crop is tried for a first time. The extension of flax cultivation in the British Isles would be very useful to the important industry of the linen manufacture, and would add a remunerative crop to the limited list of the British agriculturist. At present the area occupied by flax is chiefly to be found in Ulster. The present year's return gives 102,789 acres for this province, the rest of Ireland showing only 4,097 acres. I am not aware of any accurate statistics on the subject regarding England and Scotland, but a few thousands would probably cover the quantity of acres they produce. The variation in the number of acres of flax in Ireland is very remarkable. The lowest I can find a record of in this country was in 1848, the number being only 53,863 acres. One of the highest seems to have been in 1863, viz., 213,922 acres.* Of course, a short Irish crop causes large importation of foreign flax, and this leads to extensive payments abroad instead of at home. The first difficulty that meets the inexperienced farmer after his flax is gathered off the field is the steeping process. The celebrated Louis Crommelin (appointed overseer of the linen manufacture in Ireland by King William III.), writing in 1705 on the subject of preparing flax, quaintly says:—"Flax may be prepared without watering by grassing it until such time as the stem corrupts; yet it is better to water it where it can possibly be done without great inconvenience." Now, so far as I can form an opinion, this plan of preparing without watering, commonly called "dew rotting," is quite unsuited for any but the very coarsest flax, such as would not be spun into yarn used for making bleaching cloth; and my object in writing this small paper is to warn the inexperienced that if once flax be so treated the prices obtained will be comparatively low, and the result, if the article goes to a bleach-field, will be very unsatisfactory. There is something in the process of steeping flax—a process more accurately, perhaps, described by the common expression of retting or rotting—which seems necessary to ensure the attainment of high colour when the prepared fibre is manufactured into cloth, and arrives at the bleaching department. The fermentation, which seems of a putrefactive character, acts on the juices and gummy matters which cement the woody stem to the pure fibre of the plant, and also not only assists the after separation of these, which is the object of the subsequent scutching operation, but has such a powerful effect on the colouring matter of the fibre as to render the change required in bleaching much more safe and successful. But, though grassing alone is not sufficient to make a proper preparation of good fibre, it is, after the steeping is over, a most useful and necessary addition.

I need not cumber these few remarks with a description of the steeping of flax in the ordinary way. The printed instructions for the cultivation already referred to give ample information also on this point. What I want to call attention to is the fact that the best flax, unless properly watered and grassed, will not be likely to prove remunerative to anyone; and I hope that those farmers who reside at a distance will follow the example of those in Ulster, and give some time and trouble to this rather difficult part of flax management. Let the cheaper plan of dew rotting be never applied, except to rough, coarse flax, and the result will, I feel sure, be more profitable to all concerned. There is another point worth mentioning on the subject of steeping flax; brackish water, such as may be met with in the low-lying districts near the sea, should be carefully avoided. The result of using such is now, I believe, generally admitted to be injurious to the fibre intended for white linen, and it gives a leaden dull colour in many cases to the flax itself. With respect to improvements in the flax steeping process, there is really very little to report of late years. The ordinary open-air system is carried on now much the same as when Louis Crommelin wrote in 1705. Various new plans have been suggested, and to some extent tested with more or less success.

So far back as 1808 Mr. O'Reilly, of Belfast, suggested boiling the flax in hot water. Mr. Shenck more recently patented a system of fermenting in large vats, in a covered building, with water heated to about 80° or 90°, and, no doubt, this plan worked pretty well. I think if this system could be extended, and grassing in the ordinary way added to it, some good might result; though I should not like to say positively it would be a financial success. The system proposed by Mr. Watt, and in operation for several years, is slightly different. The flax is placed in an iron steam-tight chamber, with a condenser on the top. The steam introduced at the bottom heats and softens the flax, and, being condensed in contact with the roof of the chamber, falls down in water through the flax, washing and cleansing it on its way. The flax is afterwards heavily rolled and dried. This plan may suit for coarse and strong flax intended for making strong threads and lines used in the brown condition; but I think for the fine fabrics that the old method will be more successful in every respect. Mr. Andrews, the Secretary of the Flax Supply Association, informs me that he has successfully tested a plan of fermenting in covered vats, the temperature of the air in the building being increased by steam heat to the required point. If the agriculturist had no other cost and difficulty than the simple cultivation of the flax plant, the extension of the growth of flax would be comparatively easy to carry out. The trouble of steeping and after management renders the crop less popular than it should be. The advantage of producing on the farm a large quantity of flaxseed, so well known for the nutritive qualities it contains, would of itself be an attraction to many intelligent farmers, for there is no doubt by a little skill and care the greater portion of the flaxseed can be taken off and preserved for feeding purposes without any injury to the fibre. The time may arrive when a regular and extensive business may be taken up in all flax-growing districts by enterprising individuals with the object of buying the flax from the farmers in the green state, and treating it in an improved way on a large scale, combining probably the steeping of the flax and scutching operations in the same establishment. Meantime, let farmers who wish to make profit in growing flax attend as carefully to the watering process as to the field cultivation, and avoid as a general rule the imperfect dew rotting system, or the use of brackish water in any of the pools intended for steeping this valuable plant.

In conclusion, I may remark that the present month of August is the time the farmers of Ulster are in the habit of watering and grassing the flax crop; and the air in many localities is so full of the odour arising in these necessary processes, that it is possible, if the cause is not explained, that many of the members of the British Association, who come from a distance, may form a prejudice against our climate and atmosphere. I can assure those strangers, whose presence amongst us at this great meeting we cordially appreciate, that this unpleasantness is of a

* The next year, 1864, was still larger, but being exceptionally so, I prefer not quoting the very highest, but one of the largest, such as 1863, which is over an average.

transient character, and will pass away in a few weeks; while we may reasonably hope that the beneficial effect to science in this neighbourhood, by the scientific contributions and advice of the many talented men met together, will have a permanent and useful influence in years to come.

THE SALT WORKS OF VOLTERRA

The royal salt works of Volterra, in the province of Pisa, are the most important in Italy, and are situated on the River Cecina, about seven miles from the town of Volterra, near the terminus of the branch line from the railway from Leghorn to Rome, called the station of "Le Saline." These works have been leased by the Government to a contractor for 25 years.

The salt occurs in beds in the ash-grey miocene or middle tertiary clays, and several pits, averaging from 20 to 30 metres in depth, have been sunk in a place called "Le Moje Nuove," about a mile distant from the works. The pits being supplied with water filtering naturally through the soil, the brine constantly varies in strength according as the rainfall is more or less, and from other changes of the atmosphere. The brine is pumped up by horse-power and conducted in a wooden canal to the works. As some of the pits yield a weaker brine than the others, they are employed in dry seasons for reducing the strength of that of the pits which contain more salt to 20° or 21° Baumé, which experience has proved to be generally the most convenient strength for evaporating.

The works are provided with five complete sets of evaporating apparatus placed in suitable buildings; the pans for evaporating the brine are made of boiler plate, and are 28 ft. 9 in. long, by 21 ft. wide, and 1 ft. deep; to each pan are attached two others of similar dimensions for concentrating the brine. Each of the evaporating pans is provided with three fireplaces, and the waste heat is turned to account for the concentrating fires.

The brine is conducted from the pits to large wooden tanks placed at a higher level than the evaporating apparatus, and from thence it can be drawn as required, passing first to the upper concentrating pan, which is heated to 30° C. (86° F.), then to the lower one, where the temperature is raised to 70° C. (158° F.), and finally to the evaporating pan, which is heated to boiling point. Every six hours the salt that has been deposited is scraped out and allowed to dry for a short time, and then put into sacks. About two tons of salt are produced every six hours, and the daily production of the establishment ranges from 40 to 43 tons. The fuel used is chiefly brushwood, and it is found that to produce one ton of salt one ton of wood is consumed. These works also produce refined salt and *sale pastorizio*, or salt for agricultural purposes.

The refining of the common salt from the evaporating pans is a very simple operation, consisting in merely heating it until it is reduced to a fine powder, and it is afterwards pressed by hand in moulds into blocks weighing one kilogramme each, which are packed in paper by women and girls.

The salt for agricultural purposes (*sale pastorizio*) which is sold at a comparatively low rate, consists of the refuse scrapings of the evaporating pans, which are ground in a mill, together with gentian root, red earth, and vegetable charcoal, and this mixture, to which a little water is added, is pressed by hand into moulds of cylindrical form, about six inches in diameter and seven and a-half in height. These cylinders are afterwards dried.

The retail price of the refined salt is 76 frs. per 100 kilos.; that of the common salt 66 frs., whilst the salt for agricultural purposes is sold as low as 12 frs.

The whole operations are conducted on the piece-work system, the men earning from 2 to 3 frs., and the women and girls from 1 to 1·50 frs. per day.

Arrangements are also being made for the manufacture of soda from the brine on a large scale, by an improved process, invented by Signor R. Campani, the chemist to the works. This manufacture will shortly be in full operation, and will, without doubt, form an important addition to the establishment, and tend to increase its prosperity.

THE TEA INDUSTRY IN BENGAL.

The Government of India, in consequence of the great and growing importance of the Indian tea trade, have thought it desirable to obtain certain general statistics in regard to the present position of tea culture in all parts of the empire. For this purpose schedules were issued to the owners of the plantations, with the request that they would furnish the desired information, accompanied by a brief history of tea planting, and by a well-considered estimate of the present position and apparent prospect of tea culture in each district. The opportunity was thus given for ascertaining at the same time what obstacles to the fullest development of this important branch of industry existed in each locality, and what, if any, measures could properly be adopted by Government in furtherance of the tea cultivation. Although inaccuracies are believed to exist in the returns, owing to a misapprehension of the meaning of some of the questions, and unwillingness on the part of the planters to respond to the request in one district, that of Luckimpur, considering the difficulties attending all the earliest attempts of this kind, the results may be considered very satisfactory; they will furnish an opportunity for persons interested in the present and future of the tea industry to examine all the points of greatest interest in regard to that industry in a manner which has not hitherto presented itself, or been available for the purpose. The advantage of such a return, which is probably the commencement of a series, is therefore sufficiently apparent.

It has been found that tea is attained to a greater or less exent in five divisions in Bengal, viz., Assam, Dacca, Kuch Behar, Chittagong, and Chota Nagpur. The area of waste land at present held by persons connected with the industry, as shown by the records of the different district officers, amounts to three-quarters of a million of acres. Out of this area the returns show that 75,000 acres are actually cultivated with tea, that is ten per cent. of the total acreage held for tea purposes.

At the head of the divisions comes Assam, in which tea is grown in five districts—Seelsagar, Durrung, Luckimpur, Nowgong, and Kamrup. The total area taken up for tea planting is stated to be 364,990 acres, and the amount cultivated (exclusive of the unreturned gardens of Luckimpur) to be 26,853 acres, a little more than 7 per cent. The area under mature plant is returned at 21,890 acres, that under immature as 4,963. The produce of both classes during the year was 6,150,764 lbs., of which 1,500,000 lbs. were produced by the Assam Company. Next to Assam comes Dacca, with two tea growing districts—Silhet and Cachar. The amount of land taken up for tea is 281,174 acres, which will shortly be reduced to about 200,000 acres, when certain changes have been effected. The cultivated area amounts to 36,751 acres, more than 9 per cent. of the present holdings, and about 13 per cent. of the probable revised acreage. The area of mature plant is put down at 23,031 acres, and that of immature plant at 3,720 acres. The out-turn of the division in 1872 was 5,296,169 lbs. Next to Dacca in importance as a tea-growing division is Kuch Behar, with two tea districts—Darjeeling and Goalpara. The area taken up for tea purposes is 133,024 acres. The amount returned as cultivated is 14,369 acres, or about 11 per cent. of the entire area held for tea. Out of this 10,181 acres has been returned as mature, and 4,457 as immature. The out-turn of the division in 1872 was 2,955,926 lbs. In the Chittagong division there is only

one tea-growing district—Chittagong itself. The area taken up for planting is shown as 23,890 acres, but this is probably under the mark. The amount of cultivation is said to be 1,203 acres, of which 1,034 is returned as mature, and 169 as immature. The out-turn for 1872 is given as 204,112 lbs. The tea cultivation of Chota Nagpur is very unimportant, though there are gardens in two districts—Hazaribagh and Lohardugga. The entire area taken up is returned as 1,504 acres, and the total cultivation 894 acres, of which 835 is shown as mature, and 59 as immature. The out-turn for 1872 was only 53,200 lbs. The result of these returns shows that the produce of the whole province of Bengal amounts to about 15,000,000 lbs., although the figures are at present somewhat conjectural.

According to the opinions expressed by Mr. Edgar, in his general report upon this census of the tea districts, there cannot be the slightest doubt that the industry is in an infinitely better and safer position now than it was ten years ago. The existing gardens are, as a general rule, well filled with plant, highly cultivated, and carefully managed. The amount of tea produced per acre, although falling far short of the sanguine expectations of the first days of tea planting, is satisfactory in all the most important districts, while the prices obtained this season show that the average quality must be very good. There is, he thinks, every reason to hope that tho labour difficulty is disappearing in Cachar, and in spite of the complaints from Assam there are evident signs of improvement in that province. In Darjeeling there is at present some difficulty, but the labour question is even less troublesome than it has been at all times in Assam and Cachar. But while there seems every reason to hope that the industry is now entering on a period of prosperity and stability such as it has not hitherto experienced, it would be most unwise to ignoro certain unpleasant signs which seem, when read by the light of past experience, to indicate a recurrence to that spirit of speculation and want of foresight which so very nearly ruined tea planting in former years.

SERICICULTURE IN NEW SOUTH WALES.

During the late exhibition at Sydney, a meeting was held to hear Mr. Brady's statement with respect to what he has accomplished on tho river Tweed during the past season with such grain as he took there of his own and M. Roland's (Switzerland). He was freely questioned by the gentlemen present, and a good deal of information was elicited. It seems that he took with him to the Tweed, where some preparations had been made in the way of planting mulberry-trees, 14 or 15 oz. of M. Roland's regenerated grain, and six of his own acclimatised Australian grain. One season's manipulation had given him 2,000 oz., which is to be kept for supplying co-operators—should they appear—or sold. In consequence of the healthy character of the worm here, it is deemed better to supply grain than silk, the process being simpler and more profitable. Italian and French sericiculturists depend now on Japan seed mainly, which is far from good. Their purchases amount annually to about £2,000,000, and there is no doubt we could offer them a better article than they get now. In the course of conversation, Mr. Brady explained that, instead of being confined to one rearing a year, as most countries are, he has discovered that by a judicious lowering of temperature and provision of food, a continuous production of worms should be produced throughout the year, and in this way the profits would be highly multiplied, and the employment constant. Cold is here the agent. For this ingenious method of hybernation, Mr. Brady deserves the greatest praise. He stated his ability in this way to produce worms on any day he wished, and so healthy is his grain, that he can depend on 35,000 worms from every 45,000 eggs.—*Warehouseman.*

THE BAMBOO.

A pamphlet has been published at Cairo by the Agricultural Department of Egypt, on the Indian Bamboo, which, it is said, is being acclimatised there with great success. The following notes are taken therefrom:—The gigantic bamboo, which is of colossal dimensions, growing to the height of 20 mètres, with a circumference of 40 to 50 centimètres at the base (say 65 feet high and 15 to 18 feet in circumference), from tho joints of which, especially those of the middle and upper parts, grow numerous branches with long leaves, is the most vigorous species of this arborescent plant. It was introduced some years ago into the gardens of the Khédive of Egypt, at Ghézireh, from whence it has been multiplied in two or three other gardens of Egypt. It was so much admired by the Emperor of Brazil, on his visit to the gardens of the Khédive last autumn, that he expressed his determination to import it into Brazil, and to cultivate it upon the Imperial estate as a shade for animals during the heat of summer. The gigantic bamboo originates in India and China, and is highly appreciated wherever it is cultivated, being used for posts in pavilions and the houses of the inhabitants. The hollow joints are utilised for carrying liquids, for flower-vases, &c.; and in China, and especially India, for bottles and tobacco-boxes, highly wrought and polished, and sold at great prices. The larger stalks are also used for bridges, water pipes, and carts and other vehicles. In fine, the wood is employed in the arts, in a multitude of industries, and for implements of agriculture. This species of bamboo vegetates with such rapidity that it can almost be said that one can see it grow. Its progress may be seen from day to day, and at Ghézireh it has been known to grow 9 inches in a single night. In China, criminals condemned to death are subjected to the atrocious punishment of impalement by means of the bamboo. A humid soil is congenial to the gigantic bamboo, although it suffers under a prolonged inundation. It is proposed in Egypt to cultivate it upon the borders of the canals in the vast domains of the Khédive. There is also in the gardens of Egypt another species of bamboo, believed to be the *Bambusa arundinacea* of Wildenow. It presents the following characteristics:—The stalks are smaller and shorter than the gigantic bamboo of India; it attains about 12 mètres (39 feet) in height; it forms larger tufts or clusters than the great bamboo, and throws out a greater number of stalks, which are furnished with numerous slender and flexuous branches, bearing ordinarily tolerably large thorns, a little arched at the joints or articulations, and the leaves are smaller than those of the gigantic species, being rounded at the base, lance-shaped, tapering to a point, and a little downy. There is also another species of bamboo which it is proposed to cultivate in Egypt. It attains the height of 5 or 6 mètres, produces enormous clusters of canes, about the size of the finger, and makes excellent props for use in horticulture. A plant of two or three years' growth will furnish a hundred stalks, forming a cluster of vast size. This species is the *Bambusa edulis*, so called from the fact that its young shoots are edible, and in China regarded as very nourishing. There is still another species of bamboo to which the attention of the cultivators in Egypt is called. It is the black bamboo (*Bambusa nigra*). It is distinguished principally by its slender branches, which are of a fine black colour, and from which canes are manufactured extensively for exportation. Pens are made from the smaller stems, which are commonly used for writing in Egypt.

The South Australian railways and tramways, which last year realised £160,000, it is expected this year will yield £140,000. From the land sales £250,000 was expected, as against £185,000 last year. The total revenue was estimated at £7,000 more than last year.

ITALIAN COMMERCE IN NEW YORK.

The report of the Italian Vice-Consul at New York, on the state of Italian commerce and navigation at that port, will not be read without interest, more especially at this time, as it touches upon the coal question. This report demonstrates clearly the immense progress that has been made of late years by Italian shipping. During 1873, the number of Italian ships that entered the port of New York was 426, manned by 5,546 seamen, and bringing 69 passengers (this small number of passengers is due to the fact that all these vessels were sailing crafts). The number of departures were 408. These vessels came from Palermo, Castellamare, Genoa, London, Queenstown, Marseilles, Antwerp, and those that left were bound for Naples, Cork, Hull, Gibraltar, and Falmouth. The total tonnage of these 426 vessels amounted to 200,264, giving an average per ship of 470·10 tons each. Compared with the results of the last four years, it will be seen that the tonnage has nearly doubled itself year by year, and this plainly shows that the number of ships has increased at least 30 per cent.

The following shows the movement of shipping during the last four years:—

	1870.	1871.	1872.	1873.
No. of ships	86	160	259	426
Total tonnage ..	31,865	60,560	109,555	200,264
Average tonnage	370	378·50	422·95	407·10

A better idea may be formed by comparing it with the traffic in 1873 by ships of other nations, as will be seen by the following table:—

	Steam-ships.		Sailing-ships.	
	No.	Tonnage.	No.	Tonnage.
Great Britain....	597	1,521,185	1,606	624,540
Italy	..	..	426	200,264
Germany	169	153,760	318	90,851
France	27	58,760	10	2,298
Austria	..	..	163	102,485
Sweden & Norway	21	34,716	524	199,908

It will be seen from this that Italy follows immediately after Great Britain as regards the importance of the movement of her shipping. As may be easily imagined, a great increase may also be observed in the value of the imports and exports, and whilst the former in 1869 amounted to 2,759,575 dols., their value in 1873 reached a no less sum than 6,130,570 dols.

The imports from Italy consist principally in oranges and lemons, maccaroni, sumac, rags, sulphur, and dried fruits. The sale of Italian wines cannot as yet be said to be fairly established at New York, although they are beginning to be appreciated, and especially the "Vermouth" of Turin, which finds a ready market. The imports from other countries consist chiefly in rails, old iron, lead, salt, glass-ware, French wines, and soap.

The exports as compared with those of 1869 have increased in still greater proportion, and whilst in that year they represented a value of 4,200,000 dols., in 1873 they amounted to 15,675,000 dols. The articles exported are chiefly cereals, petroleum, tobacco, drugs, alcohol, dye woods, and salt meat, cereals and petroleum representing at least two-thirds of the total exports.

The amount paid for freights to Italian vessels amounted in 1873 to 11,196,000 francs in gold.

In the conclusion of this report the writer recommends strongly the export of American coal to Italy, and points this out as a fresh source of gain to shippers. Italy, he states, would derive more advantage by obtaining her fuel from America than from England, where from strikes and other causes the price of coal has so increased that it is impossible to get it delivered at any of the Italian ports under from 50 to 60 francs per ton (this refers to steam coal, viz., West Hartley steam coal), and this is necessarily a serious obstacle to the development of navigation. Discoveries of coal are being made daily in the states, without mentioning the mines of Georgetown, in Maryland, Pennsylvania, Sydney, Cape Breton, &c. The coal from the mines of Cumberland, which produce yearly 800,000 tons, may be shipped at various ports, as, for instance, at Baltimore, Alexandria, Georgetown, which are open to vessels drawing from 15 to 20 feet of water. The present prices free on board are at Alexandria $4\frac{1}{4}$ dols. (paper) per ton, and at Baltimore $4\frac{1}{2}$ dols. The freights for the Mediterranean ports vary from 5 to 6 dols. in gold, and shipping dues about 8 cents. per ton. This coal is used extensively by many large steamboat lines, and the advantage will be readily seen that would be derived by Italy in importing the coal from America. The report contains also a great deal of other information which will certainly be of interest to shipowners, not only of Italy, but of other nations.

THE INDUSTRIES OF ANCONA.

One of the principal industries of the district of Ancona, in which Consul Tomassini resides, is in flour and maccaroni, the latter article being exported in rather large quantities. Jesi, a town distant about twenty miles, is distinguished for its preparation of rice. A great improvement has taken place in the cultivation of the grape and preparation of wine. A small provincial exhibition was held, at which fifty-three different qualities of wine were exposed, all belonging to the province. Of these qualities twenty-five were dinner wines, eighteen dessert, and ten fancy wines. A society, formed in Loretto, produced a quality which was highly praised, and is now being sold as an imitation of champagne. Red and white wines are exported only in small quantities, which, no doubt, is in consequence of the export duty being rather high. There are thirty-three silk-spinning machines in the district, of which eight are worked by hand and twenty-five by steam. In the year 1871 five were closed, and the remaining twenty-eight spun 467,493 kilos of cocoons (467 tons). Besides the cocoons produced, a great quantity of those produced in other provinces of Italy, Greece, Spain, and France, are brought to Ancona for spinning. The silk produced in the district is held in very high estimation, especially at Lyons, where it is considered better than the quality produced in North Italy. Goat and lamb skins, which are accumulated from other parts, are not only used locally, but are sent abroad in great quantities, especially to France and Germany. Hides are principally imported from South America and Asia. Since the opening of the Suez Canal, direct importations have been made from India. Rope and yarn form important articles of export to Greece and Austria. Rope for naval purposes is exported in fair quantities to Dalmatia and Trieste; that made by machinery is sent to Genoa, Naples, and Venice. Besides these, hand-made canvas is held in very good repute, and, taking into consideration the quality of the thread, its perfection and moderate price, it may be compared with any other made by machinery. Linen is an article of industry made principally by women in the rural districts, and occupies about 200 looms; it is sold principally in Rome and Comarca. At Fabriano there is a large manufactory of earthenware, all made by hand. In the same town there is a manufactory of "Vermouth," and it is also renowned for the different liquors manufactured and exported abroad. At Jesi a soap factory produces about 150 tons of soap in a year.

The condition of the port, relative to its depth of water, has not improved. Since the Italian occupation of Venice, Ancona has in a great degree been left aside,

and public works of great utility, that had been commenced in earnest, have suddenly ceased. As long as Venice remains a free port, Ancona can never compete with that city, especially when Venice has the privilege of subsidized steamers communicating with the most distant regions. The local commercial community are continually petitioning Government concerning their present state of isolation, but so far all remonstrances have been in vain.

OBITUARY.

Sir John Rennie, F.R.S.—The death of this eminent engineer took place on the 3rd instant. Sir John Rennie was the son of Mr. John Rennie, also a member of the engineering profession, and was born in 1794 in Stamford-street. He was educated by his father for his own profession, and one of his first works was the execution of his father's design for the new London-bridge. It was upon the completion of this work, in 1831, that the honour of knighthood was conferred upon Sir John. About that time the question of railway communication was growing into importance, the first railway had been made and was working, and Sir John quickly identified himself with the movement. He soon became practically connected with the construction of railways, and during the remainder of his professional career was largely identified with their progress both at home and abroad. Two other important works commenced by the elder Rennie were the drainage of the Lincolnshire coast at the Wash and the construction of the harbour at Ramsgate, both of which schemes were carried out by Sir John. The docks at Whitehaven were also made by Sir John for the Earl of Lonsdale, and he was engaged on various other works at home and abroad. His services on the Continent were rewarded by several distinctions, the Knighthood of Wasa of Sweden and that of the Tower and Sword of Portugal among others. Sir John was a member of the leading institutions connected with his profession. He was also a Fellow of the Royal and other Societies, in the proceedings of which he ever took an active interest. His connection with the Society of Arts commenced in 1849; he was a Vice-President for some time, and generally took an active interest in many of its undertakings.

NOTES ON BOOKS.

The Manufacture of Colours for Painting. By Riffault, Vergnaud, and Toussaint. Revised by F. Malepeyre. Translated by A. A. Fesquet. Philadelphia, *H. C. Baird;* London, *Sampson, Low*, 1874.

This is an American translation of the French work, published simultaneously in England and the United States. It is intended to be an exhaustive treatise on the subject, and goes deeply into its various subdivisions. Beginning with an account of the researches into the nature of ancient pigments made by Sir Humphrey Davy's and other well-known chemists, the work next proceeds to discuss the "Origin, Definition, and Classification" of colours, referring amongst other matters to the important researches of M. Choiseul into the relative effects of contrasted colours. From this the authors pass at once to the practical part of their labours, and take up in order the various colours, detailing the sources whence they are obtained, their manner of preparation, uses, applications, &c. After all the different colours have been treated at length, there follows a chapter upon drying oils and other dryers, and lastly a chapter on bronze and bronzing. There are also appendixes, describing several colour mills, &c. The book is illustrated throughout with a number of outline wood-cuts of apparatus employed in the various processes.

GENERAL NOTES.

The Messageries Maritimes.—The aggregate distance traversed last year by the steamers of the Messageries Maritimes was 610,689 marine leagues. The corresponding distance traversed in 1872 was 515,187 marine leagues. The increased sailings of last year occurred principally upon the Brazil and La Plata line, which was doubled in the course of 1873. A commercial line was established last year between Marseilles and London. Some extra voyages were also made last year between Marseilles and Constantinople, *via* Salonica, and between Marseilles and Barcelona. The average distance run by each steamer employed last year was 10,935 marine leagues.

Progress of Japan.—Apart from the few miles of railway now open in Japan, says the *Academy*, we hear that the extent to which, during the past three or four years, wheeled conveyances have come into fashion, is quite astonishing. Both in cities and along the high roads, where wheels can be used, the *jinrikisha*, or wheeled chair drawn by one man, has been substituted for the old *kago*, or litter carried by two men. The saving power thus obtained is very considerable, for the *kago* with two porters only travelled thirty miles a day, whereas nowadays one man draws the *jinrikisha* thirty-five miles in the same time. It is said that a Japanese used to pay 5s. 6d. for a day's journey in a *kago*, whereas he can now have a *jinrikisha* for 3s. 6d., the prime cost of the conveyance being about £3 10s.

Mercantile Navies of the World.—In a recent number of the Statistical Society's *Journal* a table was given showing the number of vessels, tonnage, &c., of all the mercantile navies of the world for 1870 and 1873. It appears that in 1873 sailing vessels had decreased—as compared with 1870—in number by 5·44 per cent.; in tonnage by 11·57 per cent.; in average size by 6·67 per cent. Steamers had in the same time increased in number by 24·59 per cent.; in tonnage by 54·94 per cent.; in average size by 24·41 per cent. The total number of sailing vessels was, in 1870, 59,518 with a tonnage of 16,042,498 tons; in 1873, 56,281, 14,185,836 tons, the average size being, in 1870, 270 tons; in 1873, 252 tons. Of steamers, the total numbers were, in 1870, 4,132 with 2,793,532 tons, average size 676 tons; 1873, 5,148, and 4,328,193 tons, averaging 841 tons each. In 1870 Great Britain carried 6,993,153 tons in 23,165 sailing vessels, and 1,651,767 tons in 2,426 steamers; in 1873, 5,320,089 tons in 20,832 sailing vessels, and 2,624,431 tons in 3,061 steamers.

The London Labour Field for Females for 1874.—The following list of occupations now undertaken by women in the metropolis has been compiled for the *Labour News*:—Actresses, allwork-maids, amanuenses, artificial florists, baby-linen makers, ballet girls, barmaids, bead jet hands, Berlin wool workers, black borderers, blacking hands, bonnet hands, book folders and sewers, boot hands, box hands, braiders, brushmakers, bustle hands, cap hands, cap milliners, cartridge makers, chambermaids, charwomen, chenille-net hands, chip sewers, chorus singers, clear starchers, clerks, confectioners, cooks, cord ornament hands, costume hands, costumiers—theatrical, crape hands, creasers, crinoline hands, crotchet workers, dairymaids, designers, dressmakers, dust sorters, embossers, embroiderers, emery-cloth hands, envelope makers, feather hands, firework makers, fish preservers, fruit sellers, furriers, general servants, governesses, glee singers, groat hands, hair sorters, hat makers, horse-cloth workers, housekeepers, housemaids, human-hair workers, ink hands, ironers, jute hands, kitchenmaids, knitters, lace hands, lady's-maids, laundrymaids, laundresses, law writers, machinists, mantle hands, map hands, market garden hands, match hands, meat preservers, milk carriers, milliners, muff hands, music hall singers, nurses, organists, paper collar, &c., hands, parlour maids, pea shellers, pencil hands, perfumery hands, photographists, pianists, pickle bottlers, pinkers, pocket-book hands, print colorists, printers, pupil teachers, sack makers, scarf hands, schoolmistresses, scullery-maids, shell trimmers, shirt hands, shop assistants, skirt hands, stampers—relief stationers, stay makers, still-room maids, stove-paper, &c., hands, tailoresses, telegraphists, upholsteresses, umbrella hands, valentine hands, vellum sewers, vocalists, waitresses, wax-work artists, weavers.

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PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The third course of Cantor Lectures for the past Session was "On Carbon and Certain Compounds of Carbon, treated principally in reference to Heating and Illuminating Purposes." The first lecture was delivered by Professor Barff, on Monday, April 13th, 1874, as follows:—

Lecture I.

Ladies and Gentlemen,—It is with very great pleasure, after the lapse of a couple of years, that I again appear before you. My subject this evening is somewhat different from that on which I lectured when I last had the pleasure of addressing you, but we all of us have our attachments for certain things, and my attachment is to particular chemical families. The subject upon which I lectured to you last was Silica and Silicon, and now I am going to take one of the same chemical family, and speak to you about Carbon. Possibly some of the things which I shall have to tell you will be familiar to many, but no doubt there are some here who do not know very much about this subject, and that must be my excuse for beginning at the very beginning, and trying to carry you on, as I hope to do, to such a knowledge of it as may enable you, who have not had a scientific education, to apply the principles which I shall be able to enunciate, and to prove by experiment to your satisfaction. I look upon this course of lectures as addressed especially to inventors. My friend Dr. Graham, who gave you such an admirable course of lectures a short time ago, addressed himself to brewers, and from my own knowledge, and from what I have heard, his lectures have been eminently successful in instilling into that class of individuals a desire to apply science to their particular manufacture. Now, my object is to assist inventors, and I think the prospectus which was put forth gives such an idea. Gentlemen who have inventive minds, and those who have a mechanical turn, cannot keep their minds quiet, and it would be wrong if they attempted to do so. They think—they invent things—they go to the patent-office and patent those things, and after doing this full of hope, at last there comes a dreadful disappointment, viz., want of success. On this matter I can speak feelingly, because many years ago I took out patents and was also very hopeful, and in every case my hopes were disappointed. In those days I did not possess the same amount of scientific knowledge which I possess now, and thus having suffered myself, I am able to give information to you, and very likely may be able to save many of you who are entering on such investigations from suffering what most inventors suffer, and which I suffered most keenly. Looking back at my very early patents, I do not find anything absolutely wrong in them; but I do find that a want of truly scientific knowledge was at the bottom of the failure in some of them. But there was also in some cases a failure in their commercial aspect, because in some instances they were not supported by sufficient capital, and not carried out properly by those to whom they were entrusted.

I cannot conceive, ladies and gentlemen, how any one can arrive properly at the conception of any apparatus for the production or economising of heat, or for lighting or for any other kindred purpose, unless he have a knowledge of the scientific principles involved in his invention. For example, if you do not know the way in which heat passes from a hot body to the bodies surrounding it, how can you know how to economise that heat? Thus, a person puts a fire into an iron grate with an iron back and with iron all round it. Now, what does this act imply? He puts in and about his fire-place something which takes away almost all the heat, or a large portion of the heat which is being generated, and that is evidently a mistake; therefore, it is necessary that a person who is thinking about heating apparatuses, should know something about the conducting power of the materials he has to deal with. We know now by experience that a fire-clay back to a grate is of great advantage, and throws out much of the heat into the room; we are told that it is so, and we feel that it does. Again, we have heard advice given in the newspapers that people should mix chalk with their coal in order to produce greater warmth. That is a very good thing, no doubt, but by mixing chalk with coal you do not generate an iota more heat from the coal than before; you do not make heat, you cannot produce it. The substance which you burn yields a certain amount of heat and no more; you can draw it out slowly, if you will, or quickly, but you will only get from its combustion a certain amount of heat. Here I have some powdered charcoal. I will put an oxidising agent with it, which means some substance that will cause it to burn rapidly, and now you see it is burning. Some of you may think it is gunpowder, but it is not, because it lacks one of the constituents of gunpowder; there is simply some charcoal and an oxidising agent. A certain amount of heat has been evolved in the burning of the carbon. If we had put it into an apparatus such as I shall show you in another lecture, we could have measured pretty nearly the quantity of heat given out in the burning of that charcoal. Now, suppose we burnt that charcoal in the ordinary way, it would have taken much longer to burn, but exactly the same amount of heat would have been given out. Or suppose the same amount of carbon as was there was taken in a piece of wood, say firewood, or in leaves, or in sawdust, and allowed gradually to decay and oxidise slowly through a long period of time, the quantity of heat given off in that slow combustion of the carbon would be exactly the same as the quantity given off here, or in the more rapid process of ordinary burning of charcoal. No skill on earth can make it give out more heat on its combustion than it has given out; you can regulate the time in which it is being given out, but you cannot regulate the quantity, that is, if all be burnt. Here is a Bunsen burner; there is a certain amount of heat being given off, but if you put your hands to it you will feel very little heat indeed. But if into that flame you put a solid substance, and make that red hot, you will feel much more heat. The solid substance does not generate heat; it only acts as a conservator or reservoir, and gives it out slowly, so that if we were to take a number of these Bunsen burners and burn them in a room which we wanted to warm, we should get a certain amount of heat evolved in the combustion of the carbon and hydrogen in the gas, but the room would not be made comfortably warm—such a source of heat would not be sufficient for our comfort. But if we take some solid matter that will not burn away, such as asbestos or solid lime, and put that into these burners and get it red hot, then we do get the heat not increased in quality, but only regulated as to its radiation, that is to say, regulated as to the quantity that is given out from the source of heat in a given space of time. No doubt some of you have seen this principle

applied to grates; you have seen fire-places arranged with lumps of asbestos and gas burners under them. When you turn on the gas, if you put your hand to the fire-place immediately you feel little or no heat from it, because the flame does not radiate out the heat in such a way as to make it appreciable to your senses, but with the same quantity of gas burning, as soon as the asbestos gets red hot, you may sit before it as before an ordinary fire; and according to some it will give out as much heat and be as comfortable as a common coal fire. I do not think it does myself, but it gives out much more than when the gas is burning before the asbestos has got hot.

From these remarks you will see how important it is that anyone who is going to invent an apparatus for heating should know, at least, these principles to which I have already alluded, namely, how heat is absorbed, how it is given out, and how it is conducted. In a later lecture I shall go through this portion of the subject, and illustrate to you by experiment the various ways in which heat is transmitted from one body to another. I heard a story the other day, and I think it is quite appropriate to mention it here, of a person who had for years devoted himself to making stoves, grates, and so forth, but when the question of how it is the smoke goes up a chimney was mentioned he expressed himself quite ignorant of the principle. That may seem strange, and those of us who know anything of the subject might be inclined to laugh, but I do not see why we should laugh, or why we should consider this gentleman was in the wrong according to his own views, for he was engaged in his business many years ago, and formerly it was not thought necessary that persons should have scientific knowledge to do things involving scientific principles. It is only of late years that we have begun to appreciate the value of scientific knowledge. I need only refer to Dr. Graham's introductory lecture, in which he treated of this, and I believe almost felt it necessary to apologise to his audience of brewers for talking of science, when they had been going on for so many years making good beer without it. But it is most important that we should, as far as we can, get to the bottom of scientific principles. By the system of education which is being adopted now throughout the land, boys are being taught science most admirably, and the rising generation will most of them know something about scientific principles.

Before I go strictly into my subject there is one other point which I wish to mention to you, and that is with regard to the taking out of patents. A person has an idea, and sets to work to bring it to perfection. He succeeds to his own satisfaction; he keeps it a secret, goes to a patent agent, tells all about the invention, a specification is drawn up, provisional protection is obtained, and then eventually after the lapse of six months the final specification is sealed; but some one also gets a similar idea into his head and patents it, and then supposing it to be a rare case, which does not often happen, that both of them succeed in attracting public attention, there is a tremendous amount of litigation between the parties. Why is this? It is because the inventor who is not a scientific man goes to a patent agent, who is not a scientific man, and between them they draw up a provisional specification in such a way that the principle which the inventor wishes to patent cannot be secured. This has not happened once or twice, but many times, and therefore if any of you wish to secure an invention, before you get that scientific knowledge which I consider requisite to draw up a patent, let me advise you to go to some scientific man and lay the question before him openly and honestly, have no concealment from him, and take his advice. He will be able to do one of two things; either to help you in getting a safe and secure patent, or else to do that which may perhaps be better—advise you to abandon the idea altogether, as not practicable or workable; and whatever disappointment you may feel in hearing that your pet scheme is of no use, it is much better to know it before taking out a patent than to find it out after expending a lot of money, and having to grieve over both the disappointment and the loss of money as well. I may also say that it is quite possible for any one who knows the scientific principle involved in his invention to draw up his own specification without the assistance of any other person whatever. He can get his own stamp, he can file it himself, and therefore save a large amount of money. I do not recommend this to anyone who does not think himself competent to do it, but rather the course I previously suggested. Of course you will take my advice for what it is worth, but you are at perfect liberty to go to the Patent-office Library, and you will find every attention from the librarians, who will help you in your searches, and I must say you cannot find more obliging or more gentlemanly persons than they are.

The subject of my lecture this evening is carbon, and I shall have to be very elementary I fear to some of you; but I think this is better than to leave any one in the room without a thorough knowledge of what I wish to communicate to you as a knowledge that can be rendered useful. Carbon appears largely distributed in nature. In the air we breath there is a great quantity of carbonic acid, the quantity of which is being increased continually by our breathing, for we are perpetually breathing it out, and it is being perpetually absorbed by plants. Again, there is chalk, which is carbonate of lime, there is also dolomite, which is carbonate of lime and magnesia, and there is also magnesite and other carbonates existing in nature, so that we have large quantities of carbon existing in the form of carbonates. With this form this evening we have little or nothing to do, but we have to do with carbon as it exists in other forms in nature. All animal and vegetable substances contain carbon without exception. You may have seen this experiment before, but it is very interesting, therefore I show it. Here is some sugar in this dish; some sulphuric acid will be poured into it, and you will see the result. The action of the sulphuric acid on the solution of sugar will be that the sulphuric acid will dehydrate it. It will take away what a person who is not a chemist would say was the water from it, and so leave the carbon behind. Sugar is composed of carbon, oxygen, and hydrogen. The oxygen and hydrogen exist together in it in such proportions as to form water, and if these unite together to form water, and then be taken from the sugar, nothing else but carbon will be left behind. That black mass which you see left in the beaker glass is carbon, of course with some other substances mixed with it, but if it were washed it would be pure carbon. Here is some sugar also which Mr. Lewis will heat in this tube, and various substances will be driven off, but the residue left behind will be carbon. After that he will heat a piece of wood in a bent tube, which will be sealed at one end so that no air can get to it. The heat will drive out the air and the oxygen it contains from the tube, and then the products of the decomposition of the wood will be seen to pass into the upper part of the tube, and then to run back again into the bent portion; they will be water, some tarry products, and various others which I need not mention. My principal object in showing you this to-night is not so much to show you the charring of the wood, as to illustrate to you the difference which there is in the heating of substances out of contact with air, and heating them in contact with air. After this wood has become perfectly charred the stopper will be taken out, and the action will be allowed to go on in the presence of air, and the charcoal will gradually disappear, the gas issuing from the end, formed of the charcoal combined with the oxygen of the air; it is called carbonic acid gas, and nothing then will be left behind but the several substances contained in the wood which are not destroyed by the action of heat, *i.e.*, the ash. When any organic substance is heated out of contact with air, we speak of the process as one of destructive distillation, by which we mean that the substance, as such, is destroyed, that it is not resolved into its ultimate constituents;

that is to say, that the elements which compose it are not separated from one another, but that it is broken up into compounds more or less simple than the elements formed in the substance itself. For example, when wood is destroyed as wood, we speak of it as destructive distillation, and if the products were collected we should find that they contained the same elements that the wood contained, only in different chemical combinations.

Carbon exists, as I said just now, in all organic substances, but it exists in some in such proportions that when they are exposed to the action of this destructive distillation, no residue of charcoal is left behind at all, the charcoal all passes away along with the other elements, forming of course new substances. An instance of this is a substance which is obtained from the sorrel plant, which also exists in rhubarb and other acid plants; it is a potash salt commonly called binoxalate of potash, from which can be obtained oxalic acid, which contains carbon, oxygen, and hydrogen in such proportions that the carbon and oxygen unite together to form two gases, carbonic acid and carbonic oxide, and the hydrogen unites with the remainder of the oxygen to form water. The consequence is that when oxalic acid is heated no carbon is left behind. Mr. Lewis is heating a small quantity and here is some of it put into this dish, you will see some smoke coming from it, but nothing will be left behind in the form of a black residue of carbon. If you now look at the bent tube in which the wood was charred, you will see the carbon which was left behind is burning away, because the air is passing through it, and carbonic acid gas is coming out of the tube.

I want you particularly to bear in mind that there are these two classes of bodies; those which yield a quantity of carbon after the other substances have been thrown off, and those which yield none, because I shall have to allude to this again when I come to speak about coal. I could not pass by certain properties of carbon in such a course of lectures, and I am sure you will agree with me that although the main object of this course is to make suggestions for the improvement of our heating and lighting apparatus, yet when there are properties possessed by some of the substances which we have to speak of, which are of great importance, I ought in passing to notice them, even although a large portion of the first lecture may be taken up in so doing, although these applications which I am going to speak to you about I daresay many of you have heard of often and often before. But what is the use of hearing these things? A person goes to his church or place of worship, and listens to his clergyman, and says I have heard all that before, but the question is, has he practised the principles which the clergyman is laying down. That is the thing which everyone should ask himself when he comes out of his church. No doubt these things have been shown you before; you have seen experiments no doubt often enough, but have you understood them? and if not, what use are they to you? Therefore I hope you will not find fault with me for again repeating these facts to you and showing them in new forms, and illustrating them by experiments which may make them so conclusive, and give you such a true knowledge of them, that you may be induced to apply them in your domestic affairs.

Here is a piece of charcoal; it is in the shape of a branch of a tree, and if I could show you a section of it by the oxyhydrogen microscope, you would be able to see that it has a perfect wood structure. This charcoal is very porous, and if you throw it into water it will float. But charcoal is heavier than water, for although it will float, it is for the same reason that an ironclad will float. Fill the ironclad with water and down it goes, but we cannot fill this with water. It is very difficult to do so. If anybody could get over that he would make a very large fortune, because then he would be able to impregnate wood through and through with a substance which would render it thoroughly uninflammable. I once, in this room, mentioned how wood might be made uninflammable. I do not know that anybody has taken it up or worked upon it, but we have had a serious instance lately of the defects of fireproof buildings made of iron and brick; now if they were built with wood rendered uninflammable by silicates no such catastrophe as that which lately happened in Belgravia could happen again. If you could only impregnate wood with silicates the object would be accomplished. Here is charcoal floating on the top of the water, and here is some powdered charcoal which will gradually sink to the bottom, showing that it is heavier than water. Charcoal has an absorbent power. It has a wonderful power of absorbing gases, and that has been explained by different persons in different ways. Here is a tube full of ammonia gas, and here is a piece of charcoal which will be put into it; you will see the ammonia will be absorbed very rapidly, and the mercury will rise up the tube. The charcoal is first heated in order that it may be perfectly dry, and that any gases previously absorbed in its pores may be driven out. You notice that the mercury is rising in the tube, and presently if the tube is filled with ammonia gas and nothing else, there will be nothing in it but the mercury and the charcoal, and the condensed ammonia. Does charcoal absorb this gas in virtue of its porosity? Some think it does, and others not. That question I will not go into now. It is sufficient for us to see that the charcoal has a power of absorbing gases, because if it will absorb ammonia gas it will absorb other gases. Here is an extremely poisonous substance, cyanide of potassium; I shall mix it with a little dilute sulphuric acid and heat them, and then prussic acid gas will be given off, which, as you know, is extremely poisonous. First of all, the gas will be passed into this tube, which contains nitrate of silver. As soon as the prussic acid gas passes into the nitrate of silver you will see a white precipitate formed, a precipitate of cyanide of silver; that will show you that the prussic acid gas has a free and clear passage, and is not stopped by anything that it is passing over. We will then divert the channel, and pass it through this tube, which contains lumps of charcoal, when you will see that no precipitate whatever will be formed, which will be a proof to you that charcoal is able to absorb this gas as well as ammonia. There you see the precipitate of cyanide of silver, and any one who has studied photography will know the nature of that body. Now the gas is diverted and is passing through the charcoal, and you see that no precipitate is formed in the nitrate of silver. This principle was applied years ago, and was described in this room by Dr. Stenhouse, the inventor of charcoal respirators, some of which are on the table. They are arranged to cover the nose and mouth, so that persons may breathe through them in a poisonous atmosphere without being affected by the poison. Those respirators contain charcoal in a state of fine division, and from the presence of the charcoal it is said that a person might even breathe this gas. I should be very sorry to try the experiment, but there is no doubt these respirators are very useful. There is one on the table similar to a quantity which were made for the troops sent out on the Ashantee expedition, so that the soldiers might wear them when exposed at night to the malarious influences of that marshy country. Whether they were used or not I do not know, but there is no doubt whatever that the charcoal will prevent the introduction into the lungs of very poisonous gases in small quantities. I have heard it said that you could breathe an atmosphere of prussic acid or of strong ammonia, but I should say, from my experience with ammonia, that it is impossible. Still it is no reason because the respirator would fail in these extreme cases why, where the quantities are great, that it should not be particularly useful to persons attending the sick bed of persons suffering from contagious or infectious diseases. Here is a substance which has the same power as wood charcoal has, only to a much greater extent. It is much more energetic

and active. It is called spongy platinum. There is a portion of it now placed over a tube, up which coal gas is passing, and you will see in a moment it will get red hot. It ought to cause the gas to catch fire, but on trying the experiment some time ago I found it would only get red hot. That is quite sufficient to illustrate the principle that certain substances have this power of absorbing gases. I believe it really promotes chemical action by oxidation. The spongy platinum is now red hot, owing to the combination of the oxygen of the air with the carbon and hydrogen of the coal gas.

Another principle which animal charcoal possesses—and this is of extreme importance in a domestic point of view—is that of dedorising tainted meat and absorbing that which produces bad smells. If you cover some putrid flesh with animal charcoal you will absolutely destroy all the bad smell. In the centre of the table there is in a glass vessel some very putrid flesh, and if the charcoal were removed from it none of you could bear the smell of it in the room, it smells so badly; it is covered with charcoal, and none of you have smelt any bad odour from it. The charcoal there is absorbing the bad smell. Nay, it is doing more than that, it is oxidising the bad gases and burning them up so that the substances which produce the bad smells are not absorbed, so as to remain in the charcoal, but they are being oxidised and burnt most effectually. The same with this platinum, I perceive no smell of the coal gas here, because it is burnt, and there is no smell from the products of the putrifying flesh, because the effluvia coming out are being destroyed or burnt, or being oxidised by the oxygen of the air through the instrumentality of the carbon. This action has been spoken of as catalytic. That is a long name, and, as far as I understand it, it means nothing. It is used with regard to substances which, although not acted upon themselves, yet have the power of producing chemical action in other bodies. It appears to me that an action quite different from that is going on here, that there is an oxidating process going on, not through the absorbent power of the charcoal necessarily, but because there is an oxidation of the charcoal going on there slowly, although the charcoal is not a substance readily and easily oxidised, and that induces the oxidation of the effluvia escaping. Whether that view is right or not I do not know, I merely state it to you as held by some. I will show you another experiment illustrative of it and illustrative of what I said about oxidation. Here is some sulphuretted hydrogen water. If I hold over it a piece of acetate of lead paper you will see it is immediately blackened. I cannot send it round for all of you to smell, and possibly if I could you would not like it, but you notice the blackening of the paper by the sulphuretted hydrogen water. I will put some of it into a bottle, and some animal charcoal shall be shaken up with it, and then we will put some acetate of lead paper over it, and I think you will find that that power which the sulphuretted hydrogen water has of blackening acetate of lead paper is entirely gone; that, in fact, the sulphuretted hydrogen is changed into something else, and the something else I hope to be able to show you, for as soon as we have performed the experiment the liquid shall be filtered off, and then we will add to it some acetate of lead solution, and you will see a white precipitate will be formed; for the sulphur in the sulphuretted hydrogen will have got oxidised into sulphuric acid, and we shall then have a solution of sulphuric acid in water, which, with the acetate of lead, will form sulphate of lead, which will give us a white precipitate. The presence of the sulphuric acid I will make more plain to you by the addition of chloride of barium, the precipitate of which can be seen at a greater distance. This animal charcoal which I am using to-night has been supplied to me by Mr. Lundy, of Leeds. He wrote to me some time ago saying he should be glad to send me some of his animal charcoal to show at my lectures if I thought there was anything in it worth notice. I find it is a most excellent animal charcoal, that it deodorises rapidly, and that it decolorises rapidly, much more so than ordinary bone charcoal. It is made from the refuse which occurs in the manufacture of ferro-cyanide of potassium; the animal refuse is perfectly charred and ground up to a fine powder, and it can be supplied at an exceedingly low cost, so that if any of you wish to try the experiments which I hope I shall induce you to do, you can give this a trial, for it can be easily obtained. Here is a by no means tempting-looking piece of meat. I went to-day to my butcher's, and asked him to let me have a piece of tainted meat. He immediately opened his eyes, and declared, of course, that there was not such a thing in his shop. However, I at last prevailed upon him to see if he could not find something in an odd corner, and finally his man brought me this piece, which he said came from the hog tub. This piece has nearly lost its bad smell, because it was put into the charcoal at the beginning of the lecture, but the piece from which it was taken smells horribly. Now, to what use can this be applied? You know how often it happens, particularly in the summer time, that when you get a leg of mutton sent home on the Saturday night from the butcher, and you want to roast it on Sunday, during a muggy night it will become tainted, and, in fact, entirely spoilt for your Sunday dinner—you cannot eat it. Now, it is quite certain that the process of decomposition that has gone on during the night has not been enough to render the meat unwholesome. There is no great putrefaction taking place—of course I am speaking of putrefaction in the ordinary acceptation of the term. Now, if you cover that meat with this charcoal, and leave it all night, the smell either will not occur or else it will be done away with. But if you do not like to cover it with charcoal and so blacken the meat, you can easily have a cupboard made, or a small box, and can line it with this charcoal in powder, which will answer the same purpose. You may make a muslin bag about three inches every way smaller than the box, drop it into the box, and then fill the space all round with animal charcoal. If the lid of the box is treated in a similar manner you will have animal charcoal all round the meat, and on putting the meat in it you will find if it is not tainted it will not get tainted, and if it has become tainted it will lose that tainted smell, and will be none the worse whatever, if it had it, when you come to cook it. I speak here from experience, because last summer I had a saddle of mutton sent from the country and had asked some friends to dine with me. It was a very fine saddle indeed, but, unfortunately, it had been badly packed, which gave it that musty smell which meat gets when badly put up in hot weather. In order that my friends might not be disappointed, and that the mutton might not be lost, I covered it for 24 hours with animal charcoal. It was then cleaned and roasted, and there was not the slightest taint upon it. Therefore, if I have done nothing else but persuade you to try this experiment yourselves, and so prevent you from suffering this disappointment which often happens in the summer time, I shall have done something by my lecture to-night.

I will next show you the decolorising power of animal charcoal. Here is a solution of litmus of a very deep colour; it shall be shaken up with some of Mr. Lundy's charcoal, and I will shake up some more with some ordinary bone charcoal, and we will see which will be decolorised most rapidly. Then it shall be filtered, and you shall see the liquid run through. Now if this animal charcoal has the power of decolorising and deodorising water, and destroying the substances which give it colour and smell, then the water which passes through must be pure—that is as regards this sort of organic substances. You will see, therefore, how effectually you can prevent any ill effects from bad water by filtering it through animal charcoal. There are charcoal filters made which can be easily obtained. But if you do not choose to buy

one, you may mix some of this with sand, and it will act perfectly in an ordinary filter. I have lately tried this in a Lipscombe's cistern filter, which answers perfectly.

Here is the sulphuretted hydrogen water, which has been mixed with carbon. I will now add this acetate of lead to it, and, instead of a black precipitate, we get a dense white precipitate. Now let me put to this acetate of lead some of the water which has not been treated with carbon, and you will see what will happen; it is perfectly black. In the one case we get sulphide of lead formed, and in the other sulphate. I consider that this illustrates a most important principle, because the carbon here has not absorbed the sulphuretted hydrogen, but has actually been the means, somehow or other, of causing it to be oxidised into sulphuric acid, which is shown by the copious white precipitate in place of the black. This animal charcoal is simply animal matter, heated out of contact with the air, that is, which has undergone destructive distillation. You may make it from bones, from the handle of an old tooth-brush, or from any such substance. You have only to take a test-tube, put in a piece of the handle of an old tooth-brush, and then heat it, and you will have the handle left behind with a polish on it just as it was, but it will be black, converted into charcoal, though also containing other substances which I shall speak of later on.

Now I have to call your attention to graphite. You will see on the table a number of most interesting specimens which have been sent to us by Messrs. Doulton, of Lambeth. Those are crucibles for melting cast iron and other things, and they are employed for that purpose because this substance will stand such a tremendously high temperature without igniting with the oxygen of the air. In our next lecture I shall show you the intense heat required to ignite graphite in a current of oxygen. There is also a large lump of native graphite, and there are three other lumps which have been lent by the Patent Crucible Company through Mr. Blunt. Then there is a lump lent by Messrs. Windsor and Newton, which is of a different quality altogether, that is of a fine quality, and is used for making black lead pencils. In front are three blocks of compressed graphite, for one of the properties of this substance is that when reduced to fine powder it can be pressed into these hard blocks, which are as hard, if not harder, than the lumps of natural graphite. Those blocks can be cut into strips and made into lead pencils. Formerly, the best pencils were made from native lumps of black lead, but now, I am told, the best are made from the compressed graphite, the graphite which you see on the table. I was asked just now whether I was sure there was no sulphur in this graphite. I cannot tell that, but formerly sulphur was used to cement together the small portions of graphite before it was so used. However, at our next lecture we will see whether there is sulphur in any of those blocks or not. There are also three specimens of another kind of graphite which arises in the manufacture of coal gas. There is one piece you see has a curved top; it has, in fact, the shape of the top of a gas retort. When the retorts are heated to a high temperature, and the evolution of coal gas is going on rapidly, there is a deposition from the coal gas of carbon in the upper part of the retorts which forms that particular substance which is called artificial graphite; it is a sort of coke, for coke is an artificial graphite, just as is the charcoal or the amorphous carbon got by the heating of wood. The uses to which this substance is applied are various. For instance, these pieces are used for what is called the Bunsen's battery, it is used in that battery instead of the platinum, which is used in Grove's battery, and is much less expensive, though it is liable to certain defects. I hold in my hand some carbon points. You have all seen the electric light, and these points are those which are used in its production. They were given to me by Mr. Ladd to-night, and they are made out of that sort of coal graphite. These are placed on the terminals of the battery, point to point. This is the one at the top, the negative, and that is the positive. Now what I am going to tell now is extremely interesting if you notice that one of these points makes no mark upon a piece of white paper, or hardly any, but the other one marks like a black lead pencil. This is the positive pole, or positive terminal, and this is the negative terminal. The negative terminal is apparently unaffected, but in the positive, the charcoal, or graphite, is converted into a substance similar to natural plumbago. Some years ago some experiments were performed with a battery of 600 cells, and it was found that carbon could be volatilised, at least it was thought so. In a vacuous space the operator brought the points together, and found that a sort of brownish vapour was given off, and that crystals of a substance like graphite were formed on the side of a glass vessel. He then tried this experiment: he got some sugar charcoal perfectly pure, and then obtained masses made of that perfectly pure carbon. He attached a crystal to the negative pole and one to the positive pole, and attached them to a battery. He found that where the galvanic current had passed for some time particles of this aggregated together, and formed a mass similar to plumbago. Now here we have an experiment confirming that research. At the positive pole we get this conversion of graphite into plumbago, and at the negative pole we get next to no change at all. I think that is a most interesting fact, and it is one that will cause some of us who are scientifically inclined to think very much.

I want to speak to you lastly about the diamond, in order to complete the subject. The diamond is the purest form of carbon we possess. This native graphite is formed in crystals, and also without crystallisation in a form called amorphous. It is the amorphous which is adapted for making pencils. But it also occurs in the crystalline form, and crystallises in what is called hexagonal bodies belonging to the rhombohedral system. The diamond crystallises in octohedra, but not always, for I have in my pocket some diamonds not octohedral, but crystallised in dodecahedrons, and another in which the faces of the dodecahedrons have three separate facets. These diamonds have been lent me by Messrs. Hunt and Roskell, Mr. Hunt kindly placing his whole stock at my disposal and telling me I might have whatever I liked. It is impossible to hand about valuable diamonds, because they are easily dropped about and lost, but after the lecture if any lady or gentleman wishes to see them I shall be happy to show them the specimens I have. Mr. Sullivan, from Messrs. Hunt and Roskell's, has also brought some others. The diamond is not pure carbon after all, though it is the purest form in which we have it, for when a diamond is burned in oxygen, in the same way that you will see that we shall burn graphite at our next lecture, a residue is left behind, an ash, and that ash strangely has a sort of cellular structure. Some one suggested to me that he thought that might lead, some day or other, to an idea of how the diamond is formed in nature. The diamond is usually of a bright light colour, and it refracts light wonderfully, being excessively dense. Its density is 3·55, or $3\frac{1}{2}$ times as dense as water, and is the hardest substance in nature. For that reason it is used for cutting glass, but a cut diamond will not do for that; you must use the natural crystalline point, otherwise you will get a very jagged cut. It must be the natural apex of the crystals. Sometimes diamonds are pink, sometimes green, and some are perfectly black and opaque.

According to *L'Economista d'Italia*, which says it obtains its information from reliable sources, the silk production of the world amounts to 8,469,100 kilogrammes; of which Italy produces 3,125,700, China 3,105,700, France 636,800, Bengal 594,000, Japan 508,000, Spain 171,400, Georgia, Persia, and Khorassan 110,000, Syria 107,500, Broussa 7,400, Volo and Salonica 83,300.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

LACE-MAKING MACHINERY.

In the machinery department of the Exhibition the manufacture of lace, although forming one of the special subjects of this year's display, is represented by one machine only, which has been contributed and worked by the Nottingham Chamber of Commerce.

The machine is known as a Levers machine, from the name of its inventor, and is provided with a double-action Jacquard apparatus for working the design or figure upon the lace. It is at present employed in weaving guipure, or narrow lace, of which 60 pieces, of about $2\frac{1}{2}$ inches wide each, or a total width of 152 inches, are being woven at once. Of this width, it is capable of weaving about one yard per hour, or a total length of 60 yards of narrow lace. The machine can be arranged to weave any desired width of lace, and even shawls may be produced by it. This is effected, not by the alteration of any of its mechanism, but in the production of the figure by the designer. For instance, the 60 pieces that are now being made are simply a repetition of the same figure, and by inserting a thread, called the "lacing thread," at the selvages or divisions of each figure, the whole of the pieces are connected together and form one piece only. By this means the entire piece when woven can be removed from the machine, and, after being dressed, the lacing threads are cut or drawn out, whereby the narrow pieces become separated, and are packed or wound upon cards as may be desired. The lacing thread is not, therefore, inserted by any special contrivance, but is introduced by the designer making a special provision for it in the formation of his design, which will be hereafter described.

It will be evident that such a machine is capable of producing all the ordinary varieties of machine-made lace, and, as far as one machine can do, it fairly represents the present state of the lace manufacture of Nottingham.

The total length of the machine is 30 feet, and the height 9 feet. It contains 2,907 shuttles, or as they are technically called "bobbins and carriages," and upwards of a hundred warp beams. The speed it is worked at varies from 110 to 120 picks per minute, which means that the shuttles are passed through the machine that number of times in each minute.

From its great size and the multiplicity of its parts it forms one of the finest examples of mechanical skill ever concentrated in one machine. In it are accumulated the result of the labour of a hundred ingenious men, the history of whose fortunes and misfortunes is of strange interest. Many of them never reaped the benefit of their inventions, but passed their lives in misery and neglect, terminated in some instances by suicide. Others, more fortunate, reaped the full advantage of their skill, and arrived at opulence.

The history of the machine itself, and the various forms and modifications it has undergone before being brought to its present perfection, affords as remarkable an instance of gradual mechanical development as can be found. It does not represent the genius of one or a few men, but rather the experience derived from a thousand different inventions.

Lace has always been admired and used as a most refined and beautiful article of dress. When made by hand it is also by far the most costly of textile fabrics. At the same time, the implements used in its production are of the simplest kind, though in the variety, extent, or richness of design no limit could be fixed that could not be surpassed by these simple means. Considering, however, the cost of production, it need not be wondered at that men have often been desirous to supplant the tedious process of hand-work by substituting machines for that purpose. The high price which hand-made lace fetched offered an ever-increasing temptation to the ingenious mechanic to attempt its production by other means, and at last it was accomplished. Not that machinery can ever surpass or equal the finest description of hand-made lace, but it can produce very good imitations of it, which have often been substituted for it, and in some cases are superior to it.

The production of pillow lace is effected simply by twisting together a number of threads in the order and combination necessary to produce the desired pattern. To do this the design is first drawn upon a piece of parchment, and holes are made in the outline of the design for the insertion of pins. Round these pins the threads are twisted, so as to form meshes. Thick and thin threads can be combined, or three or more together. As the lace is made the pins are moved. In the process of knitting the operation is different, in order to form the fabric. Knitting, in its simple form, is effected by using one thread only, upon which a series of loops are made, and they are connected together by intersecting each other, as is well understood in the common process of knitting. Knitting and lace-making are, therefore, widely different in their modes of production; but as nearly all the first attempts for the making of lace were tried upon modifications of the stocking-frame or knitting-machine, it may be desirable to trace briefly some of the most important inventions that have led to the invention of the machine now exhibited.

In the early part of the sixteenth century the art of knitting had become very general throughout England, and knitted caps and stockings were taking the place of those articles which were previously made of cloth. The manufacture of silk goods, such as damask, had also become known and practised, and the knitting of silk stockings quickly followed. In the time of Queen Elizabeth articles of silk had become so common that the nobility employed women whose duty it was to superintend the silk clothing. They were termed "silkwomen," and they became so numerous and influential that they formed themselves into a society.

Queen Elizabeth's silkwoman, Mrs. Montague, in the year 1560, knitted a pair of black silk stockings which she presented to the Queen, who was so much pleased with them that she never afterwards wore stockings made of cloth. Silk stockings were not, however, unknown before that time, for it is said that Henry VIII. by great chance occasionally procured a pair of them from Spain. It is also related that Sir Thomas Gresham presented Edward VI. with a pair of long silk stockings, which at the time commanded much notice.

Towards the end of the reign of Elizabeth knitting had become a most important branch of industry, and from its nature it was admirably adapted for domestic employment. It was not only practised as a common household requirement, but numbers of persons were engaged and employed by masters who carried on the business on an extensive scale.

To this period may be traced the rise of the manufacturing arts in England. Weaving and spinning had been introduced, and were widely practised, but machines of an automatic nature may be said to have been unknown. The various manufactures depended upon the handicraft skill of the workman, for he had little assistance from any mechanical contrivance. A change, however, was about to take place, the effect of which is in full force at the present day. This was caused, it need scarcely be said, by the invention of the stocking-frame by William Lee. The great peculiarity of this invention is that it is probably the first invention of any kind for the purposes of manufacture that may be classed

as an automatic machine. Hitherto such machines as were used may be considered as tools or implements only.

The history of Lee and his invention is so well known as not to require a repetition here, but it may be mentioned that the first machine he made was, as might be imagined, a very rude instrument. It consisted of about twelve needles only, and its production was simply a coarse worsted garter. Lee was patronised by Lord Hudson, through whose influence Queen Elizabeth was induced to see the machine, and she went to Bunhill-fields, where the machine was erected, for that purpose. The object of Lee was to endeavour to obtain a patent from the Queen, even if she gave no further encouragement. But he could not obtain this. Elizabeth thought and expressed herself, that "to enjoy the exclusive privilege of making stockings for the whole of my subjects is too important to be granted to any individual. Had Mr. Lee made a machine that would have made silk stockings, I should, I think, have been justified in granting him a patent for that monopoly, which would have affected only a small number of my subjects."

It was evident that the Queen was disappointed with the first products of Lee's invention, but he did not lose the hint concerning silk stockings. At last, in 1598, he succeeded in making a machine by which he made a pair, which he presented to the Queen. But it added nothing to his advantage, and he obtained no patent. Other misfortunes fell upon him. Lord Hudson died, upon whom he had hitherto depended. He was neglected, and fell into a deep melancholy. Some time afterwards he was invited over to France by the minister of Henry IV., and he went, taking with him his machines. Before he could make arrangements for establishing the new business the King was assassinated. Lee thereby lost all hope, and died at Paris in 1610. During his illness Mr. James Lee, a brother of William, who was at Rouen, where it was intended to carry on the manufacture, went to Paris, but he found on his arrival that his brother was dead and buried. On his return to Rouen he, with seven of the workmen who had gone with them from England, returned to London, taking with them the machines they had brought. These machines were set up and worked in Old-street-square, and became the foundation of the London hosiery manufacture.

From this time no improvement appears to have been made upon Lee's stocking-frame until 1758, when Mr. Jedediah Strutt added to it an apparatus by means of which ribbed goods could be made, and the machine was called the "Derby rib machine." The advantages derived from this invention were so great that the attention of many men was directed to it, with a view to still further improvements. Numerous inventions were the result, which met with more or less success. The most important of these was that patented by Morris and Betts in 1764 "For making by a machine to be fixed to a stocking-frame eyelet holes or network, having an additional row of frame tickler needles."

This invention, although patented by Morris and Betts, was the work of one Butterworth, a stocking weaver at Mansfield, who having devised the plan had to reveal it to Betts, a smith, for the purpose of getting the working parts made. Butterworth was unable to find money for the patent, so Betts obtained it, and in conjunction with T. and J. Morris took out the patent in their joint names. This is one of those instances which unfortunately disgrace the history of many of the inventions during the progress of the manufacturing arts in the latter part of the last century.

The tide of invention had now fairly set in, and many ingenious improvements were the result. In 1769 the first figured lace-web was made by Mr. Robert Frost, on a frame arranged by Thomas Taylor, of Nottingham. This led to further improvement, and a Mr. Broadhurst, of Nottingham, improved Frost's machine by reversing its action. In 1771 Marsh and Horton took out a patent for knitted or knotted hosiery, which was further improved upon and patented in 1776 by Horton. He aimed at and succeeded in knotting every loop of the web, thus making an elastic as well as a sound fabric that would not run on the thread being broken.

In 1775 a most important step was made, which may be considered the first that led the way direct to the invention of the lace-frame. This was the invention of the "warp" machine. By combining warp threads, as in the common loom, with the formation of loops by means of the stocking-frame, a new kind of fabric was produced. The loops were made round the warp threads, but the work was not elastic. It was the invention of Crane, of Edmonton. Various modifications and improvements were made upon the above-named inventions for the purpose of making lace or bobbin-net. This was at last accomplished by Mr. John Heathcoat, a native of Duffield, near Derby, and the invention was patented in 1808 and 1809.

In the production of figured lace it is requisite that the threads should be arranged in such a manner that they can be twisted round each other any number of times, and in any quantity and arrangement. In bobbin-net it is also requisite that the threads should be twisted round each other and follow the arrangement necessary for the production of meshes of uniform size and order. Previous to Mr. Heathcoat's invention, the meshes were produced by loops or knotting, and not by twisting the threads round each other, as in the production of pillow-lace or bobbin-net. He was the first who arranged the threads one part in a warp and the other part upon bobbins. The bobbins were fixed in carriages, on thin shuttles, which were made to slide in grooves in a comb-bar. The comb-bar being divided for the warp to pass between, the shuttles as they passed from one side of the comb-bar to the other necessarily passed through or between the threads of the warp. Now, if the warp threads, being placed in regular order, were kept in that position, and the shuttles also were kept moving backwards and forwards through the warp or between the threads, then no work would be the result. But after passing the shuttle through the warp, as before stated, if a lateral movement were given to the comb-bar, so as to advance it one or more grooves to the right or left of its former position, then on the return of the shuttles through the warp to the other portion of the comb-bar they would be deposited in different grooves than those they started from. Again, if this motion were repeated in certain order, the threads of the bobbins could not only be made to twist round the warp threads, but they would travel from thread to thread, and the threads of the fabric they had woven would present a diagonal appearance. This motion of the comb-bar is technically called "shogging," and by its means the diagonal arrangement, or "traverse," is given to the threads. By this means a firmly made fabric is produced, for if there were no traverse, then on the breakage of any of the threads the work would run or untwist. Mr. Heathcoat having thus solved the problem of forming regular meshes by twisting threads round each other, and then passing from thread to thread and repeating the operation in regular order, accomplished all that was required for the production of bobbin-net. The advantages were so great that in all directions a fresh impetus was given to further improvement. Amongst the various inventions thus brought into existence was the invention of the machine now known as Levers' machine, the specimen now exhibited being on that principle.

Mr. John Levers was originally a machine maker, or frame smith, of Sutton in Ashfield, but he removed to Nottingham, where he extended his business. The success of Mr. Heathcoat's invention had already given rise to a new invention, which, as in many other instances, was simply reversing the process of working the machine. In Heathcoat's machine the bobbin and carriages travelled or traversed, and the warp remained stationary. But it occurred to Mr. John Brown, of New Radford, that by traversing the warp thread, instead of

the bobbin thread, a better result might be obtained. This contrivance he patented in 1811. The result was that many of the artisans of Nottingham, seeing the success of Brown's traverse warp, and that he had not been interfered with by Mr. Heathcoat, had an idea that similar efforts might be carried on without incurring the penalties of legal contravention. With this idea it is supposed that Levers also devoted his mechanical genius and skill to the subject. Mr. Felkin, in his "History of the Hosiery and Lace Manufactures," to which this account is much indebted, gives an interesting account of Levers' invention, from which the following particulars are taken :—

"In carrying out the invention Levers worked in a garret at the top of a building situated in a yard on the northern side of the Derby-road, Nottingham, and so quietly and secretly as not to be seen by any one, even of his own family. The carriage and bobbins, things which presented so much difficulty to Mr. Heathcoat, with some of the inside parts, had been made as thin as was requisite by a relative, Benjamin Thompson, an extraordinarily clever workman in metals. He was never permitted to see the machine in progress, but was the first, except its constructor, to witness its completion. Levers had no son; but two brothers and a nephew John. All worked afterwards with him, and the nephew always stated that they saw the frame for the first time when it was ready to work. They found it to be 18 inches in width, waiting for materials, and prepared to start, which it did without difficulty. The entire isolation of the inventor during this period was a remarkable fact. Levers had expended his available means in the lengthened experiments and necessary expenditure incurred during the years 1812-13.

"The house of John Stevenson and Skipworth, carrying on a lace business in Nottingham, was induced to furnish the funds required for producing more machines, upon what terms is now not known. Several were built, one of which was retained by Levers for experimenting upon. The others were worked in a shop, on their owners' premises, in St James's-street. It is probable that the then existing patent rights on the one hand, and the profits daily realised by Levers and his patrons on the other, were the reasons why no patent was obtained to secure what was new in his method. For it seems to have been the prevailing notion among the mechanicians of the time that a patent must be taken out for all the machine, and not, as might have been, for any parts or combinations only which were really new.

"In 1814, John Farmer, with another hand, worked one of these machines, 54 inches wide, each taking five-hour shifts, the machine working twenty hours a day. The production was four pieces of ten racks each weekly. The wages were 5s. per rack, *i.e.*, £5 for each workman a week. Some of the bobbins, and all the carriages in the machines, were stamped out by B. Thompson, who employed a very similar process to that described in Mr. Heathcoat's specifications, to get the sides of the bobbins flat and true. Two half-circles of very thin brass were placed within each bobbin, fitting exactly the inside; they were put on an arbour, passing through the centres, and were screwed together very tight, and heated until the arbour showed a bluish tint, from which, on gradually cooling, the inside half-circle plates were removed. The bobbins came out perfectly flat, and capable of turning without friction or accident in the carriages. This in Levers' machines, where often thirty carriages and bobbins must work together edgewise within the space of an inch in width, is evidently a matter of the first importance.

"Levers left Stevenson and Co., but for what reason the connection was broken is not known. In 1817, he worked in a shop in the higher part of St. James's-street, and it was at this time that he altered the arrangement of his frames. They were at first made to work in a horizontal position, but he now made them to work in a vertical one, as at present in use. In 1821, Levers went to France, and set up his machines at Rouen, and there died. Levers is said to have been a friendly, kind-hearted man, and a great politician. He was fond of company, music, and song, and was bandmaster of the local militia. But his domestic relations did not conduce to his comfort; his wife was not a helpmate, and unhappily for his progress and fame he was a free-liver and irregular in his habits of business. He sometimes worked day and night if a mechanical idea or contrivance struck him, and would then quit all labour for days of enjoyment with chosen boon companions. He was frequently heard to say that the machine he had constructed was only in its infancy, because of the great facilities it afforded for alterations and improvement."

His opinion has certainly been verified, for since the successful application of Jacquard apparatus to it, the power it possesses for the production of figured lace is almost without limit. To adapt the Jacquard machinery to lace machinery proved a long and tedious task, and many years were passed before it was successfully accomplished. The difficulty arose from the circumstance that a widely different requirement was exacted from the Jacquard when applied to the lace machine from that used in the common hand loom, for which it was originally intended. When used in the hand loom the operation of the cards upon the needles is simply to throw those hooks out of contact with the griffe which are not required to be raised. Thus only those threads of the warp are raised for the passage of the shuttle that are necessary for the formation of the design or pattern. It matters little whether the hooks are raised two or three inches in height so long as the shed is high enough for the shuttle; in the lace-frame this is quite another matter. Not only do the perforations in the cards select the particular threads to be moved, but they also regulate the exact distances they are required to move. These distances are so small that the most exact working of the parts is absolutely requisite to insure the formation of the pattern.

In the frame now shown there are, as before stated, 19 shuttles working freely in the space of one inch. Now, to produce the figure it is requisite to be able to draw any of the warp threads in such a position that the shuttle, as arranged by the designer, shall pass at the side of any particular thread, and the position must be very exact to accomplish this. Sometimes the thread is drawn only one space, in other cases they are drawn twenty spaces and upwards. These spaces being only 1-19th of an inch from centre to centre, in many cases only 1-30th of an inch, it follows that to stop exactly at the proper place, the mechanical arrangement for that purpose must not only be true, but made upon a principle that will stand the wear and tear of rapid and hard usage. It was also necessary that the Jacquard should be able to work at a speed not only equal to that of the lace-frame, but to do its work easily at what ever speed was required. These conditions are admirably supplied in the Jacquard apparatus connected to the lace-frame, the principle of which will be hereafter described.

The importance of the Jacquard in conjunction with the lace-frame cannot be overrated, and it is questionable whether the modification now shown is not the most valuable and ingenious part of the machine.

The name of Jacquard, from whom the machine takes its name, is generally associated with the idea that he was the inventor of the perforated cards which form the gist of the invention. There is good authority to show that this was not the case. So early as 1725, a M. Bouchon employed a band of pierced paper pressed by a hand-bar against a row of wires, so as to push forward those which happened to be opposite the blank spaces, and thus bring loops at the lower extremity of vertical wires in connection with a comb-like rack below. This being then depressed by hand, pulled down the selected wires, and with them the tail cords of the draw-loom to which they were connected. Falcon, in 1728, substituted the chain

of cards on a square prism, as still used, for the continuous band of paper of M. Bouchon, and placed his horizontal wires in several ranks as now used.

In 1746, the celebrated Vaucanson suppressed altogether the simple and tail cords of the draw-loom, and made the loom completely self-acting by placing the pierced paper or card upon the surface of a large perforated cylinder, which travelled backwards and forwards at each stroke, and revolved slowly by means of ratchet work. He also invented the rising griffe, and thus made the machine almost the same as the actual Jacquard.

The history of Jacquard is too well known to be repeated here, and although he cannot lay claim to the invention of any of the most important parts of the Jacquard machine, still he has the credit of reproducing and carrying out in the early part of this century the ingenious contrivance that had been made early in the century previous. In its introduction Jacquard met with great difficulties and oppression, but the time had arrived when the invention was absolutely a necessity, and no auxiliary machine has ever proved to be more effectual or useful than the Jacquard machine. "The merit of Jacquard," observes the Rev. R. Willis, in his Report on the Paris Exhibition of 1855, "is not, therefore, that of an inventor, but of an experienced workman who, combining together the best parts of the machines of his predecessors in the same line succeeds, for the first time in obtaining an arrangement sufficiently practical to be generally employed."

As far as space admits, the writer has endeavoured to trace the more important parts in the history of the lace machine down to the present time, and as it does not appear that any description has ever been given of it, excepting those contained in the specifications of patents, intended for the use of practical men only, to whom they are alone intelligible, it is proposed to describe, in a second article, the action of the Levers machine, and the general principle upon which it depends.

(*To be continued.*)

The following is the return of admissions to the Exhibition for the week ending Saturday, September 12th:— Season tickets, 981; payment, 16,003; total, 16,984.

EXHIBITIONS.

ST. PETERSBURG EXHIBITION.

The following are the preliminary official regulations respecting the permanent Exhibition of the Russian Polytechnic Society, consisting of engines, tools, and machinery recently brought into use:—

Objects of the Exhibition.

The object of the exhibition is to convey a knowledge of new engines, tools, and machines, both Russian and foreign; to try them, to assist in their introduction into general use in Russia, and to facilitate the negociations of Russian manufacturers and proprietors with the makers of the various engines and machines both Russian and foreign.

For the purpose of this exhibition the Russian Polytechnic Society has provided a special position annexed to the Museum of Applied Science.

Conditions.

1. The objects admitted to the exhibition will be:— Engines of all kinds (those of the portable class only excepted), machines, machine tools and apparatus, introduced since the year 1872, and the use of which may be beneficial to Russian trade and manufacture. The society, however, reserves to itself the right of limiting, according to the available space, the number of objects for exhibition.

2. The exhibits will be admitted from the 1st of July to the 1st of October, Russian style (that is to say from the 13th of July to the 13th of October, according to our reckoning), in each year.

3. The exhibition will be opened to the public on the 15th of October in each year and closed on the ensuing 15th of April, Russian style (that is to say, opened on the 27th October and closed on the 27th April).

4. The official examination of the objects exhibited will be made during the first two months of the exhibition, and the awards made public.

5. Medals or "honourable mentions" will be awarded to those of the exhibitors who shall have sent engines, machine tools, or apparatus for accomplishing the same work in a more perfect manner than those previously in use. If these appliances be signalised as of great importance to Russian industry, and if they be found capable of a wide-spread application in Russia, the Polytechnic Society, by virtue of Article 2 of its statutes, will not fail to commend the exhibitor to the favourable notice of the Russian Government.

6. Engines, machine tools, and apparatus, which have been shown at this exhibition, cannot be admitted a second time, unless some essential improvements shall have been made in them.

7. In order to afford a thorough knowledge of the engines and machines exhibited, they will be put in motion, and must be set to work in public on the request of persons appointed to examine them, or of intending purchasers.

8. For driving the machines, the society will supply gratuitously to the exhibitors motive power and driving shafts; but pulleys and belts, as well as the materials to be operated upon, must be supplied by the exhibitors.

9. The Polytechnic Society of Russia will freely give its aid towards effecting the sale and purchase of the objects exhibited, but it will be glad to receive donations in aid of the maintenance of the exhibition and of the museum from those exhibitors who may have derived advantage from the sale of their productions in Russia.

10. The engineers and mechanics attached to the service of the society will gratuitously superintend and put in motion the engines, machine tools, and apparatus exhibited.

12. Exhibitors who may have sent their machines in pieces must entrust the erection to their own engineers at their own cost, and the engineer in charge of the machine must remain at the exhibition at least eight days after the erection shall have been completed, in order to put the society's engineers in the way of working the machines exhibited.

13. The insurance of the exhibits until their arrival at their destination will rest entirely with exhibitors, but the insurance during the time the exhibition shall remain open, as well as the keeping of packing cases in which the articles were contained, and which may not have become broken in unpacking, will be undertaken by the Polytechnic Society.

14. Slight repairs required to be done to the exhibits, such as the renewing of paint, the re-placing or re-adjustment of portions which may have become broken, provided that they be of little value and without influence on the general working of the machine, will be executed at the expense of the society. With respect to machines, the main portions of which may have become broken, or which, after being erected, may be found incapable of working, the society reserves to itself the right of excluding such from the exhibition. However, in case the exhibitors or their agents desire to re-place the broken parts, or generally to set to rights an object which shall have been excluded, a maximum delay of six weeks may be granted by the society.

15. Every person who desires to take part in the exhibition at the museum of applied science, should give notice to the Russian Polytechnic Society or to its

representatives in each country, and at the same time send a complete specification as well as drawings of the machine, tool, or apparatus to be exhibited, adding also the selling price.

16. From the time that the society or its representative shall have consented to admit the proposed object to the exhibition, the exhibitor shall undertake to conform to all the conditions of the exhibition, and will receive a form of way-bill, not filled up, as well as a pass for sending, free of duty, the articles named in the way-bill, in the case of these articles being sent from a foreign country.

17. The Custom-house dues need not be paid unless the exhibit be sold without being returned to the manufacturer.

18. Those objects which may not have been sold, as well as those which have been excluded from the exhibition by virtue of article 14, should be immediately taken charge of by the exhibitors, in which case only the packing of such objects, in cases not broken up, shall be undertaken by the society.

19. The drawings of all the exhibits sold shall remain in the museum of the society.

20. Trade advertisements of all kinds, which may be affixed to the walls or pillars, shall be admitted to the exhibition on payment of 7 roubles 40 kopecks (£1 sterling) per square metre (about $10\frac{3}{4}$ square feet) per month.

21. The advertisements will be translated into the Russian language, and, at the request of the exhibitor, 1,200 copies will be printed for the price of 7 roubles 40 kopecks (£1 sterling) for each page whatever be its size.

22. With the advertisement may be sent samples of products which may have recently been offered for sale. The samples, bound up in books or albums of small size, will be admitted gratuitously; those sent in packets will be subject to payment on the same scale as the advertisements, but in all cases the price of each object must be given.

National Exhibition of Industrial Art, Brussels.—This exhibition, which, it will be remembered, was announced to be held in the building intended hereafter for the great central markets of the city, has been opened. The exhibition has been organised entirely by private individuals, without any aid whatever, either from the government or the city, with the exception of the loan of the building itself. A very large number of manufacturers responded to the appeal of the committee, and in spite of the strict terms of the programme that nothing could possibly be admitted which did not exhibit an effective application of art, the space proved much too small for the applications, and the exhibition includes 550 separate collections of industrial art manufactures, representing seventy-two different industries. The collection gives a high idea of Belgian art industry, which in many departments, and especially in carved woodwork, has no superior; but the exhibition, large and fine as it is, is but the preface to a greater work. This project includes a great national exhibition in the capital of all the artistic manufactures of the country, and a permanent museum of selected specimens. "If in the order of material interests," said the Burgomaster in an opening address, "there exists a condition of labour which merits all the solicitude of those who hold in their hands a portion of the public authority, it is that which consists in the application of the arts to industry," and he called upon the government and the local authorities to lend their aid to the plan, and, as the Burgomaster said, lay the foundation of a Belgian South Kensington. His Majesty, in his reply, congratulated the Burgomaster on his project, and expressed the deep sympathy which he felt towards such a valuable movement in aid of national art industry. The plan of the future great exhibition and museum is as follows:—The large plain which is now known as the Champ des Manœuvres is about to be given up by the military authorities, and it is here that the Burgomaster and his co-operators in the scheme propose to erect two buildings, one temporary, for the purpose of the exhibition only, the other permanent, to be used first for the exhibition, and afterwards to become the permanent museum. The Exhibition has proved highly attractive. The *Moniteur Belge* says that more than fifteen thousand persons had visited before the 12th instant, and that many visitors of the first day have returned again and again. Tickets are being sold for a lottery, of which the prizes are in the Exhibition. The sum thus raised will be employed for the purpose of erecting the various buildings alluded to above.

COAL MINING IN ITALY.

The following paper was read before Section G of the British Association for the Advancement of Science by Mr. P. Le Neve Foster, jun., C.E.:—

Although mineral fuel may not be so abundant in Italy as in many other countries, there is no reason why that which she possesses should be neglected, and it is the object of this paper not only to give some account of what has already been done, but also to point out what might be done towards extending coal mining in Italy. I believe that one of the principal reasons that many of the numerous deposits of fossil fuel have hitherto remained unworked to have been in the unfortunate title of "lignite," which has been applied to the coal of the Tertiary formation, in contradistinction to the "true coal" of the carboniferous beds of the Palæozoic period, and has thereby prejudiced the general public against its use, as to many people "lignite" signifies a very inferior article, presenting the appearance of imperfectly decomposed wood. The coal-fields which form the subject of this paper are situated in the Tuscan Maremma, and appear to have had their origin in the middle Tertiary series (Miocene), and by some violent upheaval caused by the intrusion of igneous rocks have been broken up into a series of small basins. The coal of this district is of excellent quality, and it is to the action of heat from the intrusion of the serpentine, trachyte, and other eruptive rocks that the perfect mineralisation of the vegetable matter may be attributed.

One of the best known coal basins is that of Montebamboli, to the west of the town of Massa Marittima, situated about thirteen miles from the coast. This mine was opened in 1839, and was extensively worked for many years, but now it is abandoned. The coal from these mines was of so bituminous a nature as to be difficult to distinguish from Newcastle coal. It is said also that it produced an excellent coke. The basin of Montebamboli is about three miles in circuit, and contains two seams of coal, the upper one being 1·20 metres thick, and separated from the lower, which is 0·60 metre in thickness, by a layer 6·50 metres in depth of limestone containing *Dreissena Brardi* and other fossil fresh water shells. The upper strata consist of conglomerates, calcareous breccia, and of alternate beds of clay and sandstone, containing fossils of marine origin; these are followed by a clay locally termed Mattajone, in which several varieties of the *Unio* and other fresh water shells are found, together with impressions of exogenous plants; this clay is succeeded by alternate beds of limestone and sandstone for a depth of about 25 metres, and forms the roof of the upper seam of coal. In these limestones the *Dreissena Brardi*, *Paludina*, *Planorbis*, and other shells of lacustrine origin are found, together with remains of plants. The lower seam rests on a bed of Alberese breccia from 5 to 10 metres in thickness, beneath which follow immediately the schist and Alberese limestone of the Eocene period, which, however, are much broken. The seams vary in inclination from 0 deg.

to 60 deg., but the general dip of the coal is 32 deg. The mines were worked by five shafts, the deepest being about 100 metres. A railway, 16 kilometres ($9\frac{1}{2}$ miles) in length, was made to convey the coal to the coast at Torre Mozea, near Follonica. Not many miles south-east of the town of Massa Marittima is the coal basin of the Val di Bruno, situated at the foot of an extensive range of hills and mountains which form a vast amphitheatre, enclosing a large area of plain watered by the torrent Bruno and its tributaries, the Carsia and Confiente. On the south, and situated on the summit of a rugged mass of rock overlooking that plain, is the now ruined castle of Pietra, celebrated by Dante as the prison of the unfortunate Pia de' Tolomei:—

> "Ricordati di me, che son la Pia
> Siena me fe'; disfecimi Maremma;"

alluding to the proverbial unhealthiness of this district.

The mines of Casteani are perhaps the most important that are at present worked in Italy, and are owned by Signor Ferrari-Corbelli. The mineral rights extend over an area of about 5,000 English acres. The coal is found in two seams entirely in the upper clays, are extremely plastic, and generally of a bluish colour, with different gradations of shade from almost white to black, and near the roof of the coal they assume a schistose structure, and are of a darker colour. These clays are not particularly rich in fossil remains, the flora being represented by the *Quercus*, *Platanus aceroides*, *Castanea*, *Fagus dentatus*, and impressions of ferns. The shells are chiefly of the genus *Ostrea*, and the jawbones with teeth of the genus *Sus*, and the carapaces of tortoises represent the fauna of that period. The upper coal seam is 6 metres in thickness, and is separated from the lower one—which is from 0·80 to one metre thick—by a layer 8 metres in depth of clay, in which no fewer than from seven to eight little seams of a few centimetres in thickness are found. The dip of the seam is from 25° to 30°. The strata here are less broken than at Montebamboli, though the seams are occasionally thrown up into saddles. The upper seam alone is worked at Casteani, and consists of about 0·50 metre of shaly coal of inferior quality, followed by 0·50 metre of coal of first quality; then 1·50 metre of coal of fair quality, but not so compact, which is sold as second quality, and is succeeded by 2·50 metres of first quality resting on a bed 0·50 metre thick of inferior coal of similar quality to that of the roof.

Owing to the thickness of the seam and the pressure of the upper and lower beds of clay, it is found necessary, in order to get out the greater quantity of the coal, to work the seam in three leads on the long wall system, taking out the bottom for a depth of two metres first, and after filling up the space that was occupied by the coal with earth, the middle two metres is next taken out, and then the top. The earth for filling in is brought from the "mulniello," as the place is called when the earth is allowed to fall in for that purpose. The following is an analysis of this coal by Professor Bechi:—

	First quality.	Second quality.
Fixed carbon	0·6185	0·5368
Volatile matter	0·3760	0·3900
Ash	0·0055	0·0732

The getting of this coal is carried on by piecework, the miners receiving on the average 2·50 frs. per ton. This includes the filling in and underground conveyance, but not the raising, timbering, driving of levels, and other works. The rate of wages at these mines is—Carpenters, blacksmiths, timbermen, &c., from 70 frs. to 80 frs. per month; miners, from 1·70 frs. to 2 frs. per day; and labourers, 1·50 frs. to 1·70 frs. per day.

At the Casteani mines there are three shafts and two inclined planes. The principal shaft (Il Pozzo Teodoro), sunk to the dip, is about 100 metres in depth, and in this the greater part of the coal is raised to the surface. This pit is provided with cages and winding gear worked by a double-cylinder high-pressure engine; the other pits serve for ventilation, and are provided with ladder for the ascent and descent of the men. One of the inclined planes is 57 metres in depth, and is used for raising the coal from the upper workings. The annual output of these mines averages 20,000 tons, and the coal is sent chiefly by rail to Leghorn and Rome from the Potassa station, which is about five miles distant from the mines. The price of the coal at the pit's mouth is 16 frs. per ton for the first quality, and 12 frs. for the second; delivered at the railway station, 5 frs. extra is charged. The number of men employed at the mines is about 225, of whom 180 are engaged underground. The miners are lighted at their work by open oil lamps, but in some parts of the mine, especially where the ventilation is bad, and where there is danger from explosive gases, the safety lamp is used, and each workman is supplied with printed regulations for using the lamps and testing the presence of gas in the workings.

There is no doubt that these mines are not worked to the extent that they are capable of, and in the hands of an energetic company, and with a tramway to the railway station, ten times the quantity of coal might easily be raised and sent away. Close to these mines a French company are sinking a pit on a small property called Casa Vecchia; this pit has now reached a depth of 105 metres, through the blue Tertiary clays and hard conglomerate; and from the appearance of the strata that have now been reached, there is every probability that coal will be met with shortly. To the north of these mines, on the Perolla estates, borings were made last year, and a small seam of coal found at a short depth below the surface. A search for coal has also been made at Pietra (a large estate, occupying the greater part of the south and south-eastern portions of the plain) by a firm of English capitalists, and an inclined gallery was driven for a distance of 50 metres, following to the dip of a seam, the outcrop of which was found on the side of a hill called the Petrajo; and there is every reason to believe that when this gallery has been pushed to a greater depth, and below the level of the plain, this undertaking will be rewarded with success, and a thick seam of coal will be met with. To the east of the Val di Bruno, and south of the village of Monte Massi, is an extensive coal-field, and important outcrops may be seen in the beds of the torrents Follonica, Ritolla, and Raspolina; and in the bed of the former, at a place called Casetta Papi, there is an outcrop of coal six metres in thickness. Several pits have been sunk here, and large quantities of excellent coal found; but the mines are not worked at the present time. About a mile and a-half further east, and at a place called Poggio Moretto, other pits were sunk many years ago, but the mines have not been worked to any extent. An English company, the Sassoforte Collieries Company, Limited, was formed last year to work some extensive deposits of coal, near the little village of Sasso Fortino, and they purpose shortly to construct a railway from the mines to the station of Rocca Strada, a distance of about fifteen miles. The coal of the Acqua Nera is one of the best in Italy. An Italian company have lately commenced working some mines near Murho, a small village about fifteen miles from Siena, and are now completing a railway, $13\frac{1}{2}$ miles in length, to the station of Monte Antico, on the line between Grosetto and Siena. There are numerous other deposits of coal in the valley of the Ombrone, towardes Monte Amiata, and only require an energetic company to develop them. Amongst these may be mentioned the discovery of coal at Bacinello (about 15 miles from Grosetto), where the outcrop of a seam, two metres in thickness, has been laid bare by the action of a torrent. Coal has also been found at Acqua Salata, Val di Nebbia, near Paganico, at Val di Becco, below Stribughiano, in the torrent Ansidonia, not far from Arcidosso, Val di Catabbio, and Monte Buono, near the Roman frontier; and traces of the carboniferous strata are to be met with in all directons.

In conclusion, there appears to be no doubt that coal-mining in Italy has a brilliant future in store, and in the hands of English capitalists will become a most profitable undertaking; and if proper care be taken in the selection and purchase of mining property, and in its judicious management afterwards, the coal mines of the Maremma will yield abundant returns for the money invested in them.

CORRESPONDENCE.

CONGRESS OF ORIENTALISTS.

SIR,—Having been named as a delegate of the Indian Section of the Society of Arts and of the Anthropological Institute to the Congress of Orientalists, I regret, on behalf of many interested, that the benefits of this brilliant gathering of the most distinguished men from all parts of the world, are little likely to be obtained. The experience of the British Association and the usages of such assemblages have not been applied, and with the name of sections we shall lose their practical and scientific results, while the interests of our Indian empire, which should be paramount on such an occasion, must be neglected.

Two hours are provided for the meetings of each of the six sections, and of this time an hour will be given to an inaugural and popular address of a president. Those who have been unhappy enough to send papers, or even notes on discoveries from home or abroad cannot have them read, still less discussed, nor is it sure their titles will be enumerated.

Many of us have been strongly desirous that the objects of the Indian Section of the Society of Arts should not be altogether lost sight of, and we had hoped, fruitlessly as it would seem, that in the section of ethnology we should be allowed to bring forward and discuss the important subject of the Oriental Institute proposed by Dr. Forbes Watson to be established in connection with the Indian Library and Museum. Not less important than this is the proposal submitted by myself to the Society of Arts, that an Oriental Congress should yearly be held in one of our cities, in which we can deal not only with subjects of Oriental learning, but with the practical science relating to our Indian possessions, China, and Japan.

It is to be hoped, nevertheless, that this appeal, which will appear on the last day of the Congress, may not be without permanent fruits.—I am, &c.,

HYDE CLARKE.

32, St. George's-square, S.W., September 14th, 1874.

A French journal connected with the metal trade gives the following curious estimate of the value of a piece of iron costing in its rough state 1 fr., after being employed for different manufactures. Made into a horseshoe it is worth 3 frs.; into agricultural implements, 4 frs.; forged into ornaments, 45 frs.; converted into needles, 75 frs.; into steel buttons, 900 frs.; employed as polished steel for decorative purposes, 2,000 frs.; and made into shirt studs, 6,000 frs.

With reference to a paper, recently read before the Society on the subject, it may be interesting to note that the lighting of street gas lamps by electricity seems to have proved successful in Providence, Rhode Island, the board of aldermen having authorised a contract to be made with the inventor for its application to the lamps of that city.

It is proposed to undertake a regular *exploitation* of the Muncayan copper mines in Manilla, in consequence of some very pure copper (about twelve tons) having been got from them.

GENERAL NOTES.

Compiegne Museums.—The Palace of Compiègne is apparently to be devoted to the purposes of a public gallery. The fine Gallo-Roman collection, which was for some time exhibited in the orangerie of the palace, has been placed in the Salle d'Armes, and a considerable collection of old pictures sent from the stores of the Louvre in the noble Salle des Fetes and adjoining rooms. A third and novel collection has just been instituted in the Salle des Gardes. This consists of the antiquities brought from Cambogia by the expedition headed by Lieutenant Delaporte, of the French navy. The most remarkable items are eighty pieces of sculpture and architecture, including a group of two giants supporting a dragon, another giant resting on a club, several other statues of divinities, kings, and women, an elephant, lions and dragons; a number of statuettes, and small groups in stone and in bronze; a pediment and entablature with *bas-reliefs*, a number of architectural details, casts from sculptured works, a few inscriptions, a plan of the Kluner ruins as far as they have yet been explored, and a number of photographs. To which will be added shortly a further collection made by Captain Filor and others. This is the first museum founded in Europe illustrative of the civilisation of the ancient Cambogians, of whom little or nothing is known, but who covered Indo-China with immense and splendid monuments. The museums are now open to the public on Sunday, Monday, Thursday, and Saturday.

American Pig Iron.—In 1854, the production of pig iron in the United States was only one-fifth that of the United Kingdom; in 1873, it was considerably more than one-third. Pennsylvania produces nearly one-half of all the pig iron made in the United States.

Western Australian Telegraphy.—All the settled districts of Western Australia are now in telegraphic communication with each other, a line to Champion Bay having been lately opened. In seven years Western Australia has constructed 800 miles of telegraph.

Emigration from Genoa.—During the month of July, 1874, the number of ships that sailed from Genoa with emigrants for South America was 5, the number of passengers 900, and crew 259. During the same month of the previous year, 7 ships, manned by crews of 360 men, left that port with 1,030 emigrants.

The Hoosac Tunnel.—This important tunnel, although bored through the mountain which had to be penetrated, is still not by any means completed. Two years will, it is thought, elapse before it can be opened for traffic. Much brick arching has to be done, a railway has to be laid through the tunnel, and connections have to be formed at both ends with the railways which have to run through it.

Coal in India.—The coal lately discovered on the Dehra Ghazee Khan frontier is not so plentiful as was expected. The Government geologist reports the coal to be good, but says that though the seams extend for several miles, they are not thick enough for remunerative working. Coal-boring operations on the banks of the Godavery, in the Nizam's dominions, have been attended with very promising results, and there seems every prospect that large deposits of coal will be discovered.

Production of Iron in Namur.—The Namur Chamber of Commerce and Manufactures has recently published its general report for 1873. The production of pig iron in this province last year amounted to 45,732 tons, showing an increase of 3,972 tons as compared with 1872. The iron works of the province delivered for consumption last year 35,872 tons of iron, of an estimated value of upwards of £360,000. In the total of 35,872 tons, the Thy-le-Chateau Works figured for no less than 35,656 tons.

Railways in England and Wales.—At the end of last year there were in England and Wales 11,369 miles of railway lines open; the total capital paid up, including shares, loans, &c., was upwards of £490,000,000; and the total number of passengers conveyed, including season ticket-holders, stood at upwards of 400,000,000. The total traffic receipts of the year amounted to £49,000,000; the working expenses were nearly £26,000,000; and the net traffic receipts £23,000,000.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

GENERAL EXAMINATIONS, 1875.

TECHNOLOGICAL EXAMINATIONS, 1875.

The Programmes of each of these Examinations are now ready, and may be had on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The second lecture of the third course of Cantor Lectures for the past Session, "On Carbon and Certain Compounds of Carbon," was delivered by Professor Barff, on Monday, April 20th, 1874, as follows:—

Lecture II.

Mr. Chairman, Ladies, and Gentlemen,—The element which I had the pleasure of speaking to you about at our last meeting is one which has the power of combining very readily with oxygen gas. It will combine with it directly, and also indirectly. I use this term indirectly, because in my next lecture, when I have to speak of the compounds of carbon, oxygen, and hydrogen, I shall show you that hydrogen only under very peculiar circumstances combines directly with carbon. Carbon combines directly with oxygen, sometimes at the ordinary temperature of the air, and sometimes above the ordinary temperature of the air. In all chemical bodies where one element combines with another, the combination takes place in definite proportions. If I take up any chemical compound, it does not matter what it is—suppose we take that bottle of oil of vitriol—all the elements in it are combined in certain definite proportions; if a sample of oil of vitriol, provided it be pure, be obtained from any source, the elements forming it, will be combined in the same proportions as they are in that bottle of oil of vitriol. And so it is with all chemical compounds.

Now, to-night, I am going to depart from a practice which I have adopted ever since I have had the pleasure of lecturing here. I am going to speak a little about chemical symbols. I have not done so before because the substances which I dealt with were so excessively complicated that had I spoken to you about their symbolic representations I am sure I should only have mystified rather than enlightened you.

Now, I have a good opportunity, and also I feel it to be useful to do it, for this reason. You who are turning your attention to a scientific view of these subjects which are uppermost in your minds, will look at chemical books, for you will say we cannot carry away all that is said in a lecture, nor are you expected to do so, because, generally speaking, lectures only give hints, as it were, to help you to direct your thoughts rather than to give you full matter to think upon. If you read chemical books you will always find symbols in them, and therefore it is well that you should quite understand what these symbols mean.

Suppose we take a piece of black charcoal. Suppose it to be pure carbon. Suppose we weigh it, we should find say that its weight was 12 grains. Now I can tell you directly how much oxygen will unite with that. I can tell you that 16 parts of oxygen will unite with 12 parts of carbon to form one of the products of which I have to speak to you this evening, and that 32 parts of oxygen will unite with 12 of carbon to form another product which will require our consideration also. This is invariable. There is no exception to it. You will notice then in reading a chemical book about carbon the letter C, and other letters in combination with it frequently. Now what does this letter C mean? for you must have a clear understanding of this, or else the knowledge will always bring to your mind not clearness but confusion. C is not a letter used as this gentleman whom you see here is using symbols of shorthand. C does not mean carbon. C means a definite weight of carbon, and C means 12 parts by weight of carbon. Whenever then in a chemical book you see the letter C, that C represents a sentence, and that sentence is "12 parts by weight of carbon."

Now suppose this 12 parts by weight of carbon be united with 16 parts by weight of oxygen. We must have a symbol to represent the oxygen, and the symbol which represents that is the letter O. CO then means a sentence, and translated it is this, 12 parts by weight of carbon and 16 of oxygen, and I cannot conceive that you can render it in fewer words than that. Some persons will say "CO, that means carbonic oxide." No, it does not mean carbonic oxide; it means 12 parts by weight of carbon, and 16 of oxygen; 28 parts by weight of carbonic oxide. Then suppose we have a second 16 parts by weight of oxygen, then we have CO_2, which does not mean carbonic acid, but means 44 parts by weight of carbonic acid. It also has another meaning, not simply of weight, but of measure, and of that I shall have to speak to you later on.

So the few symbols I shall have to use to-night I think you will be able to understand from what I have now said to you. I shall have to mention some other elements besides these, and when I do use a symbol for those elements I shall tell you what the symbol means, viz., the weight of the element.

Now carbon, it is said, has never been vaporised. I believe that is true. Although some experiments have been performed by chemists, only one I believe has been able to do anything in the way of producing something like vapour of carbon. He heated some carbon compound *in vacuo* with a battery of 600 cells, and then it is said that he got a blackish brown vapour, and that on the sides of the vessels after the experiment certain black crystals were found. We generally say that carbon has never been vaporised; whether it has or not I cannot tell you. I have told you simply of this experiment, which is no real proof that it has been vaporised. But as soon as ever carbon comes in contact with this element, oxygen, under suitable conditions, with which it can unite, then it does form a transparent and colourless gas; in fact, two transparent and colourless gases, which I shall have to bring before your notice this evening.

I must speak to you upon this subject in an elementary way, and I am sure you will not find fault with me for doing so, for reasons which I gave you before, because I want you to be perfectly prepared for the applications of these principles in our later lectures, so that I shall not then have to do more than simply revert to them in passing, and that I shall not have to disturb the course of my lecture at that time by giving you

knowledge with which we ought to commence our investigations.

Now, carbon combines with oxygen at the ordinary temperature of the air, and also at high temperatures. If you take some leaves or some sawdust and put them in a bottle, and stopper the bottle up, and keep it for a time, you will have that bottle filled with carbonic acid, whereas it was first filled with air. I am not going to show you that experiment to-night, because I have shown it here before. Most of you, therefore, will have seen it, but you shall see the same experiment in another shape. I am not going to take decaying leaves or sawdust, but I am going to take a piece of manure that was picked up in the road. It was put into the tube to-day, and you notice that air is being sucked over it—passed over it—and you notice that a deposit is taking place in that lime-water there, showing that carbonic acid is being formed by oxidation of the carbon in this substance at the ordinary temperature of this air. I do not mean to say that if we put a thermometer into that tube the temperature would be the same as that of the room, because chemical action is going on here, and there is a burning going on slowly. Therefore the temperature inside this tube is greater than the temperature outside the tube. But you see most distinctly the air is passing through, and we are getting carbonic acid formed every moment in small quantities. You all know that if a haystack be put up green the chances are that the haystack will take fire. Why will this happen? Simply because its carbon, the hay being moist, will unite with the oxygen in the air, heat will be evolved, and at last the temperature will rise so high that it will set fire to the grass or hay. And here we have got by the oxidation of the carbon evolution of heat. What do we get in our fire-places? Evolution of heat. That is why we have fire-places. That is why we charge them with fuel and apply a light—for the same reason in both cases—because the carbon in the fuel, as the carbon in the grass, is oxidised by the oxygen of the air. I shall have again to speak of the subject of burning, but what I want you to understand now is this, that the burning goes on steadily and slowly in nature, although we may have never known anything about it before, or never have heard that the action is perfectly analogous to the case of the heat generated in the haystack to the heat generated in the burning fire.

Then, again, let me refer to our own bodies. We get hot; we have a certain animal heat, below which if the temperature of our bodies fall, we die instantly. You know this is the case where persons in cold climates are frozen to death, or a limb may die, without the whole body dying. But if a man lies down to sleep in the cold, and the vital forces are not sufficiently energetic, the temperature of the body falls so low that he sleeps a sleep from which he never wakes again. Now what is it produces the heat of our bodies? It is not simply, but in great part, owing to the burning or combustion of the carbon and of the hydrogen of the food which we eat, and the products of combustion in all instances are the same. Put a vessel full of lime-water, which is an indicator of the presence of carbonic acid, put that into the haystack and it will turn milky; put it to the fire-place where gaseous products of combustion will go into it, it will turn milky; breathe into it, it will turn milky; showing that in all instances the products of combustion are the same, simply because the processes are the same, only that they are carried on under different conditions.

Now I dwell upon this because I think it is so important to get these ideas fixed in the mind. I felt it to be so when I first studied chemistry; I felt it to be most important to get these things into my own mind, so that they might became part of my thoughts, and I wish to enable you to do the same. There is one point I wish to notice in passing which is very important, and one to which I have given considerable attention and thought, and I am very glad to find that my thought has been in the right direction; for in consulting with Professor Oliver, the Curator of one of the museums at Kew, I found that the very things that I had been thinking about had been investigated by others in several instances, and although the channels of our thoughts differed somewhat, yet in the main they went to the same end.

Underneath the surface of the earth we have more carbonic acid, much more than we have above its surface, Four parts in 10,000 is the proportion in the air—not at this moment in this room, but over this great city, or over the great Atlantic, for the proportion varies very little indeed when the air is taken from different places. But underneath the surface of the earth we have a very large amount of carbonic acid—what percentage I cannot tell—but I hope some day to be able to tell you, or, at all events, publicly to the world, the quantity found in the different depths of the earth; and the influence of this carbonic acid there is ever interesting. The mineralogist will see that the consideration of it is very important. The botanist will see that it will in fact be to him of far greater importance even than to the mineralogist, for it has always been in my mind, as in the mind of some botanists, a very striking thing, when you consider that only 4 parts in 10,000 of the carbonic acid is the quantity in the air, and yet all vegetation takes its carbon from carbonic acid. Now I find that my ideas are confirmed, viz., that there is a much larger quantity of carbonic acid under the earth, and therefore in the water that impregnates the earth. Now it is not difficult to understand that there is an accumulation of carbonic acid which goes to support the plant, and to enable the plant to build up its structure, and to afford those products which are useful for the support of animal life. This point is not irrelevant, because it is from this source that we get our fuels. It is from this source that we get our coal, for our coal, as you know, was once wood. Therefore it does behove us to understand how it is that the trees and plants and flowers which grow, and which form our food, in producing sugar and fuel for our fires, it is of importance and of great interest to know how it is that they get the material which builds up their structures, and where they get it from. Surely this is a matter of importance, and therefore I mention it to you this evening.

We will now pass on to consider the properties of carbonic acid gas, however it may be found. But, before I go to that, I want to call your attention to an interesting matter here. I said just now that carbon and oxygen unite together directly at high temperatures, or at low temperatures. In the presence of moisture, carbonic acid gas is the product in almost all cases, because the air is in excess of the carbon acted upon at the time. But I wish to call your attention to the circumstances under which another product of oxidation is formed, in which the carbon is in excess of the oxygen. Here in this tube I have got a black powder; it is common black lead—plumbago. It has been oxidised by means of chlorate of potash and nitric acid, and a substance here is formed which has properties different from the graphite from which it was formed. This substance was discovered by Sir Benjamin Brodie. You may get from this substance graphitic acid. It contains oxygen, hydrogen, and carbon. Now, if these be heated—you see the black powder is three-fourths up the tube—this will swell, and it will pass up the tube probably nearly to the top, and a change will take place in it. You see it is beginning to rise now. If you notice, it is swelling and passing up the tube. This shall be thrown out, and I will perform an experiment with it. If we throw a little powdered graphite into the flame you will notice that it will not catch fire. This will readily burn. Now the graphite will not burn, so that the graphite has been converted into a form of ordinary charcoal. Let us now connect this with the diamond. Suppose you heat a diamond in a vessel from which air

has been excluded; if you heat it by the electric current these phenomena take place. First of all the diamond increases in size; instead of being transparent it becomes opaque; if, at this stage you take it out and take the specific gravity of the substance, you will find that it is much less than the specific gravity of the diamond. If you go on heating the diamond it turns out a black mass. That black mass is identical with graphite. If you put that graphite with chlorate of potash you will produce this substance. So that we are able to take the diamond and reduce it to charcoal. We cannot, I am sorry to say, build up the diamond from charcoal.

I will show you this same graphite, which has been crystallised in molten-iron, or cast-iron, which contains something under five per cent. of carbon. The iron has been allowed to cool slowly, and then the graphite has crystallised out, and the iron has been dissolved by hydrochloric acid.

Now let me call your attention to the properties of carbonic acid. That large jar on the table professes to be filled with carbonic acid. It was filled before the lecture, and I hope the various currents of air passing over it have not driven it out. You see then carbonic acid gas is colourless and transparent. If you were to put your nose to it you would find it had no smell, and if you were to breathe it or draw it into your mouth you would find that it has not aste. You know well-made soda-water has no taste. If soda-water has any taste, it is owing to the fact that there is some alkaline substance dissolved in it.

Now another physical property of this gas is of considerable importance—carbonic acid gas can be condensed to a liquid. You might be inclined to ask of what importance is that to us in a lecture on carbon. Much, as you will see. It can be condensed to a liquid but at a considerable pressure. You see that this gas extinguishes a light. Substances will not burn in it. Neither will animals live in it. If I were to put a mouse into it it would die. I will tell you what this has to do with my subject. Although I am here to explain to you these principles which can be usefully applied to illuminating purposes, I think you will see I am not going beyond my mark when I suggest something that will destroy heat and illuminating action, and that will put out fires.

Now you know carbonic acid gas has been used as the material in the fire-extinguisher. Carbonic acid gas under pressure is used there. What I want to suggest is this (I do not know whether a gentleman is present now who attended my former course of lectures, but a gentleman connected with the Fire Brigade wrote to me about the use of silicate in preventing the burning of the canvas with which fire-escapes are made), that carbonic acid gas, if it were condensed to a liquid, as a liquid would occupy an infinite less space than the gas occupies, so that a very large quantity of carbonic acid gas could be condensed into the liquid state and held in a small vessel. What I suggest is this, that at all fire-escape houses bottles containing this liquid carbonic acid gas should be kept. Of course they must be iron, and strong enough to bear a heavy pressure, for the pressure is about 40 times 15 lb. to the square inch. In order that the gas might escape readily when thrown into the burning building, these vessels should be made of a cylindrical form, drilled with holes, and those holes filled in with a fusible metal. You see, then, directly this apparatus is thrown into the fire the fusible metal will melt, and the liquid carbonic acid would escape and become gaseous, and of course its volume would increase far beyond the volume it had while condensed; and I do believe that in some of those unmanageable fires where human beings are not in the burning houses, these vessels thrown into the fire would extinguish the fire almost immediately. The experiment I have never tried in this form, but it is one in which it is perfectly reasonable to expect would produce the result. Nor do I think the obligation is put upon chemists to try these experiments. It is for us to suggest them, and if we do not choose to endeavour to secure them to ourselves, and selfishly keep them for our own benefit, I think if there is reason in them, the least that those can do who are connected with this most important subject of preventing fires and putting them out wherever they unfortunately occur, is to go into some experiments which would not be expensive, to see whether the suggestions that such men as I may throw out are of use or not.

Now carbonic acid gas is usually prepared by the action of some acid on a carbonate. If ever you wish to make carbonic acid gas for experiments, all you have to do is to get a bottle of this shape, and put into it some marble with a little water, and then some hydrochloric acid—common muriatic acid—carbonic acid gas will be given off, and the decomposition takes place here which I will describe to you. Carbonic acid gas passes into lime-water, and these form a substance which is chemically the same as that from which the carbonic acid is evolved in this vessel. Now you take common chalk for this purpose, or marble is better, because the action goes on more steadily. It is more vigorous, in the first instance, with chalk, but if you want a continued stream of carbonic acid it is better to take some white marble, or common limestone will do.

$CaO\ CO_2$.—That symbol represents the composition of common chalk or marble, or black marble. They are all of the same chemical composition, only in the black marble there is usually some organic matter that gives the black colour. That symbol Ca means 40 parts by weight of the metal calcium, for lime is an oxide of a metal called calcium. O means 16 parts by weight of oxygen. C 12 parts by weight of carbon. O_2 32 parts by weight of oxygen. That forms carbonate of lime, which is usually written in chemical books in this way, $CaCO_3$. That is how it is usually written, but you see it comes to exactly the same thing. I have put here a sort of rational formula for you. CaO is lime—CO_2 carbonic acid. The substance which we have put with that is hydrochloric acid, and that is represented by the symbol HCl, which represents 36½ parts by weight of hydrochloric acid, 1 part by weight of hydrogen, 35½ parts by weight of chlorine.

Those quantities will not act upon one another; therefore, we must double the quantity. Now, twice 36½ parts by weight of hydrochloric acid will act upon 100 parts of carbonate of lime, and this will be the result—chloride of calcium and water will be formed, and carbonic acid set free.

Now I have thus far spoken to you about chemical symbols. I shall not go on with it; there is no necessity. I gave you my reason for it just now. I hope the little information I have given you will be enough to enable you to interpret them. In all chemical books you will find a list of atomic weights of the different substances, and the symbol beside it always means the atomic weight of that substance. Let me state that in making carbonic acid gas it is better to use hydrochloric acid rather than sulphuric acid, as the latter forms an insoluble sulphate of lime which retards the evolution of the gas.

This is an experiment to show the density of carbonic acid gas, which is rather a pretty one. Here is a balloon filled with atmospheric air. I will now put this into the jar of carbonic acid; the tendency of the balloon is now to go up. You will notice that the balloon will float somewhere in the jar, but it will not go to the bottom. This shows that carbonic acid is heavier than air.

The following experiment is to show that although carbonic acid is heavier than air, yet that it mixes with the air, ascending contrary to its gravity. Here is a jar full of carbonic acid gas; above it I place a jar full of air; they are mouth to mouth. In the upper jar is lime-water, and you notice it does not become milky. Presently the carbonic acid will ascend into the upper

vessel, and its presence will be indicated by the lime-water becoming turbid. Carbonic acid gas is heavier than air; it is 22 times as heavy as hydrogen. That means that if this vessel were full of hydrogen, and of the same size, the carbonic acid would weigh 22 times as much as the hydrogen. Now atmospheric air is about $14\frac{1}{2}$ times as heavy as hydrogen; therefore you see that carbonic acid is to atmospheric air in proportion as 22 to $14\frac{1}{2}$; therefore it is heavier than air. Now, how is it, if this gas is so much heavier than air, in so short a space of time it has gone up there, and indicated its presence by turning the lime-water milky? I will answer the question directly. If you notice, that balloon will go on sinking, for the gas in the balloon is lighter than the gas in the jar, otherwise it would fall. But in course of time the gas from the jar will pass into the balloon, and the gas from the balloon will pass out into the jar, until at last the gases in the two vessels will be of the same density, and of course the balloon will fall. Here it is. It is by the law of diffusion that we get this rapid action. Now this law of diffusion is one to which I shall have to call your attention by-and-bye in a later lecture, when I am speaking about the various currents of the air. Therefore I show you the experiment now, that I may not have to repeat it again, and I hope you will keep it in your memories until then.

I had intended to speak to you about the density of carbonic acid gas and so forth, and of the combination of gases by volume. I will not do that at present, but I will say in passing that, inasmuch as we are always breathing out carbonic acid gas, and inasmuch as all gas lights and fires burning give out carbonic acid gas continually, and animals breathing give out large quantities of it, it would collect on the surface of the earth, and we might get suffocated by it, just as dogs are suffocated by carbonic acid gas in those Italian caves we read of where they are put in to show the influence the gas has upon them. But it is owing to this law of diffusion that we do not get so suffocated, for the foul air in the bottom of this room is continually diffusing through the air, and gets carried out by the good system of ventilation which is used in this lecture-hall.

If I take a piece of charcoal and burn it, I shall get carbonic acid gas formed. I shall show you that experiment directly. Here is some carbonic acid gas being generated. It is being passed through that wash bottle containing some sulphuric acid, in order to dry the gas. In the bulb of this tube there is a small piece of metal called potassium, it is being heated in a current of carbonic acid gas, and I hope that you will see presently that the potassium will catch fire and burn. Now, although what we put into that jar of carbonic acid did not burn just now, that is, carbonic acid would not support the combustion of carbon and oxygen and hydrogen in that tube, it will support the combustion of potassium, or rather the oxygen in it will support the combustion of the potassium, for the potassium acts violently upon the carbonic acid gas, takes away the oxygen from it, and causes a deposition of carbon. So that I hope to be able to show you in a few minutes a deposit of black carbon in this vessel in the place of the mass of potassium. You see there the oxygen from that carbonic acid gas is uniting with the potassium, and forming oxide of potassium or potass. You notice the white deposit on this tube, that is potass. Mr. Lewis will show you one of the properties of potass, viz., that it is an alkali. He will show you that by test paper. Look at the deposit of carbon there. That carbon was deposited from the carbonic acid gas which was generated from that marble. It would have been just the same suppose I had made my own carbonic acid gas from black charcoal. I would show you the same experiment, but we could not do it here in this room so readily, but it could be done. I could take some charcoal and burn it, so that it would pass as carbonic acid gas along the tube.

I will ask you, if you please, ladies and gentlemen, to bear this in mind, because I shall have again to refer to the deposition of carbon from carbonic acid gas. I call now attention to this experiment. Here is some charcoal, and here some graphite; one piece of charcoal and one of graphite are placed in this tube; both are being heated by a Bunsen flame; oxygen gas will be slowly passed through the tube, and you will see that the graphite will not be affected by it, whereas the charcoal will burn, and burn with a certain amount of brilliancy. In this case carbonic acid gas will be formed, and manifest its presence by turning the lime-water in this test tube milky. I show you this because when we come to speak about the different kinds of fuel, such as anthracite, coals which are bituminous, and so forth, I shall have to speak to you about the different conditions in which I believe the carbon exists in those different kinds of coal, and every housekeeper knows that it is a matter of considerable importance to get a coal that will burn freely and readily at all events in parlour and sitting-room fires.

There is an experiment going on on the table which has been going on for some time, in which carbonic acid gas is being passed through an iron gas-pipe, which iron gas-pipe is charged with charcoal, and is heated as you see to a red heat. When carbonic acid gas passes over red hot carbon—I digress for one moment to call your attention to the last experiment—you see it is beginning now; you see there carbonic acid gas formed passing into that tube turning the lime-water milky. The charcoal is burning away rapidly with considerable brilliancy, but the graphite is not affected. It requires a much higher temperature to affect graphite than to affect ordinary charcoal, and to cause it to burn, and that is the gist of this experiment. I want you to mark the difference between the two.

Carbonic acid gas is being passed over charcoal heated to redness in the iron tube. What will take place? Why, carbonic acid gas at this higher temperature will take up some more carbon; CO_2, there is our symbol, 44 parts by weight of carbonic acid. If I add to this C, that is 12 parts by weight of carbon, I shall get this result. We will rub out 2, and put another O, COO. Now I put another C, and we get CO and CO. Now that symbol CO means 28 parts by weight of carbonic oxide. When carbonic acid has taken up this extra weight of carbon, it has lost many of the properties which it possessed as carbonic acid. As carbonic acid it would not burn, for when the light was put into the vessel you saw it went out. But when the carbonic acid takes up these 12 parts by weight more carbon, and becomes carbonic oxide gas, then we have a gas which will burn with a pale blue flame. Suppose CO_2, 44 parts by weight of carbonic acid gas, occupies a definite volume, and suppose CO occupies a volume equal to it, then it is quite manifest that twice CO will be double the volume of CO, and the consequence is that when CO_2, 44 parts by weight of carbonic acid gas, are passed over carbon, they take up 12 parts by weight of carbon, and form double the volume of carbonic oxide gas. This is a thing also of importance to be remembered.

Now in what respect does carbonic acid differ from carbonic oxide? It differs in density, for carbonic acid is 22 times as heavy as hydrogen. Carbonic oxide is 14 times as heavy as hydrogen, therefore it differs in density. If 14 times as heavy as hydrogen, it is a little lighter than atmospheric air; if then it is formed in any process that goes on in fire-places, the tendency of carbonic oxide to rush up the chimney will be greater than that of carbonic acid, therefore we must bear this also in mind. Here some carbonic oxide is being burnt; it burns with a pale blue flame. Here is an apparatus arranged to show the preparation of this gas if ever you wish to experiment on this substance. In this flask I have got some oxalic acid, a substance, you will remember, I dissipated by heat in the last lecture. This is mixed with some strong oil of vitriol or sulphuric acid. The oil of vitriol takes away from the oxalic acid the element of water.

The sulphuric acid takes away the elements of water, and the gases, carbonic acid and carbonic oxide, pass off together, and then if we have time to collect them they will be mixed together in this vessel. Lime-water is turned white by carbonic acid, therefore, carbonic acid is absorbed by lime-water. But because we have so little lime dissolved in water, we use something else which acts like lime, in that it will absorb carbonic acid gas. The substance we use is caustic soda or caustic potass. As soon as we get this bottle full, I will put in some caustic soda and show you the absorption of carbonic acid by it, and I will also prove to you that one half of the mixture passing over is absorbed by caustic soda, showing that one half is carbonic acid gas. We will set fire to the remainder, and you will see it burns with a pale blue flame.

That experiment going on upon the table I will not call your attention to to-night, for it will take a good deal of my time to explain it to you, and I do not want to make one lecture encroach upon another, as it must be repeated on another evening. I will leave the explanation till then. And now that you have seen the form of apparatus, and how the thing is arranged, I can revert to it, and call your attention to it when I explain the action, as it will take place under other conditions in a future lecture. What I now want to call your attention to for the last two or three minutes, is the action which goes on in the burning of an ordinary fire, or the burning of an ordinary gas flame; because I want you thoroughly to understand it that you may be able to economise heat. When a fire is lighted a draught is created. The paper is lighted first, because it burns at a lower temperature than wood. The wood is lighted next because it burns more easily than coal; it is so, because the carbon in these are in such a condition that they will more readily unite with the oxygen of the air at the temperature to which they are exposed. The heat evolved by the burning of the paper and the wood in a well-constructed chimney causes a draught. The air gets rarified, and the cold air rushes in to take its place. Suppose this to be the fire-box. This represents the bottom, and this the top. The air is in excess here. If air is in excess when it comes in contact with red-hot coal or red-hot wood or paper, the gas formed will be that which contains the largest amount of oxygen. That is to say, carbonic acid will be formed. Now, as the coal gets hot, this carbonic acid gas passes through the heated coal, and takes up twelve parts by weight more carbon. It becomes then carbonic oxide gas, and the carbonic oxide gas comes up to the top of the fire to the upper part of it, and if it is hot enough it unites with the oxygen of the air and forms carbonic acid gas again. I think you will have no difficulty in following those changes. You have no doubt noticed on a clear winter's night when the fire has burnt to a bright glow, that a pale blue flame flickers over its surface: that blue flame is caused by the combustion of the carbonic oxide into carbonic acid. The same thing takes place in a gas flame, but I will leave the description of that for our lecture on illuminating substances. What I want to call your attention to now is this, that in order that this carbonic oxide gas may be burnt it must be heated. In the experiment I showed you it was escaping into the room without burning just now. You see what happens then if you put too much coal upon the fire. The carbonic oxide is formed by the carbonic acid passing over red-hot coal beneath, but the coal on the top of the fire is not hot, and the gas being light, lighter than the air, the tendency is to go up the chimney, and so you lose a large amount of the heating power of your coal. An enormous amount of the heating power of coal is lost in this way, and I think I shall be able to show you that with $\frac{1}{2}$, or $\frac{1}{3}$, or $\frac{1}{5}$ of the quantity of coal we now daily use we may be able effectually to produce all the benefits we are now producing with this enormous consumption. You have now got a scientific reason why you should not build up fires with a large quantity of coal. You may profit by that hint, and you may profit by it to the benefit of your pockets considerably. I shall in later lectures suggest to you methods by which you may be able to keep up fires at a much less expense and without this great loss of heat occurring. In one moment, as time presses, I will show you the result of this, the last experiment. You see I have the two gases together here. Now I put some caustic soda in. If you notice the vessel, you see a vacuum is formed by the absorption of the carbonic acid gas. Now, if I open it underneath the water, the water will rush up into it.

THE JAPANESE MINT.

The *Japanese Mail* states that the mint at Osaka is in every department complete with the latest appliances and in splendid working order, including the manufacture of sulphuric acid, nitric acid, coke and gas, for the requirements of that establishment. The number of coins struck during the year 1873 were—gold pieces, 5,527,600; silver, 20,376,955; copper, 1,305,340. The striking of copper coins only regularly commenced during the month of December, although a great deal of the work had been previously done by preparing the copper for coinage. The building for the copper coinage is completed, and is attached to the mint. It is 440 feet long, in red and white bricks, with stone basement, altogether very substantial and ornamental. The machinery is capable of striking some 140,000,000 copper pieces annually. Some of the gold and silver coins have undergone a trifling alteration in diameter, greatly improving their appearance, and the subsidiary silver coins have also been slightly increased in weight. The design in these coins has also been changed, so as to indicate the value in large Japanese characters on the reverse, while on the obverse side the value has been introduced in Roman letters, which is a great convenience to foreigners, and will go far to encourage their being made current in the Chinese ports and the neighbouring colonies, where the want of subsidiary silver currency is greatly felt. Roman letters and numbers are also indicated on the obverse of the copper coins. The old gold coins, such as the "Obang," "Kobang," "Nibu," and "Nishiu," are no longer in circulation; this is also the case with the silver "bu" and "ishiu." The old copper coins, however, are still in circulation, and do not bear any fixed value as compared with the gold and silver yen; these are being used at the rate of the day, and will continue so until gradually replaced by the new denomination.

Chicago is supplied with water by means of a tunnel two miles long carried out to the middle of Lake Michigan. The capacity of this tunnel is stated to be 57,000,000 gallons per day, and yet Chicago commenced in 1872 building another tunnel (nearly twice as large as the first), which it is expected will be ready for use at the commencement of 1875. Chicago will thus next year have water supply arrangements adapted for a population of about 5,000,000.

Under the title of "Scientific London," Messrs. Henry S. King and Co., will shortly publish a volume describing the principal scientific institutions of the metropolis, including the Royal Society, the Society of Arts, the Royal Institution, the Institution of Civil Engineers, the Society of Telegraph Engineers, the Statistical, the Royal Geographical, and other societies. The author of the book is Mr. Bernard H. Becker.

A telegraph cable has just been successfully laid from Para to Cayenne. The West Indies will shortly have an alternative route to England, *via* St. Vincent (Cape de Verde) and Madeira, besides being placed in communication with Cayenne, Para, Pernambuco, Bahia, Rio de Janerio, Buenos Ayres, Valparaiso, &c.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

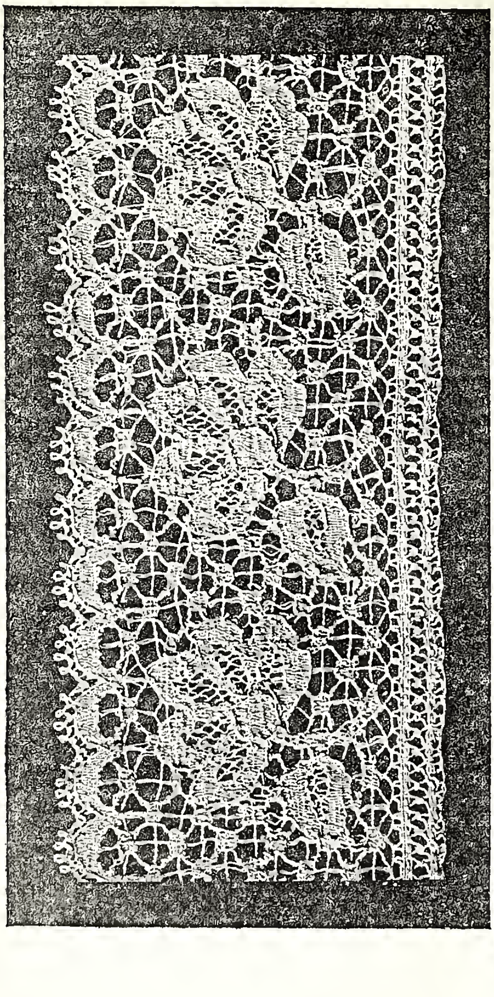
LACE-MAKING MACHINERY.

(Continued from p. 899.)

In the previous article on the above subject it was endeavoured to give a concise history of lace-making machinery, showing the most important steps that had been made, from time to time, which led to the comparatively perfect machine now known as the Levers machine. It is proposed now to describe the principle upon which the action of the machine depends. There is no question but that the task is one of some difficulty, still notwithstanding the limited space, an attempt will be made to put the subject in as clear a light as possible.

Lace-making consists in twisting any desired number of threads round each other in such a manner as to form meshes. To do so the threads may be twisted either two, three, or more together, or thick and thin threads may be so combined. For the formation of any desired pattern, or figure, it is requisite that any one, or more, of the threads may be twisted round any one, or more of the adjoining threads. It is not necessary that the threads should be able to pass completely from side to side of the lace and then be made to twist round the most distant threads, but so long as they can be moved a moderate distance, with perfect freedom, to be twisted together with one or more of the neighbouring threads, that is all that is required, so far, for making ordinary lace.

Fig. 1.



Before the invention of the bobbin and carriage, by Mr. Heathcoat, a very similar process was, to a slight extent, effected in the common hand-loom in the weaving of gauzes and whip nets. In weaving gauzes tho adjoining threads of the warp were twisted half round each other, and by repeating the process backwards and forwards, a gauze mesh, or intersection, was formed. In this case the weft thread held the twisted warp threads in their proper position. But the process was very limited in extent, and it required a great amount of tedious labour even for the production of small designs. One shuttle only was requisite for gauze weaving, the warp threads alone being moved to form the twist.

Fig. 1 represents a portion of the guipure or narrow lace now being made in the Exhibition, and is of the same size as the lace. As before mentioned, sixty of these pieces are being made at once, forming a total width of 152 inches. It will be noticed that the figure is repeated or woven three times, which has been done merely to give in the engraving a better idea of the lace. In the production of the sixty pieces the pattern is merely repeated sixty times in the arrangement of the frame or loom, all the sixty pieces being governed by one apparatus. They are woven in a vertical position, or, as shown, in the position of the figure. In the production of each of the sixty pieces, 48 bobbins and carriages, or shuttles, and 100 beam or warp-threads are required, or a total number of 148 threads for each piece.

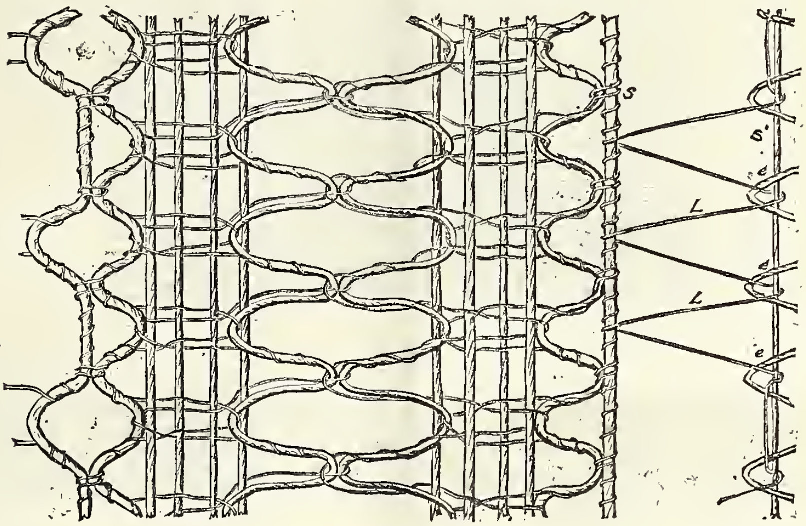
Fig. 2 represents a portion of the right hand or plain border of the lace, as it would appear when magnified, and shows about half an inch in length of the actual selvage of the lace, which may be seen by comparing the looped meshes of the two figures. In Fig. 2 the extreme thread of the lace is shown at s, and the thread L, L, is the temporary, or lacing thread, which connects the selvage to the opposite selvage of the adjoining piece of lace; in short, the loops *e*, *e*, *e*, are the loops which appear at the edge of the curved border of the lace, as may be observed in the left hand selvage in Fig. 1. The lacing thread is connected to a thread placed vertically, s′, as shown in the back of the loops in Fig. 2, consequently, the whole of the sixty pieces are held together in this manner. These threads are not removed until the whole width of the lace has been made perfect and dressed; when they are "drawn" or cut, and the pieces of lace become separated. In Fig. 2 the looped or curved selvage appears straight, the loops being in a right line above each other; but in Fig. 1 the same loops are no longer in a right line, but form the curved line as shown. This arises from the circumstance that Fig. 2 shows the border as the lace would appear in the process of weaving, when the necessary tension was operating upon the threads. When the lace is removed from the loom the tension no longer exists, and the twisted threads assume the form intended by the designer of the pattern or figure.

If the threads in Fig. 2 be examined they will appear to consist of three descriptions, viz., 1st, vertical threads, which retain one position only; 2nd, threads which form half-loops or ziz-zags; and 3rd, threads which are twisted round the other, in order to bind them together. The latter thread is that which has been inserted by the shuttles or bobbins and carriages.

Now, although it would seem that three different kinds of threads composed the design shown in Fig. 2,

still there are really but two descriptions, viz., the warp and the weft. The warp threads are shown much thicker in proportion to the weft threads than actually used in the production of the lace, but this has been done in order to represent the manner in which the threads are twisted more distinctly. It will be found that the threads running in a looped or zig-zag direction are merely vertical threads that have been drawn from side to side according to the arrangement intended by the designer. This is effected by varying the degree of tension upon the threads, and to accomplish this for the production of complicated designs, or figures, requires consummate skill and labour on the part of the designer. His design must not only show the work to be performed by each of the threads in all their various twistings, but the different degrees of tension must also be shown. When the design is made, it is then transferred to the "drafting" paper, which shows the extent of motion of each of the warp threads laterally. From this draft the Jacquard cards are perforated to correspond. To produce the pattern,

FIG: 2.



or one of the flowers shown in Fig. 1, requires 160 Jacquard cards, each 30 inches long by $2\frac{1}{8}$ inches wide. Before these cards could be punched for the production of the small figure or flowers, with the borders annexed, the design and draft have to be completed, and the amount of labour necessary, even for so small a figure, can scarcely be realised. But to give some idea of it, a copy is given in Figs. 3 and 4 of a portion of the actual design and draft that were used for the formation of the lace shown in Fig. 1. Thus in both the figures, 3 and 4, only 1-50th of the design and draft are represented. In other words the whole of the two figures, 3 and 4, shown, merely represent one quarter of an inch, square, of the lace in Fig. 1. Consequently for the production of lace of more extensive and elaborate designs it may be easily understood how great is the amount of skill and labour required.

In Fig. 3, thick and thin lines are shown in a zig-zag direction. In the actual design two different colours are used instead, in order to prevent confusion, and to

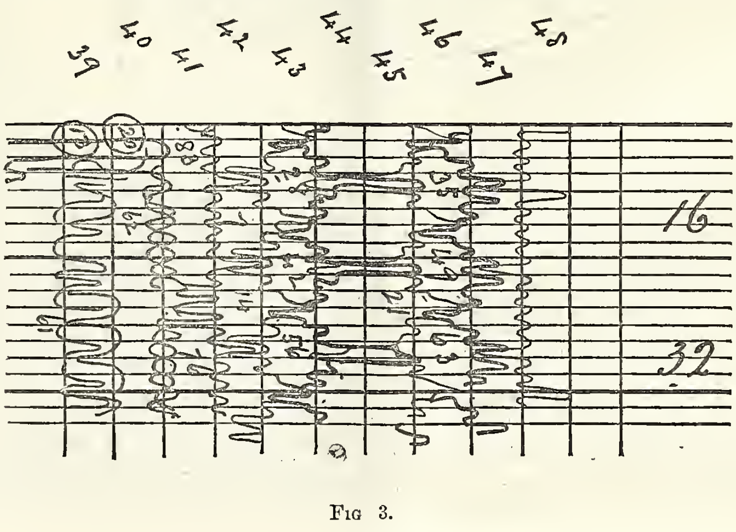


FIG 3.

enable the designer to trace the threads more clearly when transferring them to the drafting, Fig. 4, than it would be possible to do if they were drawn in one colour only.

From the above it will be evident that upon the ability of the designer far more depends than in the designing of other fabrics, and the admirable way in which the machine is contrived, to meet the requirements of the designer, alone gives ample proof of the genius of the inventor.

Each of the threads forming the lace, whether weft or warp, has a separate shuttle or warp beam, and the various shuttles and beams have more or less friction applied to them in order to produce more or less tension upon the threads as they are woven. In the shuttles, or bobbins and carriages, the friction is caused by a small spring, which not only presses upon the bobbin to cause the friction, but at the same time holds the bobbin in the carriage. These springs are varied, either by using stronger springs or bending them so as to exert

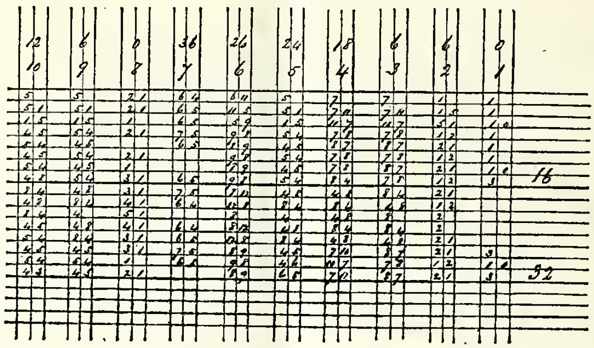


Fig. 4.

greater pressure, to several degrees of strength. Fig. 5 represents a bobbin and carriage, also a section of the same, and the letters refer to the same parts in each. The bobbin B is composed of two thin discs of brass, $2\frac{1}{8}$ inches diameter, or twice the scale shown in the figure. The weft thread is wound between the discs, and it passes from thence through the eye *t*, at the top of the carriage. The carriage *a a* is made of steel plate, a hole being cut through it of about the size of the bobbin, excepting at the lower part, where a thin flange,

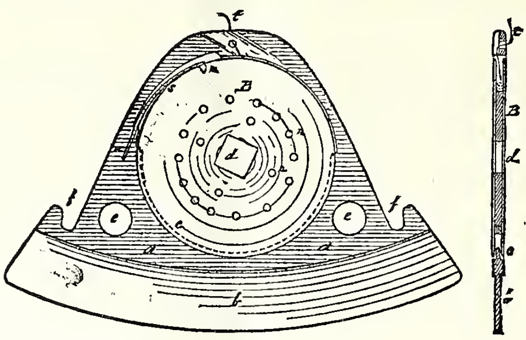


Fig. 5.

shown by the dotted line at *c*, is made to fit between the discs of the bobbin, and thus hold it in position. The small spring *s* has a nib, *n*, upon the end of it, the thin portion of which also is inserted between the discs, whilst the broader or upper part presses upon the edges of the bobbin and holds it down upon the flange *c*, as before described. The spring *s* is rivetted into the carriage at *u*, and it will be evident that according to the degree of pressure put upon the bobbin by the spring, so will be the amount of friction and tension upon the thread when unwound. The bobbins will each hold about 120 yards of thread, which is wound upon them when removed from the carriages and placed upon a spindle passing through the hole *d*. The lower portion of the carriage *b* is made much thinner, as will be seen in the section. It is this part of the carriage that slides between the comb plates, as will be hereafter described. The section of the bobbin and carriage is shown much thicker than they are actually made, for in the machine nineteen of the carriages work freely, with room between them for the passage of the warp threads, in the space of one inch, and in some instances as many as thirty to each inch in width of the lace made. In making the lace, as before described, 48 bobbins and carriages are used for each of the 60 pieces. This number is not absolutely correct, for although 48 spaces for 48 shuttles are used, one of the shuttles has been omitted from each of the 60 pieces, these shuttles not being required at the extra width of the space occupied by the lacing thread, as shown at L, L, Fig. 2.

The warp threads, of which there are 100 to each of the 60 pieces of lace, are placed upon 100 separate warp beams. The corresponding threads in each of the 60 pieces being used or woven in equal lengths, and requiring the same tension upon them, it follows that one set of beams may contain the threads for the whole 60 pieces

as freely as for one piece of lace. Therefore 100 beams are equivalent to having a separate beam for each separate thread in the whole of the 60 pieces.

The friction to cause the tension upon the warp beams is effected in a similar manner to the ordinary loom, viz., by winding a cord round the end of the beam and attaching a spring or weight to it. The tension is regulated by the strength of the spring and the number of turns that the cord is wound round the beam, or the small pulley fixed on the beam for that purpose. This will be better understood by referring to Figs. 10 and 12, in which the warp beams are shown at *w.w*. They have a small pulley fixed on one end, and round this pulley the friction cord is passed as many times as may be necessary. Thus, at *p*, Fig. 12, the cord is shown with one end attached to a stud, or peg, fixed to the frame in which the beams are placed, and after it has been wound round the pulley *o*, once or several times, the other end of the cord is attached to the spiral spring *s*. The warp beams are made of tin, and are about 1½ inches in diameter, with small gudgeons at the ends.

It will be evident that various degrees of tension can be placed upon any of the 147 threads which compose the lace, and it now remains to see the important uses to which this simple matter is applied, and the effect it produces.

Fig. 6 represents five threads hanging from a rod *h*. The thread, *a*, has but a slight weight or tension

FIG: 6

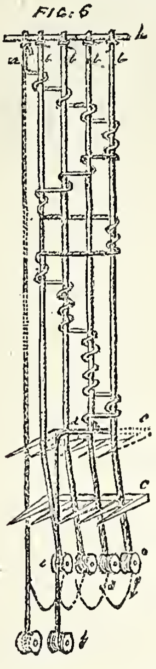
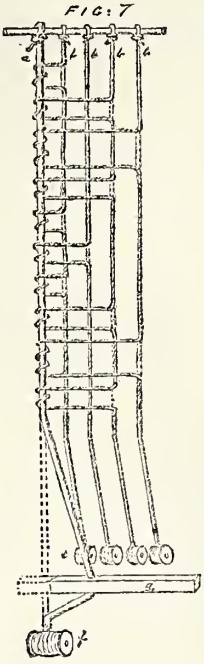


FIG: 7



applied to it, whilst the threads *b*, *b*, *b*, *b*, have a much heavier one. The bobbins *e*, round which the latter threads are wound, are supposed to oscillate in the direction of the dotted lines shown at *o*, *o*, the points from which they move being at the level of *d*. If these four threads are made to move, or oscillate altogether, they really represent the motion of the shuttles and weft threads of the lace machine, whilst the thread *a* would represent one of the warp threads. So long as the threads oscillate without any movement of the thread *a* no effect will be produced, and the threads will remain intact, but if during the oscillation the thread, *a* be drawn laterally across the path of the bobbins *e*, then on withdrawing or advancing the thread, it will be found, on continuing the oscillation and movements of the thread *a*, that it will become twisted round the threads *b*, *b*, accordingly. In this manner the various threads round which the thread *a* has been twisted, simply correspond to the distance that it has been moved at each oscillation of the threads *b*, *b*.

There is a comb or fork shown at *c*. The action of this is to beat together the twisted threads in a similar manner to the use of the reed in the common handloom. But in lace-making the comb must be withdrawn completely clear of the threads after each oscillation, in order to allow of the lateral motion of the warp threads, which the comb would otherwise prevent.

It may now be seen that, owing to the extra tension upon the threads *b*, *b*, *b*, *b*, the thread *a*, after each twisting, is held in the position it was drawn to, for it has not sufficient strain or tension upon it to draw the threads *b*, *b*, *b*, *b*, aside. Consequently, the effect produced is similar to the looped threads before alluded to, and shown in Fig. 2.

On the other hand, if the thread *a* had a greater tension upon it than any of the threads *b*, *b*, *b*, *b*, then the latter threads would be drawn aside in a reverse manner. This will be evident on referring to Fig. 7, where the tension upon the threads are reversed to those shown in Fig. 6. In this instance the threads *b*, *b*, *b*, *b*, are, after each oscillation, drawn completely aside, and in this manner the action of drawing the fine, or weft threads, shown in Fig. 2, in the various positions there represented, and particularly so in the case of the lacing thread L L is effected.

It may be seen now that the various strains or degrees of tension that the threads are subjected to, perform a most important part in the manufacture of lace. The weft threads themselves have but a simple oscillatory motion, the shuttles simply sliding backwards and forwards from front to back of the machine. The warp threads, on the contrary, are moved to a greater or less extent laterally, and it is in the exactness with which these motions are made, upon which the proper formation of the lace depends.

It is in this portion of the machine that the greatest ingenuity has been shown, and in peculiar application of the Jacquard apparatus to effect it, is, perhaps, unsurpassed by any other mechanical invention.

In the production of the lace, as before described, 100 warp or beam threads have been used, and each of these threads must be so arranged that any one, or several of them, may be moved laterally as far as required. They may be required to move only past one of the oscillating or weft threads, or past ten or twenty. The spaces through which they move being in the present machine only 1-9th of an inch for each thread they pass, some idea of the exactness of the motion may therefore be formed. When 30 shuttles or bobbins to the inch are used instead of 19, then the difficulty becomes far greater still. The way in which this has been effected leaves nothing like uncertainty in the process, but performs the operation with the greatest precision and rapidity.

The processes to be accomplished by the lace machine consist as follows:—

1. In giving the weft or bobbin threads an oscillatory motion.

2. In giving each of the beam or warp threads a lateral motion to any required distance, so that they may be intersected by the shuttles and weft threads at the place desired.

3. In varying the degrees of tension upon the various threads.

4. To beat or comb together the twisted threads as they are formed.

The purpose of each of the above operations having been described, the method adopted for carrying them into effect will be readily traced in the action of the machine itself, which will next be described.

A general view of the machine is represented in Fig. 8, where it will be seen to consist of two separate machines, rather than one only. The larger portion is the lace machine or frame, and the smaller machine is the Jacquard apparatus.

The lace frame consists of a massive iron framework, well fitted together and fixed as firmly as possible, in order to prevent vibration. Both machines are driven by the same shaft, A, by means of a strap and pulleys at I, near to which is also fixed on the same shaft a heavy balance or fly-wheel, to give steadiness to the motion of the machine. Near the top, and at the back of the lace-frame, is a revolving shaft C, which is driven by a connecting shaft and wheels, fixed at the end of the frame next the driving pulleys. Upon this shaft C are placed various cams, and it is consequently named the cam-shaft. Below this shaft there is a vibratory or rocking shaft D, which is worked by means of the cranks on the shaft A and connecting rod attached to crank levers, as shown at D.

The Jacquard machine is connected, and worked by means of the wheels shown at B.

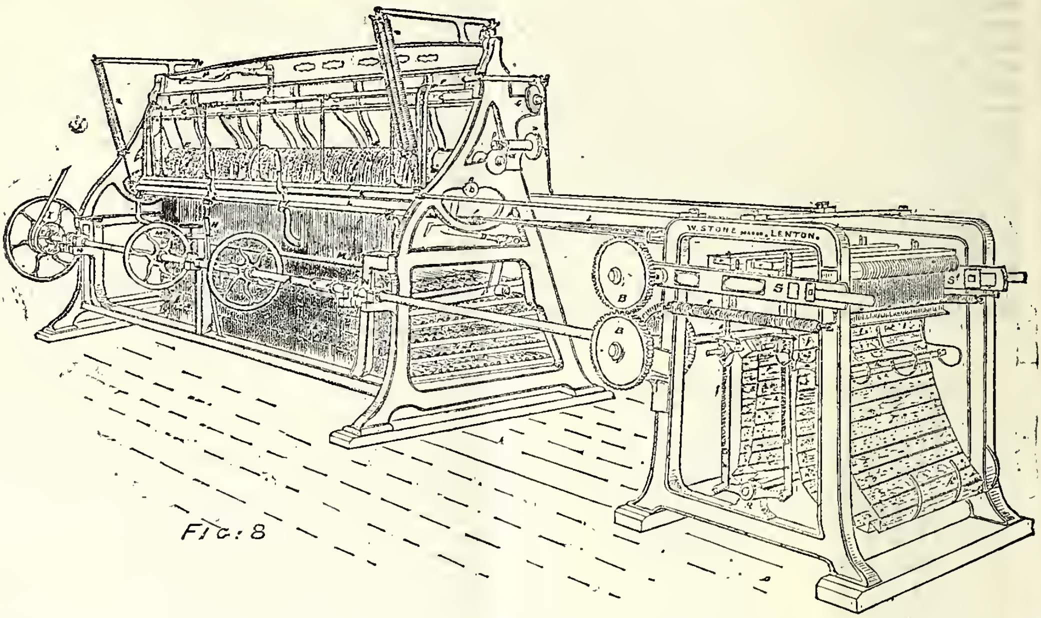


FIG: 8

Fig. 9 is a section of the lace frame, showing the most important parts. The warp beams are shown at *w*, *w*, from which the threads are passed through eyes fixed on the bars *x*, *x*, and from thence they are carried vertically through the perforated plate M, and the slide-bars *y*, *y*, and are finally attached to the lace-beam E, upon which the lace is wound as it is made. At *b* will be seen one of the bobbins and carriages, with the weft thread leading to the point *s*, which is the centre of the arc, or point from which the oscillatory motion of the shuttles or carriages move. As before described, the carriages slide between the comb or guide-bars *c*, *c*, and as they pass from one comb-bar to the opposite one, they necessarily pass through the warp-threads *y*, *y*. At L will be observed an angle bar. There is also a corresponding bar on the opposite side, and upon these bars the shuttles which protrude through the comb rest. These bars are called "landing bars," for when the shuttles are pushed through the warp they "land" upon the opposite landing bar, and are then drawn completely through to the other side. In the moving of nearly 3,000 shuttles, as in this instance, considerable friction would arise if they were made to slide through the comb without the aid of the landing bar. Attached to each landing bar is a catch bar *k*, *k*. In Fig. 5, representing the carriage, there are two slots *f*, *f*. These slots are for the purpose of the strip or blade of the catch bar *k*, *k*, to fall into, and by that means the whole of the carriages are drawn across. On returning to the opposite side, the catch bar pushes the carriages until they are within reach of the opposite catch, when it drops into the grooves, at the same time the pushing bar is withdrawn. In this manner, by means of the catches and the landing bars, the carriages are moved from side to side of the comb bar.

In the carriages will also be noticed two holes *e*, *e* Fig. 5. When they are removed from the frame for the purpose of being refilled with thread, a strong wire is inserted in these holes, by which means the lace-maker can remove several hundred carriages at once, which would otherwise take considerably more time to perform.

In the diagrams, Figs. 10 and 11, the carriages may be seen at *b*, *b*, also the comb plates *c*, *c*. The weft threads are shown at *a*, *a*.

The motion of the carriages from side to side of the comb bars, and the varied pressure, but upon different bobbins, by the springs, constitute all that is required from them. The oscillating motion is given to the landing and catch bar by means of connections to the rocking-shaft D, Fig. 8.

The arrangement and movements of the warp or beam threads is a very different matter, for each of them can be moved separately. This will be best understood by referring to the diagrams, Figs. 10, 11, and 12, which, instead of showing the whole of 147 threads, as used in the weaving of the lace described, show only 45, which will be quite sufficient to describe the actions of the Jacquard apparatus.

Fig. 10 is a longitudinal section of the machine; Fig. 11, a plan of the same; and Fig. 12 is a sectional plan taken at the level of M, Fig. 10.

There are only eight warp beams represented, viz., four tiers in height and two in width, as shown at *w w*, Figs. 10 and 12. The threads are passed under the bars *j* and *b*, and thence through the holes in the plate M.

Now it is at this point where a most important and ingenious arrangement occurs, which, when understood, will at once explain the design and draft shown in Figs.

3 and 4. It will be noticed in Fig. 10 that there are 24 threads which pass from the beams through the plate M. These threads are not continued upwards in the same order, but are simply divided into three sets or rows of eight each, and they are threaded through the eyes of the slide bars, which lead to the Jacquard apparatus, accordingly. In Fig. 10 the three sets of eight are seen to converge at *i*, *i*, *i*, where they pass through the eyes of the slide bars. This will be seen on a larger scale in Fig. 13, which represents in section the eight bars with the threads *c* passing through the eyes at *d* and *b*, As there are only eight slide bars and twenty-four threads shown in the diagram, it follows that each bar guides three threads. Consequently, if any of the bars are drawn forward, they draw with them the three threads to an equal distance. For instance, the normal condition of the bars would place the threads in three rows, as shown as *i i i*, Fig. 10, but if the bars be drawn to certain distances, then the threads may be placed in the position as shown in the dotted lines, Fig. 10. Thus, any set of the three threads can be drawn to whatever intermediate space that may be required. In Fig. 11 and 12 the spaces through which the threads, shown by the dotted lines in Fig. 10, have been drawn, can be seen. In Fig. 11, the first eight threads would be in their normal position at o, but as the bars have been drawn to various distances, the holes shown upon them show the distances they have been drawn from their normal position, or straight line. This will be more clearly observed by noticing the extent to which the spiral springs, *s*, *s*, have been drawn, also the various distances, at which the opposite ends of the bars protrude at *c′* in the same figure. In Fig. 12, the plan of the Jacquard card, marked No. 2, shows that the nearest bar has been moved five spaces, or past five of the shuttles, and the last bar has only been moved one space. It is upon this principle that the 100 slide bars in the machine are used for making the 60 pieces of lace. In Figs. 10 and 11 only eight bars are used, and they would produce three pieces, or repetitions of the same pattern. But there is this difference in the two cases, that in Fig. 10 the 8 threads are concentrated in one line only, whilst in using the 100 threads in the large machine they have been concentrated in 7 sets or lines. These points or lines of concentration are called "stops," and it is from them that the designer measures the distances that the threads must be moved.

Figs. 3 and 4 may now be understood. In Fig. 3 the numbers 39 to 41 refer to the number of the shuttles, and 16 and 32 are the numbers of the oscillations or cards to be used. It will be remembered that Figs. 3 and 4 only represent 1-50th of the actual design and draft, consequently only 10 of the shuttles are numbered, also 32 out of the 160 cards, in like manner.

As before explained, one of the shuttles was dispensed with, only 47 being used. The one marked 45 in Fig. 3 is the one that was omitted.

The numbers filled in the body of the design refer to the particular beams which supply those threads, and the tension is also arranged accordingly. In Fig. 4 the top row of figures represent the "stops" above mentioned, and the second row the consecutive numbers of the warp threads, of which there are 100, but only 10 are there shown. The numbers 16 and 32 represent the cards, or 32 out of the 160 required for the pattern as in Fig. 3.

The figures are arranged in two columns. Under each of the consecutive numbers at the top, which corresponds to the numbers of the warp threads, and under No. 6, representing the 6th thread of the warp, appear the numbers 6, 11, 11, 5, 5, 9, &c., which refer to the number of spaces that the thread must be moved through, in a similar manner as shown in the case of Fig. 12. In the left hand column the odd numbers of the cards are represented, and the even number on the right. Thus the eight lines, or spaces between them, show the 16 cards, as numbers in the right hand margin. Where no figure occurs in the columns, it is understood that the last number must be repeated. This plan of double columns has the great advantage of showing at a glance the two sides of the cloth, so that the designer can use the threads to the best advantage and effect.

The application of the Jacquard apparatus to the lace machine is quite upon another principle to that

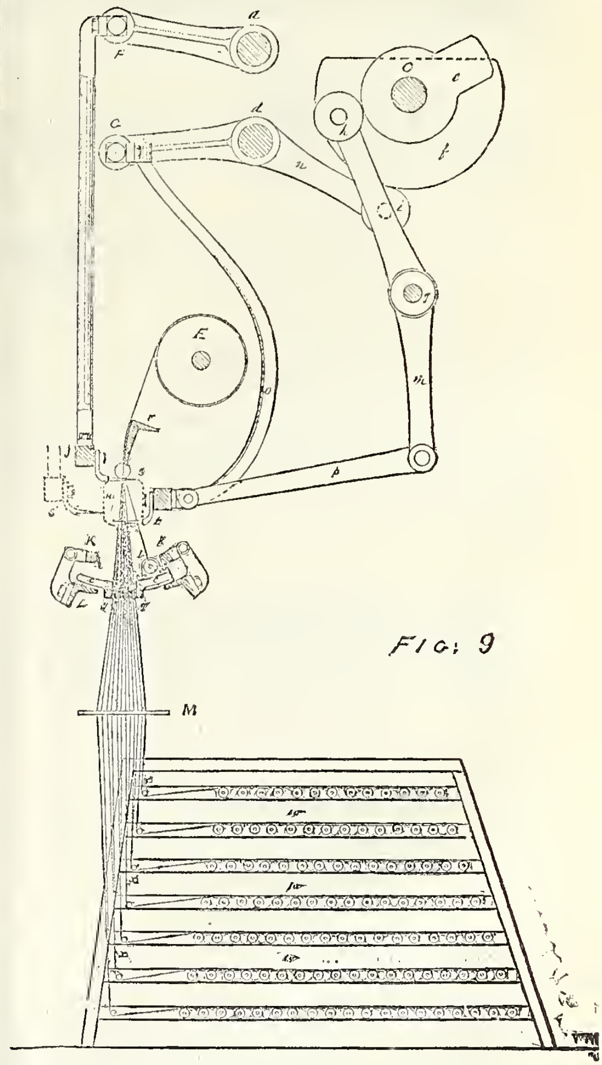


FIG: 9

applied to hand-loom weaving. In that system of weaving the cards are perforated directly according to the corresponding warp threads that have to be raised, each warp thread having its appointed hook and needle, and a position upon the card. But in the lace frame, each thread having to be moved to various and certain distances, a very ingenious method has been invented, which accomplishes what is wanted in a most effectual manner. It is done by using a series of wedges of different thickness. These wedges are inserted between a sliding bar and a stud fixed upon each of the slides which move the warp threads. Now if a wedge, representing in thickness the distance through which the slide is required to move, be placed between the bar above-mentioned and the stud on the slide, then it will push the slide a corre-

sponding distance. If two wedges are used, then a greater distance can be passed through.

At D and D′, Fig. 10, three wedges are shown, of three different thicknesses, viz., 1, 2, and 4. If all three wedges be inserted, the bar will be moved equal to 7 spaces. In the figure only two are inserted, viz., the first and third, which represent 5 spaces. In this manner any number of spaces from 1 to 7 can be accomplished by the three wedges shown. If another wedge equal to 8 spaces be added, then any number up to 15 spaces can be drawn. In the lace machine there are five wedges used, viz., of 1, 2, 4, 8, 8, spaces. With these from 1 to 23 spaces can be used.

In Fig. 8, the slide bars *b*, are shown leading from the Jacquard to the lace frame. There are 100 of these bars, all so thin are they that they all work freely in the space of $1\frac{1}{4}$ inches, besides leaving ample room for the warp threads to pass between them, in the same way as shown in Fig. 13. These thin bars are made of fine steel, and are perforated with holes similar

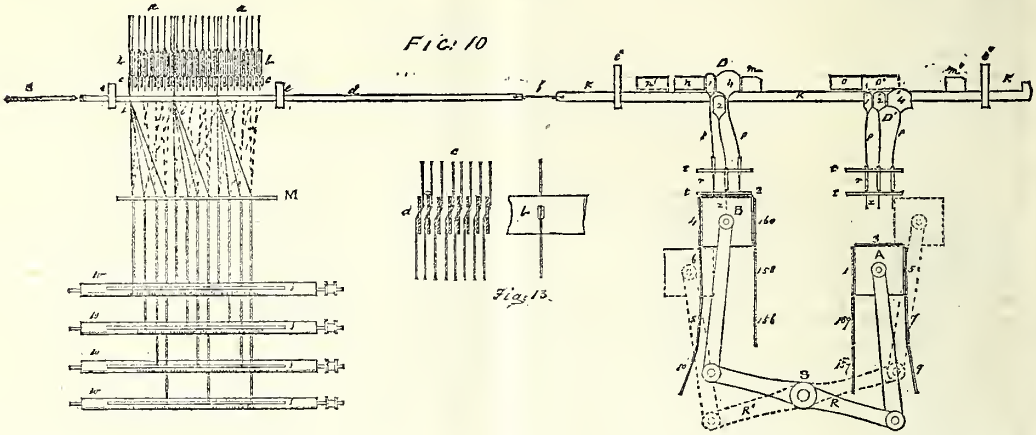


FIG: 10

FIG: 13.

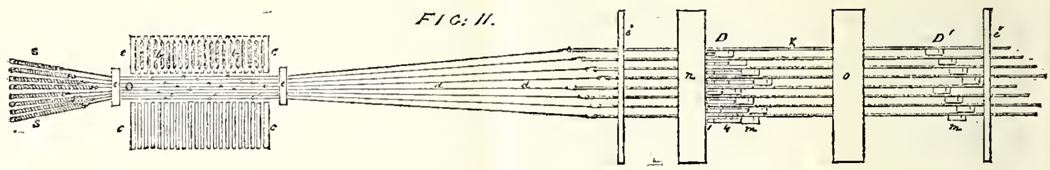


FIG: 11.

FIG: 12.

to that shown at *b*, Fig. 13. One end of the bars is attached to a spring, as shown at *s*, Fig. 11, and the other end is attached to the slides of the Jacquard machine, shown at *c*, Fig. 1, and *k*, Figs. 10 and 11. In Fig. 10 the attachment is shown at *f*. The Jacquard slide bars *k*, in the same figure, are made to move freely in the guides *i*, *i*. At the extreme end of the bar, a nib or projection is left on the bar to form a stop, against which the spring at the other end tends to draw the bar *k* against the guide *i*. On the upper edge of the bars two studs or plates are fixed, *m* and *m′*, Figs. 10 and 11.

There are two bars shown at *n* and *o*, in the above figures, which are made to slide simultaneously in opposite directions to each other; consequently, one of the bars is always advancing towards the stops on the slides *k*. The dotted lines *n′ o′* in Fig. 10, show the extent of their motion. The bar *o* is shown drawn in such a position that the edges, D, below it can be raised above it.

If any of the wedges are raised, then, when the slide moves, it blocks them between the slide *o* and the stud *m′* in a similar way to the position of the wedges 1 and 4 shown at D, which are blocked between the bar *n* and the stud *m*. In this case the slide bar K is moved five spaces. Whilst the wedges D are in work there is ample time for the wedges D′ to be inserted, for they work upon the same bars, although upon different studs. By this means no time is lost in the movement, and the advantage of the double action is at once self-evident. The cards being divided into two sets, viz., the odd numbers to work on one cylinder and the even numbers on the other, as shown at T¹ and T², Fig. 8, and A and B, Fig. 12, enables them to be used at double the ordinary speed, with all the advantages of steady, uniform, and balanced motion. The Jacquard cylinders are worked in the usual way, and are turned by a catch, except the cylinder *f*, Fig. 8, which is turned by means of the rack and pinion as shown. The wedges are fixed on the ends of thin, flat springs, as shown at *p*, *p*, Fig. 10, and the lower end is made round, so as to pass through the holes in the card

where required. Between the spring and the round part there is a strong flat piece *r*, which is made for the purpose of working in the guide plates *t*, *t*.

The cylinders A and B, Fig. 10, are connected to the rocking shaft S by the balance lever B, by which means they are alternately raised and lowered, for the purpose of turning and changing the cards, 160 of which are used in the formation of the lace as before stated. Now the cylinders in their upward movements raise the wedges D and D¹, unless there are holes in the cards. Where there are holes, of course the round end of the needle passes through the card and the wedges are not raised. At Fig. 12, two cards are shown, the one marked No. 2, is the same as shown raised on the cylinder B, and the wedges are inserted as at D, Fig. 11. The distances to which the slides are moved are shown by the figures 1, 3, 5, 7, 2, 4, 6, 5, at the end of the card, which figures represent the wedges that would be raised by the card. For instance, opposite to 1 there are two holes, but the first space is blank, consequently No. 1 wedge would be raised. Opposite to 5 there are two blank spaces, consequently they would raise No. 1 and No. 4 wedges, as shown at D, Fig. 10.

It has now to be observed that the cylinders and wedges altogether move latterally in conjunction with the slide bars *n* and *o*, Fig. 10. If this were not the case the wedges could not be kept in position. The dotted lines show the reverse motion of the cylinders, when following the movement of the slides *n′* and *o′*.

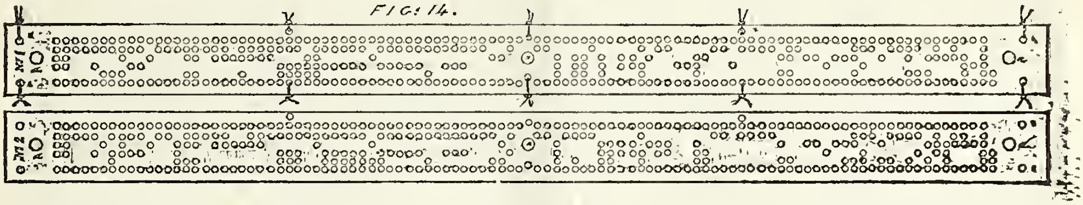
In Fig. 8 the slides are shown fixed on the side bars *s*, *s*. These bars are moved by means of cams fixed on the shaft moved by the wheel B, one of the pulleys worked by the cam being shown at the back of the wheel B. There are two pairs of these bars, one pair at each side of the Jacquard machine, and the slide bars are fixed upon the top of them, as shown. The springs *m*, *m*, return the slides to their proper position after each revolution of the cams.

Fig. 14 represents two of the cards actually used in the machine, viz., Nos. 1 and 2. They are 30 inches long by 2½ wide. There are 100 rows of holes in each, corresponding to the needles of the Jacquard, besides the needles which work the selvages at the extreme sides of the 60 pieces of lace.

It is in this manner that the Jacquard operates upon the warp threads and effects in the most exact manner all that is desired by the designer.

When the warp threads have been moved according to the arrangement of the cards, the meshes or twisted threads have to be beaten or combed together. This is done by means of two "point bars" placed at opposite sides of the lace, whose operation is similar to that shown at *c*, *c*, Fig. 6, and in Fig. 9, at *t*, *t*. The dotted lines *u* show the position of the points as they descend, for it is only on their ascent that they pass through the lace and thereby comb the threads together. The point bars consist of a row of fine steel points of about 50 or 60 to the inch, and of course they extend the whole width of the lace. They are inserted into the lace and raised, and then removed clear of the lace and lowered by means of a combination of levers and two cams fixed on the cam shaft C. These cams operating upon the levers *n* and *m*, and turning upon their fulcrums *d* and *q*, accomplish the motion as above described. In the sketch, only the levers and cams connected with the back point bar is shown; the front bar being moved in a similar manner it is unnecessary to show it.

FIG: 14.



Although the most important movements of the machine are those above described, still there are several others that require notice. The lace beam E, Fig. 9, is worked by means of the worm and wheel shown as *o*, Fig. 8. The worm is driven by means of a catch, which is moved by a cam and lever in connection with the shaft C. There are three ratchet wheels of different pitch, or distances of the teeth, so that more or less motion can be given to the beam E under various circumstances. Temples are also used at each end of the lace beam, as in the common hand-loom, for the purpose of keeping the lace stretched. The warp threads A, after passing through the perforated board M, are not carried up to the slide bars vertically, but are made to lean considerably on one side. This is for the purpose of keeping the thread pressed constantly on one side or edge of the holes in the bars—otherwise, unless the hole was exceedingly fine, there would be too much movement of the thread, and the spaces could not be moved through in an exact manner.

The front catch bar *j*, Fig. 9, is also shown at J, Fig. 8. It is provided with handles, so that the weaver can raise it clear from the carriages when he requires to remove them, or to repair any broken threads. The front point bar, in a similar manner, is raised by means of the lever P.

The machine is thrown in or out of motion by means of the lever H, which is connected to the fork or strap-guide at the pulleys on the driving shaft A.

The ends of the warp beams are shown at *j*. At the point *a* is shown the centre of the arc through which the landing bars move; and it is of the greatest importance, in fixing the machine, that the line from end of the frame from these points should be perfectly true.

The large springs *n*, *n*, relieve the machine of the weight of the oscillating bars, and give them more freedom and ease in their rapid motion. The rocking shafts *a*, *d*, Fig. 9, are shown also F, G, Fig. 8, and are for the purpose of raising the point bars, as may be observed in the figures.

In so complicated a machine as the lace frame there are numerous parts for the purposes of adjustment, &c., which would require a very lengthened account to describe; in fact, quite beyond the space that can be afforded here. It would also require a large number of detail drawings, as may be readily imagined. But by divesting it of all the minor parts, and confining the attention to the principles of the working of the machine, a sufficient knowledge, it is hoped, may be obtained to show the ingenious way in which the manufacture of lace is accomplished.*

The following is the return of admissions to the Exhibition for the week ending Saturday, September 19th:—Season tickets, 1,039; payment, 16,367; total, 17,406.

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* The illustrations to the above article were all prepared by the Dallastype process.

EXHIBITIONS.

Philadelphia Exhibition.—The United States Centennial Commission announces its readiness to receive applications for space in the International Exhibition of 1876, at Philadelphia. It is important that it should be known with the least possible delay what space will be required in each of the departments of the Exhibition by American exhibitors, in order that it may be determined what room can be assigned to foreign nations. Manufacturers and others who propose exhibiting on this occasion are therefore requested to make known their intention promptly, and thus avoid the disappointment of finding the room they desire pre-occupied.

THE COAL AND METALLIC PRODUCE OF THE UNITED KINGDOM.

A table recently published supplies material for a comparative statement of the quantities and value of the coal and metals produced from British ores in the United Kingdom from 1859 to 1872, the value given being that which is estimated at the place of production. Looking first at coal, we find that in the fourteen years the rise in the yield has been from 71,979,765 tons in 1859 to 123,497,316 tons in 1872, or an average increase of about three and three-quarter million tons annually. This increase has been comparatively steady, although in two years there was a decrease. In 1862 the yield fell by two million tons below the previous year, but recovered in 1863 by a rise of five millions, and in 1868 the supply was more than 1,000,000 tons below 1867, but the fall was again followed by a large rise. In 1872 the yield was about 6,000,000 tons in excess of 1871. While the supply has nearly doubled, its value has nearly trebled, and has risen from £17,994,941 in 1859 to the enormous sum of £46,311,143 in 1872. This, it must be remembered, was the estimated value at the place of production. The relative value of a ton of coals as furnished by the comparison of these figures was 5s. a ton in 1859, and within a fraction of 7s. 6d. a ton in 1872. The increase in value has been accompanied, and has partly resulted from our large consignments of coal to other countries, our exports under that head, as was shown in our notice of the export trade of the United Kingdom a few days ago, having nearly doubled in the same period to which these figures refer. The produce of the metals from British ores shows very different results. The yield of pig iron has risen from 3,712,904 tons in 1859 to 6,741,929 tons in 1872, an increase of about 3,000,000 tons. Fine copper has decreased from 15,770 tons to 5,703. Metallic lead has also slightly decreased—viz. from 63,233 tons in 1859 to 60,420 in 1872. White tin shows a slight rise from 7,100 tons to 9,560 in 1872, but the latter yield is a thousand tons below the two years immediately proceeding. Zinc has risen from 3,697 tons to 5,191, and the silver extracted from the lead has risen from 578,277 ounces to 628,920 ounces. The gross value of the pig iron has doubled with the quantity raised, and thus the relative value in 1859 and 1872 is the same. The value of the fine copper and metallic lead has decreased almost in the same proportion as the supply. The value of the white tin has, however, risen far beyond the rise in the supply, for while a ton in 1859 was worth £131, in 1872 its value was £152. The relative value of zinc has also risen, for a ton which was worth £20 in 1859 was worth nearly £23 in 1872. The value of silver remains almost the same. In the other metals returned we find that the produce of British gold has fallen almost to nil. In 1861 the yield of 2,784 ounces was worth £10,816. In 1862 the supply had nearly doubled, and had risen to 5,299 ounces, valued at £20,390. In 1863 the yield fell to 552 ounces. In 1864 it rose again to 2,887, and after several fluctuations in 1869 it stood at the minimum of 18 ounces. The total value of the coal and metals raised in 1859 was £31,680,581, and in 1872 it had risen to £68,380,976, or more than double, the increase, as has been shown, being chiefly from the coal supply.

THE PRODUCTS OF BRAZIL.

Brazil is a purely agricultural country, and manufactures can hardly be said to exist. Almost everyone who has occupied himself with Brazil has spoken enthusiastically of the wonderful fertility of the country, and many have pointed it out as a field for European emigration. Consul Leno Hunt in a series of reports observes, that it is true that it is not possible to overrate the fertility of portions of the soil, but the tracts capable of cultivation are often separated from each other by dense forests and mountain ranges. The grazing plains and cotton-producing districts are, in the far interior, destitute of roads. The best cotton producing districts in the province of Pernambuco are 200 or 300 miles from the seaboard. The northern provinces are specially subject to drought, and sometimes not only the cattle but the inhabitants die of starvation. The farming population in such cases are obliged to send to Rio and other markets for farina to enable them to support their establishments, and those who can least afford it have to migrate to spots near the margin of rivers, thus seeking shelter from the fatal lot which pursues them. At other times, during the rainy seasons, there are cattle breeders who are left without a single head of cattle, and on some estates the losses incurred amount to a thousand head. From the same causes the maintenance of any roads is rendered impossible. The forests contain an immense variety of the most valuable timber, but fifty trees have to be cut down before the particular one required can be reached.

With the vast extent of territory possessed, it is somewhat curious that great difficulty exists in the purchase of land in good situations. It is principally in the hands of large holders, who cultivate but a small portion of their properties. One proprietor in the province of San Paulo claims 100 square leagues, a very small fraction of which is utilised. The legislative chamber is principally composed of landowners and their immediate connections, and any system whereby the land should be made to revert to the Government for distribution among persons offering guarantees for its cultivation stands but small chance of success. The former legislation of Brazil also appears to have operated most injuriously to the real interests of the planter. With a view to foster the establishment and maintain the integrity of estates, it was provided that no distraint could be made, or mortgage foreclosed, unless the debt in which the action was taken amounted to a sum equal to about two-thirds of the value of the plantation, which is always estimated at an amount greatly superior to that which it would bring if sold in open market. The planter had, therefore, a practical immunity from action for debt, but for this privilege he paid a high price. While the merchant, on his personal credit alone, could obtain money at a rate of interest varying from 7 to 8 per cent. per annum, the planter, though offering the security of his land and buildings, was forced to pay rates varying from 12 to 24 per cent. per annum. Notwithstanding that this law has been abrogated, it served to load the planter with debt, and dealt a blow at his credit from which there are no signs of recovery. The excessively high export and import duties would alone be sufficient to check the production of native articles and the consumption of foreign products, but when they are supplemented by the numerous drawbacks which neutralise the great natural advantages of the country, it would not occasion surprise to find that there has been no accumulation of wealth. In testing this impression by the observation of acts, it will be found to be correct. A planter with an unembarrassed

estate is as rare as a merchant who has acquired money in trade.

The principal productions are coffee, sugar, cotton, tobacco, cocoa, and india-rubber. Coffee and the cane represent £10,000,000 sterling out of a total of exports of every description of produce whatever of £17,000,000. The stimulus given to the production of cotton, which is of admirable quality, by the suspension of its cultivation in the Southern States of America during the late civil war, resulted in the production in 1872 of Brazilian cotton of the value of upwards of £3 500,000 sterling. The growers, however, now complain that, saddled with an export duty of 13 per cent., and the price having fallen at Liverpool for the best quality to between 8d. and 9d. a pound, it will no longer pay to produce it. This is true of all districts, except those in unusually favourable situations, where transport to a market is a matter of no great difficulty. But the local charges and prices in the foreign markets leave no margin of profit upon cotton coming from the distant table lands, where it grows in the greatest perfection, and the production of cattle will again become the more profitable employment, as it was prior to the United States war. The item next in importance is that of hides. With the fertile province of Rio Grande do Sul, enjoying a temperate clime, and large colonies of Germans, which alone have any claims to be considered successful colonies out of all that have been established in the empire, nothing of any importance has been realised. People do not starve, and that is all. In 1867-8 the export of hides, principally from this province, amounted to 15,000,000 milreis; in 1871-2 it was 16,000,000 milreis. Tobacco, next in order, was returned in 1867-8 at 13,000,000 milreis, and in 1871-2 at 12,000,000 milreis, and so on with regard to all the minor productions of the country. The abolition of the duty on coffee in the United States, and its reduction from 6d. to 3d. a pound in England, have come as a most timely relief to the planter, and, with the largely increased prices for it in those countries, will enable him for some time longer not absolutely to break down. Sugar and coffee require for their production organised systems of labour, and there is no prospect of results worth mentioning by their cultivation on the Metayer principle. The desultory labours of free cultivators of these products is not likely to lead to any important results. The picture thus drawn, Consul Hunt observes, does not agree with the general idea entertained by Europeans of this country. The name of Brazil conjures up visions of endless quantities of tropical produce, diamonds, and gold, the last to be obtained as the result of a very cursory washing. The exported amount of the latter is in reality insignificant. Almost all that has been created in Brazil has been produced by the negro, and with his freedom it seems likely that the organised system of labour in which he now figures will suffer materially. That he should work for 16 or 18 hours a-day, for 1s. 6d. or 2s., in a sugar-boiling house is not probable, when he has a country at his back which seems to have been created on purpose for the benefit of squatters of the African type.

The Government has squandered very important sums in the attempt to solve what in reality is to-day an insoluble problem, namely, to obtain good agricultural labour at a low price. It possesses little land worth having to distribute, and those lands that it can dispose of are not measured. The colonist is invited to become the proprietor of a wretched patch, the conditions of the occupation of which must load him with debt, should he survive the term of serfdom imposed upon him by the contract, and this in a land extending from latitude 4° north to 33° south, with a longitudinal range almost equally vast. What Brazil seems to be seeking is a substitute for the vanishing negro, not free men to people her solitudes, whose labour is to be used, not in their own interest, but in that of their importers. She must not be permitted to enter the labour market of Great Britain with these intentions. Beyond her southern frontier, there are two countries—the Republics of the Uruguay and Argentine Confederation—poor enough in the eyes of the naturalist, and uninteresting to the ordinary traveller, the beauties of scenery being entirely wanting; they offer in compensation, however, no natural difficulties. The climate is temperate and healthy, the soil is undulating, sparsely timbered, well watered over large tracts, and produces excellent grass, the rich and deep alluvium beneath which waits only the plough or the spade to grow nearly every European product. Such natural advantages could not remain hidden. Thousands upon thousands of Europeans have, in annually increasing numbers, spontaneously sought a home there, and the foreigner already counts for something in the politics of those countries.

The same physical aspect that may be perceived at once in the Province of Rio de Janeiro is equally apparent throughout large portions of the country. Great luxuriance of vegetation, valleys of inexhaustable fertility, mountain ranges covered with virgin forests and the thinnest layer of vegetable earth, and vast tracts of red clay, almost destitute of alluvial soil. The very small quantity of soil which suffices for some plants is quite astonishing to Europeans; rocks in which scarcely a trace of earth is to be observed are covered with cacti, orchids, ferns, and other plants, all in the vigour of life. The town of Rio is admirably lighted, has a good supply of water, and a large area of the town is well drained; it is paved with granite worked from quarries close at hand. The paving in some of the principal streets, which was well laid down, has been much damaged by street tramways that have been carried through them, and this renders the transit in ordinary carriages extremely unpleasant, and at the same time expensive on account of the rapid destruction of the wheels.

The population is variously estimated between 420,000 and 500,000 inhabitants; the port, which may be entered at all times without a pilot, is inferior to no other in the world.

METALLURGICAL INDUSTRY IN SWEDEN.

Edge-tool Factories.—These shops (to the number of nine, 1872, of which one existed in the towns of Stockholm, Gottenburg, Gefle, Thorsälla, two at Nyköping, two in the province of Södermanland, and one in that of Orebro) have produced a value of 251,038 riksdalers (£13,877), or 55,140 riksdalers (£3,048) more than in 1871, and 132,447 riksdalers (£7,321) more than the average value (118,591 riksdalers or £6,555) of the production during the five years 1867 to 1871. The number of workmen employed in these factories has been about 217.

Tinware.—In 1872 four shops were at work, two at Stockholm, one at Nyköping, and one in the province of Blekingen. The number of workmen was about 185. The production is valued at 337,398 riksdalers (£18,651), or 24,582 riksdalers (£1,359) more than in 1871, and 178,153 riksdalers (£9,848) more than the average value (159,244 riksdalers or £8,803) during the five years 1867 to 1871. Besides the above-named factories, 189 similar establishments, managed by working foremen, have given occupation to 421 workmen, and 33 more, in the country, to 19 workmen.

Gun-metal and other Foundries.—These factories reached in 1872 the number of nine, two of which existed at Stockholm, one at Gefle, two at Sigtuna, one at Sundswall, one at Westeras, and one at Orebro. They gave employment to 68 workmen, and yielded a value of 107,900 riksdalers (£5,964), or 65,400 riksdalers (£3,615) more than in 1871, and 58,199 riksdalers (£3,217) more than the average value (49,701 riksdalers or £2,747) of the production of the years 1867 to 1871.

The mint in San Francisco coined from 1854 to 1867, inclusive, 242,000,000 dols., an amount equal to one-half the coinage of the Philadelphia Mint, from its establishment in 1793 to the same date. Since 1867 to the present time the San Franciscan mint has coined above 90,000,000 dols., making a total coinage of over 332,000,000 dols.

CORRESPONDENCE.

THE THAMES AT RICHMOND.

Sir,—The condition of the river at Richmond and elsewhere is the inevitable result of impeding the natural current by means of dams, weirs, and sluices for the purpose of obtaining water for mills and factories, as well as for the supply of navigable canals, objects that at the present day are well-nigh superseded by the superior economy and convenience of steam power and steam transit by land. Your correspondent "Fluviatilis," however, is slightly in error when he supposes that the silting up of the bed of the Thames would cease if all sewage were prevented from flowing into it.

Rivers are wisely ordained by Nature's laws to be the drains of the valleys they pass through, and, if not impeded by artificial checks, which convert a noble river into a series of stinking stagnant pools, are fully capable of carrying the *debris* of land out to sea, as well as all natural sewage. But, of course, all noxious and poisonous refuse discharged from mineral works and factories must be absolutely prohibited by vigorous Acts of Parliament and heavy fines for infringement.

It may be observed as an astounding fact that London, as well as many other large towns, situated upon a noble river with over four hundred feet fall, capable of supplying any amount of pure water, should be so destitute of health, that necessary principle of all comfort, and even of life itself. In order to prove the purifying power of a running stream, it is only necessary to dip a bucket of water over a boat's-side anchored at some distance below any town or village situated on its banks and delivering its natural sewage into the river. The water so dipped will, even in the present state of things, be found to be quite pure enough for all the purposes of life. For all the natural sewage, after a sufficient run, becomes rapidly absorbed or dissipated by the enormous demands of organic and vegetable life, as well as by the purifying power of the earth and atmosphere.

The removal therefore of all artificial impediments to the free current from source to mouth, would give us everywhere the inestimable blessing of a superabundance of pure water, as well as immunity from some of the disastrous effects of excessive inundations.

The first origin of the present deplorable state of all our rivers dates from before the Conquest, when Christianity was introduced by the Roman Catholics into the British Islands together with all their ecclesiastical establishments. They obtained innumerable grants of land, especially upon rivers, and about the time of the Crusades, when water power became applied, they drew large streams from the rivers to drive their corn mills, and some of them still bear the name of "Holybrook," perhaps because the abbots compelled the whole county to have their corn ground at the abbey mills, and not elsewhere.

At the time of the Reformation, when the ecclesiastics were in possession of nearly half the land of the kingdom, and that of the best, King Henry VIII deprived them of most of it, but only to grant it again to supporters and favourites, legitimate or otherwise, so that no advantage was derived by the change to the commonwealth at large. In fact, all original title to land is founded upon grants, never by purchase.

The expense of clearing out these vicious encroachments on our rivers would be great, but would be much more than covered by the great gain from having free and wholesome running rivers, as well as from some diminution of heavy losses by disastrous inundations. It should be recollected that the Canal Commissioners are hopelessly in debt for over three millions, and that at the present time all their works of dams, weirs, and sluices are in a general state of rottenness and decay.—I am, &c.,

Henry W. Reveley.

Reading.

GENERAL NOTES.

Channel Passage.—At the *séance* of the French Academy of Sciences on the 31st of August, M. Lecompte proposed to utilise the ebb and flow of the tides for compressing the air which will be required in the proposed tunnel under the channel, and especially to take the place of steam in driving the Brunton machines now being tried for the perforation of the limestone rock.

Wild Vanilla.—The journal, *La Liberté*, of Paris, says, in its weekly commercial summary, that notable quanties of vanilla have appeared in commerce, which may have a serious effect on the health of the consumers; this is wild vanilla, which, says the writer, possesses poisonous qualities which disappear by cultivation.

Workmen's Scholarships.—M. Henry Cockerill, of Aix-la-Chapelle, nephew of the late John Cockerill, who founded the great engineering establishment at Seraing, near Liège, which until the immense extension of the Creuzot works was the largest on the Continent, has placed at the disposition of the Société Cockerill the sum of 50,000 francs, to be invested in the public funds of Belgium, the interest to be applied to the endowment of scholarships, to enable the sons of workmen, or others employed by the society, to attend the courses of study at the Mining School of Liège.

The Progress of British Birma.—An account of the material progress made by the province of British Birma since the annexation in 1852 is given by the *Rangoon Gazette.* In 1853, the imperial revenue of the province was £531,701; in 1865, £1,030,060; in 1872-73, £1,462,513—an increase of £196,713 over the previous year. In 1855 the trade amounted to something under five millions; in 1865 it had more than doubled; and in 1872-73 it amounted to thirteen millions and a quarter. In ten years, from 1862-63, the area of land under cultivation has increased 35 per cent., from 1,629,956 acres to 2,203,539. At present, to one square mile of cultivated land there are fifteen that remain untouched, and fifteen more of non-cultivable land. Population has increased, and over and above the natural increase there is a steady but unfortunately slight and not permanent immigration. When a railroad is completed to the districts of Eastern Bengal it is expected that matters in this respect will improve. In the meantime, the Irrawaddy railway works are progressing between Rangoon and Prome, and the entire distance between those cities will, it is hoped, be completed and opened for traffic during the next two years.

The Olive Crop of Nice.—The olive seems to be the richest product of Nice, certainly that which obtains the most consideration from the inhabitants. The tree is there planted over an extent of 15,000 acres, and the produce in a fairly good year is estimated at from 180,000 to 200,000 gallons. The growth, however, is very slow, and no crop of any value can be expected until the tree has attained the age of twenty years. The olives are collected in the month of December, and those which ripen earliest are the best. The collection of this fruit is made by beating the trees, but this is a very imperfect mode of gathering, as the olives are bruised, and the oil loses its quality, and is never so good as in districts where the olives are picked from the trees by hand. This mode of gathering is, however, nearly impossible at Nice, where the trees are large and the branches slender. The best oil is made from the fruit immediately after being taken from the tree, but this is only practicable where the amount of a day or two's gathering is large; it is consequently the custom of many olive growers to leave the fruit in heaps until a sufficient quantity is collected for the mill, but the inevitable fermentation of the fruit under this system very materially injures the qualities of the oil. There are about 168 oil mills, some worked by horse power, but by far the greater number worked by water power—that is, 115 mills by the latter method. Ten gallons of good olives will give from 1 to $1\frac{1}{2}$ gallon of oil, but the average quality will rarely yield more than 10 per cent. There are very nearly 800,000 olive trees in the county of Nice, and each tree will give in a good year from 50 to 150 kilos. of olives, according to size; but the harvest is most uncertain. —*Journal of Applied Science.*

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FRIDAY, OCTOBER 2, 1874.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

THE WILL OF SIGNOR PONTI.

The following communication has been received by the Secretary:—

Foreign Office, September 22nd, 1874.

Sir,—I am directed by the Earl of Derby to transmit to you, to be laid before the Society of Arts, a translation of the will of the late Mr. Girolamo Ponti, of Milan, by which he has bequeathed a portion of his property to the "Academy of Science of London."

It is understood that the relatives of the testator intend to dispute the will, and as it does not clearly appear what Society is indicated, Lord Derby has made the bequest public by publishing a notice in the *Gazette*.

Mr. E. J. S. Mildmay, the acting British Vice-Consul at Milan, who is also Vice-Consul for Austria, reports that he has received a power of attorney to act for the Academy and Hospital of Vienna.

It appears desirable that any institution claiming the legacy should do so at as early a period as possible.—I am, Sir, your most obedient humble servant,

T. V. Lister.

The Secretary to the Society of Arts.

(Translation.)

On this 5th day of the month of January, 1856,

I, the undersigned, Girolamo Ponti, son of the late Signor Giuseppe Ponti, and of the still living Signora Maria Antonia Longhi, of Gallarate (a town of Lombardy), declare as the expression of my last will that, born contemporaneously with the fortune with which Providence has been pleased to endow my house, I have never ceased from my earliest infancy to take part in the vicissitudes thereof, and to act to the best of my ability in the limited sphere which, according to my age, was assigned to me, for its greatest increase, so much so, that at the death of my father, of ever lamented memory, every member of his family was in a comfortable and independent position. Having now for a period of about four years consolidated such a state of things to my full satisfaction, and the combinations having so worked that I, on this day, find myself entirely free and independent.

I dispose of the whole of what belongs to me on this day in favour of the three academies of sciences, of London (capital of England), Paris (capital of France), and Vienna (capital of Austria), so that my said patrimony is to be divided amongst the said three academics, in equal parts, for the purpose of founding with the produce thereof the institutions mentioned below, after deduction of the following charges, that is, there shall be deducted from my patrimony:—

1st. The sum of 600 Austrian lire, and not more for the celebration of my obsequies, and a capital sum corresponding to 30 Austrian lire per annum, to be paid to the parochial authorities of the parish of the Catholic faith in which my funeral takes place, in order that six funeral masses may be said annually for the aid of my soul, on the day itself of my death, or the nearest one possible to it.

2nd. The obligations undertaken by me, and appearing in my registry and book of accounts, shall be discharged with the same precision as if I myself were still living, and therefore the salary due to the person or persons in my personal service, the commissions unexecuted, and other matters, as well as the annual provision of my father in favour of my mother, consisting of my part per annum, 666 Austrian lire 67 centimes, payable in two equal instalments, in advance, one on the 1st of February, the other on the 1st of July, of every year during her natural life. My patrimony consists for the greater part of mortgages, and taking account of interest, amounts at present to 865,000 Austrian lire,* free from all debts, appearing in my books and from the dispositions of the present, the charges, that is, above mentioned. Each of the three Academies above named shall be bound to invest in a perfectly safe and profitable manner, the third part of my patrimony which falls to its share, and with the proceeds to institute two annual competitions for ever, in equal amounts, so that together they may correspond to the total sum of the proceeds of the respective quotas, free from any expenses which may happen to be necessary for the institution of the said competitions. Consequently, each of the aforesaid Academies will have to appoint a Committee fit to decide upon the grant of the rewards annexed to the two competitions, which are to embrace the following branches:—1. Mechanics. 2. Agriculture. 3. Physics and Chemistry. 4. Travels by sea or by land. 5. Literature. The object of the Committee must be to give the preference to whomsoever among the competitors shall have advanced the sciences by the discovery of new and simple appliances, and this refers to mechanics, physics, chemistry, and agriculture; in regard to travels by sea and by land, whoever has distinguished himself by a long journey by land and by sea, or has been able to make propositions fitting to diminish the dangers inherent in the present systems should have the preference; in default of inventors and distinguished travellers, the Committee will turn its attention to the most distinguished publications of original works, or at least of translations from other languages of works upon the above-mentioned sciences and travels, including literature, that is:—mechanics, agriculture, physics, chemistry, travels by land and by sea, and literature. Moreover the decision of the Committee must be considered as final. The competitions, as I have said, are to be two in every year, and they are to begin one year after each of the above mentioned Academies shall have received its own third part according to this present disposition.

Only natives of the country are to be admitted to the said competitions, therefore only native English by the Academy of London, French by that of Paris, and Austrian Germans by that of Vienna (I say again Austrian Germans).

If my mother should outlive me, and have any claim on my estate, I beg her to renounce it, but in case she should wish to enforce it she can do so, so far as she may by force of law, upon the patrimony renounced by me, diminished, however, by the equivalent of the annual provision in her favour as above. I declare that my personal effects, the furniture that I may have at the time of my death, and the books are not included in the above disposition. I leave them to the exclusive disposal of the Academy of Vienna, in order that, as regards the effects and furniture, the proceeds of their sale may be added to the third part of my patrimony which falls to its share, and as to the books, that they may be added to its own library or any other in Vienna which shall be chosen by it for public use.

* £36,400.

Referring here to the deficiency of German books which will be found in my library, I will state that it has not been from aversion to that language that I have not provided myself with them, but from the impossibility of my learning it on account of ill-health or the cares of life, and a proof of this will be found in the various translations from the said language which will be met with among my aforesaid books. I declare that I am not at enmity with any one, and that from a principle of education well rooted in me I have never done or said evil to or of any one, wherefore I believe I have no enemies, but if I have made any, I beg them to observe that it is without my knowledge, and therefore to forgive me.

I declare, finally, that I wish to every one the greatest possible amount of welfare, but especially to my nearest relations, and that I have made the above-mentioned dispositions in the firm persuasion that every one of my said relations is in a sufficiently independent position, and to carry out in some degree the ideas which I have always cherished in the course of my life, by which, besides the particular benefit of my family, I have always wished to be able to do good to many, but have been, by various circumstances, prevented.

I have made this, my present testament, in haste certainly, but with clear and free mind, as the true and inmost expression of my last will, and all in my own hand.

Girolamo Ponti, son of the late Signor Giuseppe, and of the still living Signora Maria Antonia Longhi, both natives of Gallarate.

Addition.—I leave to the Local Tribunal the charge of appointing an upright and able person for the execution of my above-expressed will, notifying that the present writing will be found in a closed cover, with four seals in red sealing-wax. I say again four seals in red sealing-wax, of which three are outside and one inside, all bearing the initials of my name and surname, G. P., in Gothic characters. [*See the end.]

Girolamo Ponti, son of the late Signor Giuseppe, as above.

Second addition to my testamentary dispositions.

I notify that in the above-mentioned testamentary dispositions all the increments are to be considered as included which may have accrued to the time of my death from the fund of my present patrimony only (5th January, 1856). Any other acquisition, whether from maternal inheritance or otherwise, and the proceeds thereof, shall be considered as disposed of, as I now dispose of them, in favour of the Grand Hospital of Vienna, capital of the Austrian Empire, in order that they may be profitably employed, and in the most secure manner possible, in augmentation of its present endowment. The present addition is also made by me with fully clear and free mind; and I subscribe myself

Girolamo Ponti, son of the late Signor Giuseppe, and of the still living Signora Maria Antonia Longhi, as above.

* = that is =

A true Office Copy.

(Signed) Landriani, Secretary.

[Stamp of the Milan Court of Appeal.]

GENERAL EXAMINATIONS, 1875.

TECHNOLOGICAL EXAMINATIONS, 1875.

The Programmes of each of these Examinations are now ready, and may be had on application to the Secretary. A copy of the Technological Programme has been sent out with this *Journal* to each Institution. The General Examination Programmes were sent out last week.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The third lecture of the third course of Cantor Lectures for the past Session, "On Carbon and Certain Compounds of Carbon," was delivered by Professor Barff, on Monday, April 27th, 1874, as follows:—

Lecture III.

I concluded my lecture on Monday evening last by showing you an experiment by which we made some carbonic oxide gas. It was not altogether satisfactory in its results, but I think it was sufficiently so not to call upon me to repeat it to you to-night. But I have not quite finished with carbonic oxide, and I will proceed with one or two experiments on that subject before I pass on to the more particular subject of the lecture, namely, marsh gas and olefiant gas. But, if you remember, I put on the board some symbols, and showed you that the symbol CO_2 represented 44 parts by weight of carbonic acid, and that CO represented 28 parts by weight of carbonic oxide; that when carbonic acid was passed over red hot carbon its volume became doubled, and that we got twice CO, or double the volume of carbonic oxide formed, that we took of the carbonic acid to form it. Now, when carbonic oxide burns, it becomes converted into carbonic acid, and the volume of the gas does not become changed. In order that I may be able to explain to you thoroughly and clearly the subject which I have undertaken to speak upon this evening, and in order that I may be able to give to those of you to whom chemistry is somewhat of a new study the means by which you may be able to understand books on chemistry which you read, and without the knowledge of which these books will be comparatively a dead letter, I must speak to you further on the subject of symbols, and also on the subject of combining volumes, because some of the gases which we have to do with, those which are compounded of elementary bodies, occupy different volumes from what one would expect. For example, suppose I take a volume of oxygen, and an equal volume of hydrogen, and put them together, and apply a light to the vessel, all my oxygen will not combine with the hydrogen, but only half of it. In order to make the whole of it combine, I must take double the volume of hydrogen that I have of oxygen, and then, if I perform that experiment under such conditions that the temperature is over 100° Centigrade, I shall get a certain quantity of steam or water gas formed. The apparatus in which chemists perform that experiment is called the eudiometer. This is graduated with certain marks upon it, so that we can tell the quantity of the different materials which we put into it. Into the tube two pints of platinum have been passed while the glass was in the soft state, and inasmuch as glass and platinum when heated contract about equally, there is no open space left at the side of the platinum wire, but it is closely enveloped, and of course, therefore, no escape of gas can take place if it be put into this tube. Suppose a deep trough be filled with mercury, and then this tube full of mercury be placed in it, the open end being dowwards, I can then pass into the tube through the mercury as much as I please of certain gases; and the tube is so graduated that I can measure the exact quantity of any gas that I pass into it. Now supposing I were to put, say a couple of cubic centimetres of oxygen, and then double the measure of hydrogen, and then pass an electric spark through the platinum wires into the mixture of gases, the two gases will unite and water gas will be formed. The water gas will occupy exactly the same volume as hydrogen, and therefore the volume of oxygen has

become lost. Here then is condensation. It is clear that if I decompose water I shall get constituent gases occupying the space of one-third more than the gases combined in the state of steam. Now, if I take carbonic acid gas, and if I analyse it, I find that it contains exactly the same volume of oxygen that the carbonic acid itself measures; moreover, if I take carbonic oxide gas I find that it contains only half the measure of oxygen which the carbonic oxide itself measures. These are very important considerations when we consider what takes place in the burning of fires. For example, carbonic acid gas is formed in the bottom of the fire; while it passes through the fire, the carbonic acid becomes converted into carbonic oxide. Here the volume is doubled, so that you have in the middle of the fire double the volume of gas formed of carbon and oxygen that you had at the commencement. Then, again, when it burns at the top, the carbonic acid is formed again, and you have double the volume that you had at the bottom, because carbonic oxide is burned into carbonic acid.

Now we have an experiment here to show you that where carbonic oxide is burnt the product is carbonic acid. My object is to encourage you who have an inventive turn of mind to study the science of the subject to which you wish to apply your inventive genius, and as the subject is that of heating and illuminating, and so forth, we must understand thoroughly the chemistry of those subjects which relate to it, or else we shall never be able to conduct our experiments satisfactorily. In fact, we shall be continually falling into error as to what we do not see the reason of, and what we cannot remedy, simply because we do not know the science of the subject, and we may know it with the greatest ease, for it is perfectly simple. Here is a bottle of carbonic oxide gas. Into this some lime-water has been passed, and if it be shaken up the lime-water does not become milky. If we put a light to it the carbonic oxide will burn. You see it is burning with its characteristic pale blue flame. As soon as it is gone out, I will put this glass on the top and shake it up. Now you see it has gone almost as dense as London milk. The carbonic oxide therefore is converted into carbonic acid by the simple process of burning, and takes up another atom of oxygen, which does not increase its volume, although it changes its properties. Almost all treatises of chemistry that are written now, and which have been written for the last few years, treat of quantitative considerations in what are called French weights and measures, and therefore, in order that in reading chemical books you may be able thoroughly to understand what they mean, it would be well for you to study these weights and measures. I shall, in what I shall have to say, use French weights and measures. You remember I put the symbol C on the board, and told you it meant 12 parts by weight of carbon. Now suppose we take C to be 12 grammes by weight of carbon. A gramme is somewhere about 15 grains or a little more. That is a matter you can easily find out. Anyone in an hour or two may learn to convert English measures into French measures, and weights also. Supposing C to mean 12 grammes by weight of carbon, then O_2 will mean 32 grammes by weight of oxygen, and the whole of them together will make 44 grammes by weight of carbonic acid gas. Now at what is termed the normal temperature and pressure, that is at a temperature of zero Centigrade, and under a pressure of 30 inches of mercury, or 760 millimetres of mercury, that weight of carbonic acid gas will occupy a definite measure. As near as possible it is that of 2 (11·2) litres.

Now, suppose I take that quantity of carbonic oxide —28 grammes—those 28 grammes of carbonic oxide, under the same conditions of temperature and pressure, will occupy the same volume, viz., twice 11·2 litres. This is true of all the compound gases that I shall have to speak to you about during this course of lectures. If I wish simply to represent the molecule of the gas, then CO_2 is the symbol representing the molecule of the gas. You may say, what do you mean by a molecule? The smallest quantity of the gas which can exist in the free state. I do not ask you to draw on your imagination, and to draw the size of it, but it is the definition given to it by chemists, and that is enough for our present purpose. This (CO) represents the molecule of carbonic oxide gas, but when I say this means 28 grammes of carbonic oxide gas, it is clear I am not speaking of one molecule, but of many; how many I do not know. But when we use this CO without giving it a definite weight, we speak of it as a molecule.

The gases of which I have to speak to you to-night are marsh gas and olefiant gas, and I will put on the board the symbols which represent their molecules. Marsh gas is represented by the symbol CH_4. You all know what C means. H represents the atom of hydrogen. Now, an atom of hydrogen is not a molecule of hydrogen, but two atoms of hydrogen united together form a molecule of hydrogen. An atom of an element is defined to be this—the smallest quantity of the element which can exist in the combined state, whilst the molecule is the smallest quantity which can exist in the free state. H represents an atom of hydrogen, and the weight of an atom of hydrogen is 1. The weight of an atom of carbon is 12. H_4 therefore will represent 4 atoms of hydrogen, or 4 parts by weight of hydrogen, and the C will represent the 12 parts by weight of carbon. Now, here we have the molecule of this substance marsh gas represented by CH_4. If we add 12 and 4 together we get 16. If we take 16 grammes of this marsh gas, they will occupy the same measure as 44 grammes of carbonic acid, or 28 grammes of carbonic oxide, under the same conditions of temperature and pressure. I dwell upon this because we shall by-and-bye have to speak about the decomposition of marsh gas and the decomposition of another gas, whose name I shall mention presently, and in their decomposition we shall have to speak of a change of volume and a change which very materially affects the heating properties of this gas.

Now I will represent to you the molecule of the other gas, olefiant gas, C_2H_4, which represents 24 parts by weight of carbon, and 4 parts by weight of hydrogen; 24 and 4 equal 28 grammes, and 28 grammes of the substance occupy twice 11·2 litres, the same measure as the other gases—always of course under the same conditions of temperature and pressure. I do not think I need go into the subject of the expansion of gases by heat, because you know that if you measure gas at a high temperature the weight of that gas will be less, that is, the same volume will weigh less than at a lower temperature; it is also clear that as gases are pressed upon by the air, when its pressure is great, the volume of the gas will be reduced. If it is under more pressure, of course it is more dense, and if it is under less pressure, of course it is lighter. Here is a litre measure, and 11·2 of these measures will be the volume of 1 gramme of hydrogen. Doubling this it will give a volume of twice 11·2, or 2 grammes of hydrogen. But we have 4 grammes of hydrogen, therefore their volume will be 4 times 11·2 litres in twice 11·2 litres of marsh gas. Compared with the other gases, these two are the principal gases of our coal gas, and they are set free whenever coal burns. They are most important substances themselves for us to consider in a course of lectures like the present, and the changes they undergo in burning are of immense importance to the understanding of this subject, and to the formation of suitable and useful apparatus for our fires, and gas for the illumination and warming of our rooms. Marsh gas takes its name from the fact that it was originally discovered in marshes. No doubt you have seen in boggy places bubbles rising through the thick mud. If you take a stick, and move it about in such places you will have a succession of these bubbles rising up, and if you ever choose to follow out such an experiment as I am going to explain, and I hope you will,

you will be able to collect a quantity of this marsh gas. If you take a bottle like this, and put a cork into it, and then a funnel, and fill the bottle full of water, and then insert the funnel through a cork into the water and stir about underneath it, the bubbles rise up inside the vessel, and you will be able to collect the marsh gas, and submit it to these tests which I shall show you, which indicate the presence of marsh gas. Marsh gas is also called carburetted hydrogen, because it contains carbon and hydrogen. The other, olefiant gas, is also called carburetted hydrogen, and we distinguish between the two by calling the marsh gas light carburretted hydrogen, and the olefiant gas heavy carburretted hydrogen. And I am sure, if you will think for one moment, you will see that one deserves the name of heavy and the other light. Because, although they occupy exactly the same volume, the one contains 12 parts by weight of carbon, whilst the other contains twice that quantity by weight. This marsh gas has also acquired another name from its extremely dangerous properties, and from the explosions it gives rise to, producing loss of life, in coal mines. It is known by miners as fire-damp. Damp does not mean wet, but it comes from an old word *damp*, meaning gas or air. It is produced in marshes by the decomposition of vegetable matter, and all vegetable matter that occurs in marshes contains carbon and hydrogen. When this vegetable matter decomposes, certain other things besides marsh gas are formed; but marsh gas is formed by some of the carbon and some of the hydrogen of the vegetable matter. Here is an experiment which is one of considerable interest. Here is a bottle, which you have seen here several times before, containing some moistened sawdust, which is undergoing gradual decomposition. If you notice, the products of this decomposition are being drawn from the bottle by means of this sucking apparatus, or aspirator, as it is termed. The bubbles are passing through a bulb containing a solution of caustic potash. This absorbs the carbonic acid. You all remember that carbonic acid is freely given off when organic matter decomposes even slightly. But something else is being formed by this decomposing sawdust besides carbonic acid—marsh gas, or at least some hydrocarbon, a compound of carbon and hydrogen, which we believe to be marsh gas. The carbonic acid gas is absorbed here in the first bulb, and here again is more caustic potash in another bulb, in order to insure the complete absorption of the carbonic acid. Between is placed some baryta water, which is a most sensitive material when carbonic acid is in question, for the merest trace of carbonic acid will render baryta water turbid, even if it be so small a trace that lime-water will not be apparently affected by it. There is no turbidity in the baryta water, showing that all the carbonic acid being generated in this bottle is being stopped in these two vessels containing caustic soda. In this tube is some oxide of copper heated to redness; the gas, whatever it may be, is passing over that oxide of copper; and here we have again some baryta water, you see what takes place in it; a white precipitate is being formed, so that evidently carbonic acid is present, but it is not the carbonic acid which is formed in the first place; it is carbonic acid which is being made here by the oxidation of the hydrocarbon which is decomposed by the hot oxide of copper, and it is a clear proof that carbon is passing over here in another form than in combination with oxygen. The carbon passing over there is passing over in combination with hydrogen. The products of decomposition of this moistened sawdust are carbonic acid and a hydrocarbon, which I assume to be marsh gas. You see, therefore, this most interesting experiment illustrates to you in some way how marsh gas is formed in naturo in marshes. Now for the consideration of how it is formed in coal mines. Inasmuch as coal contains nearly the same elements that wood and leaves do, there is no doubt that a gas, which is the result of slow decomposition, is formed in the coal mines, and then suddenly from time to time it gushes out into the workings. The workings get suddenly filled, and then when this takes place the miners speak of them as "blowers." Professor Graham investigated this subject, and came to the conclusion that in the gas constituting these blowers there was no other gas whatever than marsh gas, not a trace of olefiant gas, and little or no carbonic acid or carbonic oxide. Marsh gas is usually made for experiment in the laboratory in an apparatus of this kind. You notice this is a common flask which is covered with fire-clay in order to enable the flask to resist the temperature to which the mixture inside must be raised, in order that marsh gas may be given off. Inside the flask is placed the substances from which marsh gas is evolved. The decomposition of this mixture is one which has an intense interest to the chemist, but I shall not be able to go fully into it with you this evening, as it would lead us beyond our subject altogether, but I am sure when you come to study these things for yourselves and read books of chemistry about them, you will see that it is a most interesting decomposition. The marsh gas itself can be collected here, but in order that time may not be taken up in waiting for the experiment to be concluded, some gas has been prepared before, and Mr. Lewis will set fire to it. You will notice that it burns with a pale blue flame, probably showing a slightly yellow tint. The flame is not luminous, very little more so than the flame of hydrogen gas. The decomposing substances from which the gas is got are acetate of soda, hydrate of soda, and lime. The lime acts mechanically here; it does not enter into the decomposition. It acts in this way, that it prevents the acetate of soda, and the caustic soda, or the sodic hydrate, from running into a liquid. It keeps the particles of it separate, so that the action of heat may be more regular upon it, and that the gas may be given off more regularly; but all that we have to consider in the decomposition is the hydrate of soda and the acetate of soda. I do not mean to say that no change takes place in the lime; sometimes a small quantity of carbonate of lime is formed. Natrum was the word used for sodium in former times, and chemists have taken Na as the symbol for 23 parts by weight of sodium. $NaC_2H_3O_2$, is the composition of acetate of soda. Now the composition of sodic hydrate or caustic soda, is NaHO, 23 by weight of sodium, 1 by weight of hydrogen, 16 by weight of oxygen. Now I will arrange these elements in such a way as to represent to you most clearly how the decomposition in that flask is taking place—Na, CO_2, Na, O, CH_3, H. If you simply change their position we have Na_2CO_3 carbonate of soda, and CH_4, marsh gas. What is interesting is, that the hydrogen of marsh gas comes from two sources, from the acetate of soda and from the hydrate of soda. You will be able now if you read any chemical book to understand the symbols on this subject of marsh gas, though it is usual to write out the decomposition in the form of an equation, $Na_2C_2H_3O_2 + NaHO = Na_2CO_3 + CH_4$, but I have written it in this way because I think it more strikingly represents what takes place, and the two sources from which the hydrogen comes. But you may say:—"What is the use of all this knowledge to us? Why are we to know how to make marsh gas? If I know that it is there that is all I have to do with it, and if I know something about its properties, that is all I need know about it." But I think that is not the right way to look at the question. If you have to experiment upon these heating and illuminating substances, you will frequently have to get marsh gas and olefiant gas, both pure, and mixed together, in different proportions, and you will have to see the different effects that will be produced, and surely you ought to know, therefore, the method of making them. Here we have some marsh gas in this glass vessel, but I fear there is a certain amount of impurity in it. That flame is too luminous for the true flame of marsh gas. There is a small quantity of acetone existing there, caused by the

action of acetate upon acetate under the action of heat. A very small quantity is enough to give to marsh gas a rather too luminous flame. Now marsh gas is always set free when substances containing carbon and hydrogen are decomposed slowly or rapidly. Therefore when coal is decomposed slowly or rapidly marsh gas is set free. I cannot pass over this part of my subject without saying a few words about the terrible accidents which happen in coal mines. When a quantity of this gas gets into a coal mine an explosion takes place, but there are limits as to the quantity of marsh gas and atmospheric air which will produce an explosion. I have written here CH_4 for twice 11·2 litres of marsh gas; in order that this may burn perfecty there must be sufficient oxygen to form carbonic acid with its carbon and water and with its hydrogen. The carbon in CH_4, or 16 grammes of marsh gas, will require 2 (16) grammes of oxygen, or 2 (11·2) litres of that gas for their complete combustion; and 4 grammes of hydrogen H_4, will require the samo quantity of oxygen, because H_2 requires O or 16 parts by weight of oxygen to form water with them; therefore, H_4 will want 32 parts by weight of oxygen or 2 (11·2) litres for their perfect combustion. Now, the product in the first case will be 44 grammes of carbonic acid, which will measure 2 (11·2) litres, and in the second 4 (11·2) litres or 36 grammes of water vapour or gas; this action is represented by equation, as follows:—

$$CH_4 + 2\ O_2 = CO_2 + 2\ (H_2\ O).$$

Here you have a simple method of determining the quantity of oxygen required to burn marsh gas. Assign to the marsh gas any quantity that you like, call it 500 litres, or a pint, or whatever you like, you want double the volume of oxygen to burn it, and you get the same volume of carbonic acid gas formed as the volume of the marsh gas. But inasmuch as we have not to do with pure oxygen we want to know how much air must be used to burn marsh gas. Now, inasmuch as in one volume of air there is about ⅕th its volume of oxygen, it is quite clear that we want five volumes of atmospheric air to yield one volume of oxygen, and, therefore, we shall want ten volumes of atmospheric air to yield two of oxygen, and if we want to burn a volume of marsh gas we must have two volumes of oxygen, or ten of atmospheric air. Therefore, when marsh gas is mixed with ten times its own volume of air it makes the most explosive mixture. If it is mixed with only three times its own volume of atmospheric air it will explode, and if it is united with eighteen times it will not explode, but will go on burning quietly. Sir Humphrey Davy discovered a most excellent means of preventing explosions; it is called his safety lamp. This is one belonging to this house, and I have no doubt you have had it often explained before. The principle of it is this—this iron wire gauze, which is a good conductor of heat provided it be perfect (and there are about 800 wires in the square inch), and provided it be not oxidised or broken, will conduct away the heat, and the lamp may be put lighted into an explosive mixture of marsh gas and air, and yet the mixture will not explode. The marsh gas and air that is inside will burn inside, but they will not ignite the mixture that is outside the lamp, simply because the iron wire conducts away the heat, and it does not rise to a sufficiently high temperature to explode the mixture of marsh gas and oxygen, or marsh gas and air, which require a very high temperature for their ignition. Of course when the miner sees the flame burning inside the lamp, he ought to withdraw from the workings, because there may be some imperfection in his lamp, and if there were any, even minute ones, when the mixture is in these proportions, if the temperature be high enough an explosion will take place. Here is a mixture of the two gases in these proportions, and you see that with that small quantity a loud explosion will take place. Imagine this gas to be in a much larger vessel with a contracted neck, the explosion would be much more violent, and the vessel would be broken all to pieces. When marsh gas burns there is formed carbonic acid and water. Here is an experiment arranged to show you that. Here is some marsh gas, evidently burning, and in that vessel adjoining will be some water formed, and you will notice that carbonic acid will also manifest its presence in this lime-water.

I now pass on to the consideration of the next gas—olefiant gas. This consists, as I have already said, of a much larger quantity of carbon, in fact, twice 11.2 litres contains 12 grammes more carbon, and the effect of this increased quantity of carbon is, that it makes the gas give more light, it makes it more luminous. I shall have to show you, when we come to speak upon coal gas and its impurities and its purification, that olefiant gas, which exists largely in coal gas, and is one of those gases which give it its illuminating properties. Olefiant gas is an extremely interesting body. I shall prepare some of it to-night. I shall not try to get it from any of its natural sources, I mean not by the destructive distillation of any organic compounds such as coal. Here we get it by the decomposition of a substance very well known to you all under the name of spirits of wine. The liquid here in this retort is not exactly ordinary spirits of wine, but is common methylated spirits of wine, which contains at least 10 per cent. of water, and frequently a great deal more. This will be acted upon with oil of vitriol or sulphuric acid. Now what is the composition of alcohol? It contains carbon, oxygen, and hydrogen, and in these proportions, C_2, H_6, O. I need not now interpret this formula for you, because you all are able to interpret it for yourselves. C_2H_6O, means a molecule of alcohol. Now we may consider the decomposition which is going on here as a process of dehydration. The oil of vitriol takes away from the alcohol the elements of water, so that if we take H_2 O, the elements of water, from C_2H_6O, we shall have left C_2H_4, which is the molecule of olefiant gas. I will now describe the experiment with its details.

Here is our mixture of two volumes of oil of vitriol, and one of alcohol. It is ordinarily the custom (and if you choose to make this experiment I would advise you to adopt it) to mix a quantity of sand in the liquid, and to make it into a paste, because frequently the action gets extremely violent, and an explosion takes place. It is always well to have sand in such quantities that it is visible above the liquor, and then the action goes on much more slowly and steadily. Certain impurities are given off in this decomposition, the impurities coming from the sulphuric acid, and from the alcohol, for they are both sources of impurity. In order to stop these impurities, we have certain bottles arranged here, and we hope to collect the gas in this farthest jar beyond in a pure state. The first of these impurities is the vapour of the alcohol. You know it is a very volatile substance, it gets heated before the decomposing action of the sulphuric acid takes place, and passes over as alcohol vapour. It is condensed in this flask. Another product of the decomposition of the alcohol by sulphuric acid is also given off, namely, ether, and a certain amount of it is formed and condensed also in this vessel. You notice that the contents of this flask are blackened and charred, that is because some of the alcohol is, as it is termed, carbonised there. The carbon thus formed acts on the sulphuric acid, and sulphurous acid is formed. It is a gas which is formed when sulphur is burnt, or when coal containing sulphur is burnt. I shall have to bring the consideration of it before you in my next lecture, and explain how it so happens that this gas is formed in larger quantities in the Underground Railway, so that we often suffer from it, sometimes rather seriously, when we travel on that line. Sulphurous acid is formed in the generating flask, and is absorbed here in this vessel. This first bottle contains the condensed alcohol vapour and the ether vapour; in this second bottle we have caustic

soda or potash, which absorbs the carbonic acid, and also the sulphurous acid and the vitriol in this bottle absorbs water vapour, so that we collect our olefiant gas pure in this last vessel. Now I think the action has gone on long enough. The olefiant gas is now burning. It burns with a very different kind of flame from marsh gas, and you notice that it deposits black soot upon the white porcelain held in the flame, showing that it contains a very considerable quantity of carbon. I shall enlarge on this in a later lecture, and I shall want you to remember this, if you will favour me, by following carefully the details which I have given you, because I shall treat of them again in a later lecture, and shall show their application. In later lectures I shall have to speak to you about this deposit of carbon, and to show you that it may be utilised to increase the illuminating power of our petroleum oils, hydro-carbon oils, and coal-gas. This gas about which I am speaking is called olefiant gas, because it forms a substance discovered by a Dutch chemist, which has received the name of Dutch liquid—a substace which has apparently oily properties, that is to say, it looks like oil; it is not really oil, though it looks like it, for it has a property which oil does not possess, namely, that it is much heavier than water. Here is a vessel of olefiant gas already prepared. Here is some bromine, a substance having a most offensive odour, quite as offensive as chlorine. You notice that that liquid is of a brown colour. It is quite cold, and the olefiant gas is quite cold, but the side of the vessel down which it is being poured gets quite hot, and if I shake it up you will see that the brown colour of the liquid disappears. Its colour has now all gone, and I have in its place a white substance formed by the combination of the olefiant gas with this brown liquid. When a volume of bromine vapour is mixed with an equal volume of olefiant gas, they unite together, and form a volume of this substance, that is, of this substance in the state of vapour, measured under the same conditions of temperature and pressure as were the gas and vapour before they were mixed together. This substance is called bromide of ethylene. Chlorine could be used instead of bromine, and then chloride of ethylene, or Dutch liquid, would be formed, but I prefer here to use bromine, as it is more suited for a lecture experiment. The brown colour has disappeared, and not only is the brown colour gone, but the offensive odour is gone, and instead of the offensive smell of bromine, we have got what some people consider to be a pleasant smell, one similar to that of chloroform, for chloroform contains carbon, hydrogen, and chlorine, $C_{12}H$ and 3 times $35\frac{1}{2}$ of chlorine, that is, $CHCl_3$. There we have $C_2H_4Br_2$ or, if chlorine had been used, $C_2H_4Cl_2$. The bromine and chlorine compounds smell alike. When olefiant gas is passed through a red-hot porcelain tube it deposits half its carbon, and marsh gas is formed; thus it is represented in symbols—

$$C_2H_4 = C + CH_4$$

The volume of the marsh gas is the same as that of the olefiant gas, for C_2 and H_4 occupy each 2 volumes, but if the marsh gas be passed through a white hot porcelain tube all its carbon is deposited, and hydrogen passes on thus—

$$CH = C + H_4$$

but H_4 occupies 4 volumes, and CH_4 only 2 volumes' therefore the hydrogen is double of the volume of the olefiant or marsh gas, from which it is obtained. The decomposition of these gases takes place in the burning of an ordinary gas flame, and they take place in the burning of a fire, and you will see that a knowledge of this decomposition of the gases and the change of volume in the decomposition is a subject of considerable importance. Now I will burn some of this olefiant gas in another gas, and you will see with what a smoky flame it burns. The sides of the vessel are covered with carbon. I have burnt this olefiant gas in chlorine; the chlorine has united with the hydrogen of the olefiant gas, and not with the carbon, for under these circumstances chlorine and carbon will not unite together, so that the carbon is left as a deposit on the sides of the vessel, showing the large quantity of carbon that olefiant gas contains. In my next lecture I shall speak of liquid hydrocarbons.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

MACHINERY, ENGINEERING, AND CONSTRUCTION.

(*Continued from page* 871.)

III.—Wood-working Machinery.

No. 6048. Messrs. Allen Ransome and Co. make an extensive display of their industrial contributions to the exhibition of wood-working machinery in the department of machinery in motion, completely monopolising the space in Room IV. of the Western Galleries, and also part of Room V., with thirteen different machines and their accessories, comprising the following :—Patent Single-deal or Flitch Frame; Improved plain Band-saw Machine; Improved Planing and Trying-up Machine; Patent Panel-board Planing Machine; combined Planing, Shaping, Chamfering, Mortising, and Boring Machine; Patent combined Planing and Moulding Machine; Improved Universal Moulding, Shaping, and Recessing Machine; Patent "Complete" Joiner; Richards' Patent Mortising Machine; Patent Cleaning-off and Sand-papering Machine; Shute's Patent Mitreing Machine; Improved Saw-sharpening Machine; Improved Hand-mortising Machine; and Patent Pneumatic Conductor.

Trammelled by the limits necessarily imposed by the conditions of space, and nature of the exhibition, and thereby debarred from showing the initial processes of treating timber in the rough, in log, &c., and cutting it up into materials of various kinds and scantlings, ready for farther conversion—processes effected by the larger class of machines, timber, log, and deal frames, large rack circular saw-benches, American rack benches, &c.—Messrs. Allen Ransome and Co. have so arranged the bulk of their exhibits as to illustrate completely, from commencement to finish, the machine manufacture of one particular and prominent article for building purposes, viz., a door, with the aid, of course, of such and so much skilled manual labour as is requisite to tend the machines and perfect the intermediate stages of the process, such as putting together, &c. Thus the exhibition visitor, curiously inclined, may watch every step of the production, from the cutting up of the deals and boards, to the final cleaning off and finishing of the surface of the completed door. But it may be well to note that the firm undertake this work, simply as illustrative of the uses and capability of their machines, and not as an integral part of their business, which is that of saw-mill engineers and manufacturers of wood-working machinery. Finally, it may be remarked that the firm exemplify, upon an extended scale, the application of a new patent principle, constituting an important and valuable improvement in connection with the conversion of timber into building appurtenances by machinery, namely the pneumatic conductor, for the automatic, immediate, and effectual removal of sawdust, shavings, and chips from the factory and shops where the various operations are being carried on.

The Patent Single-deal or Flitch Frame is illustrated in the engravings, Figs. 1 and 2, and is

Fig. 2.

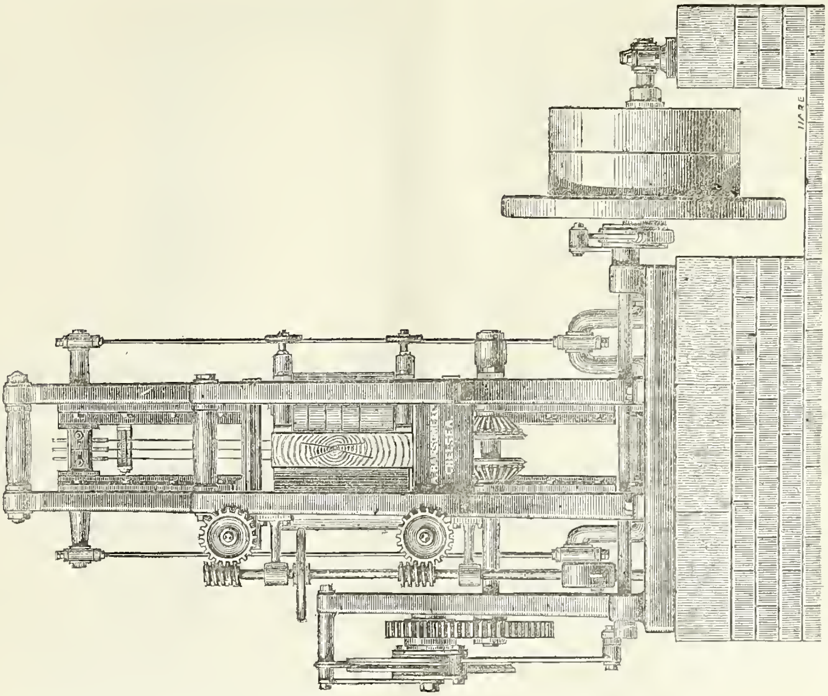
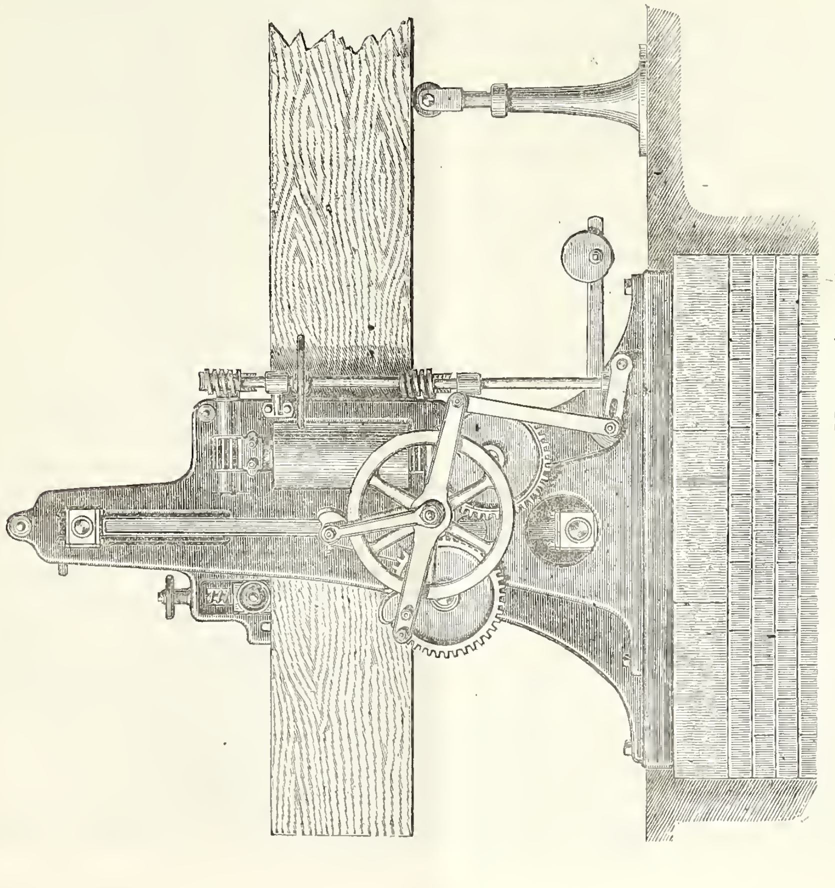


Fig. 1.



Messrs. Allen Ransome & Co.'s Patent Single-deal or Flitch Frame.

simply a vertical reciprocating sawing machine, for making from one to a dozen cuts at once, as may be required, and provided with a self-acting feed-motion. In ordinary sawing by hand, the material sawn is stationary, and the cutting implement progresses forwards, *pari passu* with the cut; but in this, as in most other machines for performing such operations by mechanical means, the cutting tool is maintained in a constant position, while in motion, and a horizontal or other suitable travelling or feed motion is imparted to the material operated upon. It is in this part of the mechanism that this improved machine differs most materially from its predecessors of the kind. These frames all stand on their own foundation-plates, which are fixed on a level with the floor of the factory, whereby the expense of excavations and masonry for foundations is avoided. The connecting rods and cranks are in duplicate, on each side of the vertical main standards, working the crosshead, to which the swing frames, which are constructed of wrought iron and steel, are attached; the saw-blades are attached, adjusted, and changed with ease and rapidity; and in the general construction of these moving parts great strength is combined with comparative lightness, admitting of a high rate of speed, which is variable, between the limits of 250 and 400 strokes per minute. The deal or flitch is supported on loose rollers in standards, and kept down in place against the upward pressure of the rising-blades by means of a top horizontal roller, made adjustable for depth and pressure by a screw and hand-wheel acting on its bearings, which are carried in suitable slides. The forward motion of the deal or flitch against the saws is effected by vertical feed-rollers on each side; thus one set of feed rollers projects beyond the fence, but is fitted with springs; and the other set, on the opposite side of the deal, are made moveable in socketed bearings, so as to admit of variable widths of deals being cut. All these feed-rollers are plain, and driven so that the feeding power is adequate, and the outer surfaces of the deals are not deteriorated by the indentation resulting from grooved or fluted rollers. The feed-motion is communicated to the feed-rollers by suitable intermediate gearing, from a friction feed-wheel, by palls working in a V-grooved periphery, which may be thrown out of contact, to stop the action when requisite; the rate of feed is variable, from 6 in. to 8 ft. per minute, by an arrangement of a slotted eccentric on the first-motion shaft. The fence-bars may be varied and adjusted by slots and screw bolts, the vertical rollers being made in segments to correspond. By this machine the boards for door panels (as also for flooring) are cut up; the styles and rails being cut by another machine, the "Complete" Joiner.

In the Improved Plain Band-saw Machine of Messrs. A. Ransome and Co., the main standard is a G-shaped hollow box-casting, combining comparative lightness with great strength and rigidity, so as to enable the machine to be worked at a high velocity without vibration, and from its curvature giving ample space for manipulating the wood in various directions around the saw. It possesses all requisites for sweep-cutting, and is made in two sizes; the smaller one has 14-inch driving pulleys, and 30-inch saw pulleys, speed 400 revolutions per minute, weight 22 cwt., to cut 12 inches in thickness, with an expenditure of about 2-horse power on the average; this is suitable for the ordinary work of builders, cabinet-makers, pattern shops, &c.; the larger size is a 3-horse power machine, weighing 33 cwt., and suitable for heavier work in railway carriage factories, arsenals, dockyards, &c.; it has 16-inch driving and 42-inch saw pulleys, driven at 350 revolutions per minute, and is adapted for cutting to a depth of 18 inches. The following are the points of construction:—The saw-pulleys are turned inside and out, and balanced to the utmost nicety, being subsequently covered with rings of band and buff leather, turned perfectly true: by an arrangement the upper saw-pulley may be readily adjusted, so as to cause the band-saw to run in any desired position on the periphery, centrally or at or near either edge thereof. It is also provided with a gun-metal bush, fitting accurately a steel pin or axis on which it runs, and kept constantly oiled by a lubricator; and this is borne in a slide, made adjustable by hand-wheel and screw, to raise and lower the pulley for saw-bands of different lengths, while a spring (or weighted lever) maintains an adequate tension on the saw, under all conditions of expansion and contraction. Special packing pieces, or adjustable guides, are provided for the saw-band, immediately above or below the material which is being cut, and thereby the back of the saw is sustained against the cut, and torsion is prevented as the wood is turned; these packing boxes are hollow steel cylinders, filled with tallow, to lubricate and keep the saw cool, and they are readily adjustable, to suit saws of various widths. By simply changing the saw the same machine can be employed for cutting through large pieces of hard wood, as well as for every variety of the finest ornamental work. Perin's patent French Band-saw Blades, which alone are used for these machines, are characterised by their regularity of thickness and equality of temper throughout, and remarkable for durability and toughness; they are supplied in bands of various lengths and widths, ready brazed up, set, and sharpened, fit for work. In connection herewith it may be noted that a special class of these machines is made for cutting metals, the table being large and strong, and the driving effected by a simple arrangement of gearing, from a counter-shaft, fitted with cone-pulleys, whereby the speed of the saw is varied from 200 to 300 feet per minute, the slow speed being used with a new sharp saw-blade, and, *vice versa*, the high speed with a blunt one. The metal is sawn cold, and in operating on ordinary qualities of wrought iron, 3 superficial inches of sectional area per minute may be cut, on the average, for three hours, without need of sharpening the saw; in brass 6 square inches may be cut per minute; this application of the band-saw has been adopted in many large iron-works.

The Improved Planing and Trying-up Machine, shown in the annexed engraving, Fig. 3, is specially adapted to true-up the stuff, taking it out of winding, and to leave at the same time a smooth plane surface, ready for being glued-up; as, for example, in planing and trying-up scantlings for joiners' work, such as doors; but they can also be employed for planing and thicknessing boards, and will work any description of wood; and by substituting, in lieu of the straight-edged cutters, any other form of iron, mouldings, beads, or rebates, of any description, can be cut upon the wood. The framing of the machine is made of adequate strength and rigidity to prevent vibration when the cutting or adze-block is run at full speed, which may range as high as 100 revolutions per second, the work being turned out at 30 to 40 feet per minute; while they are carried on a foundation which is free from spring. The feed-motion is certain and uniform, imparting to the material to be planed a steady, regular progress forwards, free from any jerks or slips, which would result in an imperfect surface. The table is made entirely of cast-iron, and truly planed throughout, being fitted at suitable intervals with improved screw-clamps, gun-metal nuts, and wrought-iron fangs, whereby the timber is securely and readily fixed; and the pressure apparatus is applied as close to the adze-blocks as practicable; thus defective work, through vibration of the material under the action of the cutters, is effectually obviated. The traversing motion of the table to and fro, beneath the cutters, is effected by Messrs. Ransome's improved smooth feed-gear, which is remarkable for steadiness; it is so devised that there is a quick return motion of 40 feet per minute, while the feed-speed, or rate of advance of the timber, itself is susceptible of variation from a slow feed of 10 feet to a quick feed of 30 feet per minute. Two diagonal levers in front of the machine serve to start, stop, and reverse the travelling table, as well as to regulate the variable speed, and this admits of

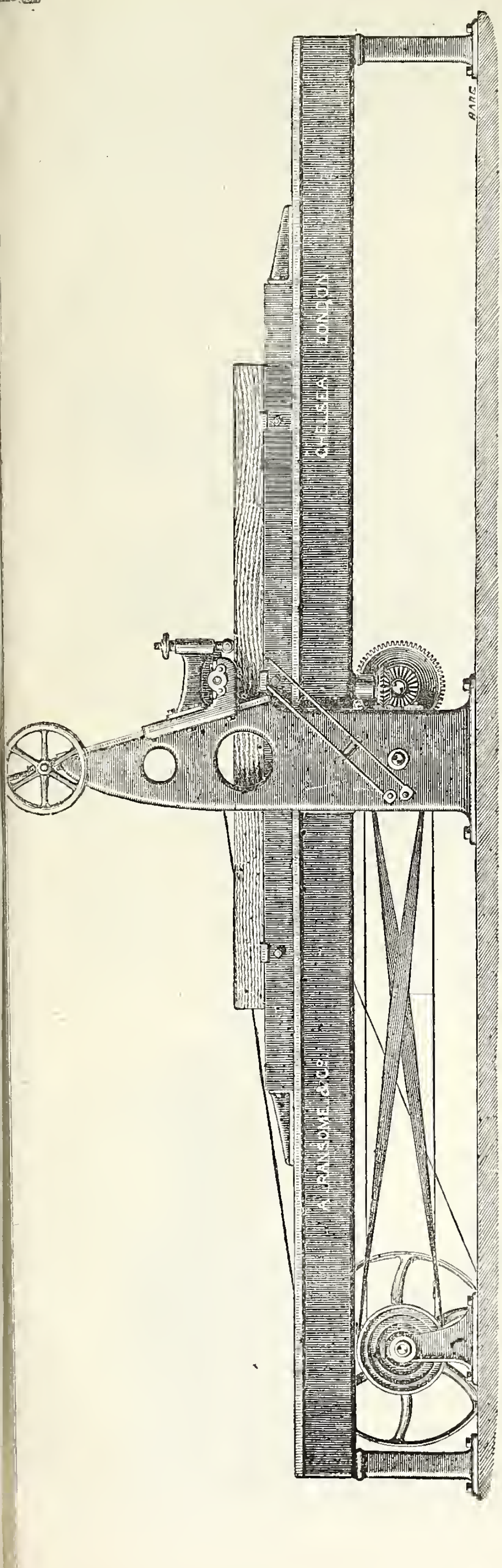


Fig. 3.—Messrs. Allen Ransome & Co.'s Improved Planing and Trying-up Machine.

instantaneous change in the feed, even while the wood is travelling forward; when the cut is light, the feed may be accelerated, but when much wood has to be taken off, retardation of the feed is advantageous; in this manner time is economised in the working of the machine, as these changes are effected while it is in continuous operation. By covering the entire surface of the table with pieces of timber, packed closely together, a great number, of the same ultimate required thickness, may be planed and trued-up simultaneously; and, as an example of the facility of the entire operations, it is estimated that all the material for 50 doors (rails, styles, and panels), may with ease be turned out by one lad, attending this machine, in a day's work of nine hours. The cutters are affixed to an adze-block of wrought-iron, and perfectly balanced on the opposite sides of the block; the adze or cutter-blocks revolve at a very high speed, and are made as light as possible consistent with the requisite strength; the same applies to the spindle of the cutter-block, which is of mild centred cast-steel, revolving in long gun-metal bearings at each end, specially constructed for high speeds, fitting with the utmost accuracy, and provided with suitable means for taking up readily any slackness or end-play, for keeping them thoroughly lubricated, and for the effectual exclusion of dust, grit, chips, &c. The cutter-block slide is provided with a graduated scale, by which the finished thickness of the scantling or work can be minutely regulated. In the ordinary sizes of these machines, the smaller, requiring 2-horse power, weighs about 2 tons, has 14-inch pulleys, with countershaft speed of 550 revolutions, adapted for scantlings up to 10 feet long by 14 inches in width and thickness; the larger size, for scantlings up to 16 feet long by 20 inches thick and wide, has 16-inch pulleys, with the same countershaft speed, weighs $3\frac{1}{2}$ tons, and requires 4-horse power.

The Panel-board Planing Machine is expressly adapted for planing and surfacing thin boards, so as to have a highly finished smooth surface, requiring no smoothing plane to follow; it will plane stuff as thin as $\frac{1}{8}$th of an inch without injury, and is not only useful for panels of railway and other carriage work, but available also in joinery and building work, for planing and thicknessing door-panels, cleaning off shelves, dresser-tops, and the like work, after being glued up. The boards are fed through the machine by two pairs of smooth feed-rollers, arranged close to their work, and all being driven; thus the pressure apparatus holds the board firmly close to the adze-block on each side, preventing vibration; and the panel surface is not in any way hacked or indented, so that when the boards are planed on one side, they may be turned over and passed through again to plane the other side. The long wrought-iron adze-block runs on spindles and bearings, constructed and lubricated as described in reference to the last machine; and the other adjustments for thickness, and for variable feed, &c., are also the same, the feed ranging from 15 to 30 feet per minute. The weight of this machine is $1\frac{3}{4}$ tons, average power 3-horse, the pulleys on the countershaft are 14 inches in diameter, and have a speed of 550 revolutions per minute; boards may be planed up to 2 inches in thickness and 24 inches in width.

The Combined Planing, Shaping, Chamfering, Mortising and Boring Machine, is a very compact and useful little machine-tool, capable of many advantageous applications, weighing only 7 cwt., and requiring but $\frac{1}{2}$-horse power; it is suitable for working plain or curved pieces, for any kind of wooden framework, with facility. The cutter spindle, driven by 3-inch pulleys, revolves, at the high speed of 4,000 per minute, in two pairs of long self-lubricating bearings, beneath a light cast-iron table, slotted to receive the cutters, and swivelling on a hinge so as to be turned over, out of the way, when not in use; the wood to be planed is passed over the table, and a very fine surface is made by the cutters. For chamfering and shaping, two semi-circular angle-brackets are fixed over the cutter-slot, at any desired distance

from each other, and the piece of wood is laid between them edge-wise, the cutter removing all that falls below these stop-collars. The boring and mortising tools are affixed to the free end of the cutter-spindle, and a suitable moveable table with the necessary traversing slide motions, vertical and horizontal, is provided; thus holes may be bored and mortises chased with the utmost speed and accuracy. By attaching collars to the spindle end a small circular saw may be fitted on for ripping, grooving, or cross-cutting, a hard wood table being fitted to the mortising slide, which serves as a small saw-bench, with a rising and falling table, and is very convenient for many purposes. These machines are sometimes made of a larger size.

The Patent Combined Planing and Moulding Machine, Fig. 4, exhibited in Room V., exemplifies one of the largest of a new series recently introduced and specially designed to facilitate and attain the execution of perfect work at the highest possible speed; they are in five different sizes, the largest working material up to 16 inches

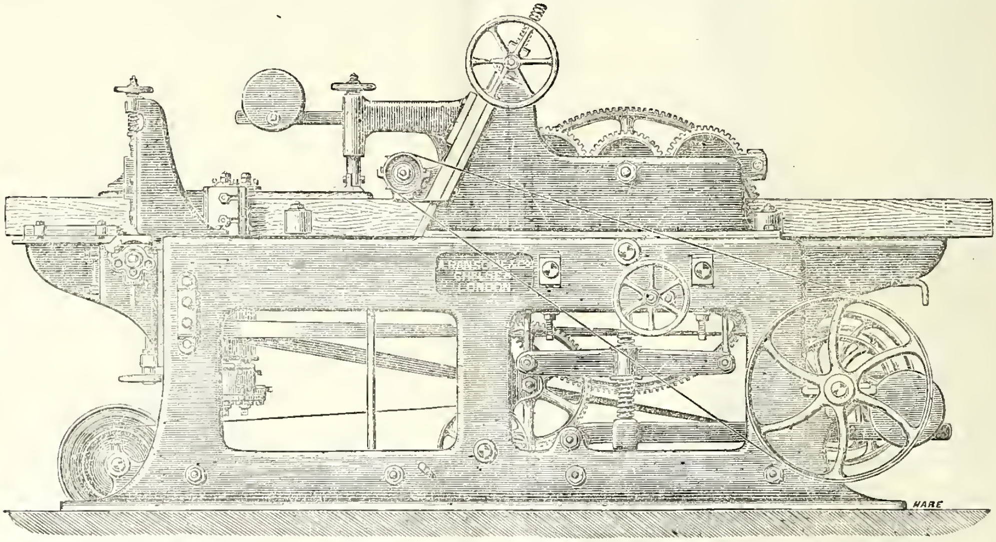


Fig. 4.—Messrs. Allen Ransome & Co.'s Patent Combined Planing and Moulding Machine.

wide by 6 inches thick, weight about $3\frac{1}{4}$ tons, and requiring about 8-horse power, with 16-inch driving pulleys; the smallest limited to a maximum of 4 by 2-inch material, 14-inch pulleys, 6-horse power, $2\frac{1}{2}$ tons weight; the driving-shaft runs at a speed of 750, and the cutter-spindle at 3,500 revolutions per minute. The feed-motion is variable, from 12 to 35 feet per minute; there are four rollers, all driven, affording great propelling power, free from jerk or slip; the pressure apparatus is simple and applied close to the cutter-blocks, which are four in number, viz., top, bottom, and side cutters, working simultaneously, so as to cut single or double mouldings to any pattern, or plane, groove, edge, tongue, thickness, and bead, match-boarding, at one operation. The adze-blocks, spindles, bearings, and lubrication are as previously described. As a large proportion of the time in using a moulding machine is necessarily consumed in setting and altering the cutters, it is of primary importance that every means of facilitating this operation, by making the cutters and adze-blocks

Fig. 5.

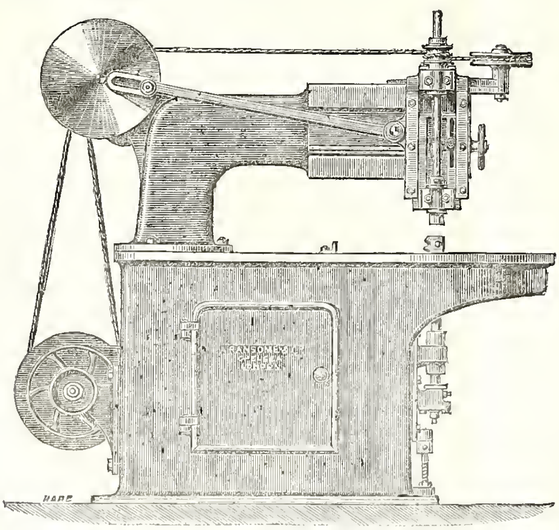
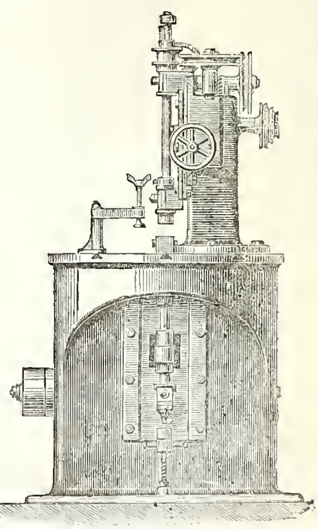


Fig. 6.



Messrs. Allen Ransome & Co.'s Improved Universal Moulding, Shaping, and Recessing Machine.

easy of access, should be adopted. Accordingly in these machines, as will be seen, all the cutter-blocks can easily be got at, in particular the bottom block (generally located somewhat inconveniently beneath the centre of the machine) is fixed at the end of the main framing, and the small table projecting beyond it is hinged at the side, so as to admit of its being swivelled out of the way, when adjustment of the cutter is necessary. In reference to tho the spindle-bearings it may be noted that the lubricating chamber is fitted with felt and floated with oil, while brass screws are provided to take up any play in the bearings.

The Improved Universal Moulding, Shaping, and Recessing Machine, Figs. 5 and 6, is of a type different to any of the other moulding machines described, and has a considerable resemblance to the radial drills of mechanical engineers. The table is made of a large size, narrowed towards the front, and the upper framing, bolted down thereto, is very strong and has a projecting arm, so that the cutter overhangs a long way; hence the work can pass under the tool, and be moved freely about in any direction upon the table; and thus work can be executed in the centre of a board as well as upon the edges, as only can be done in ordinary machines. Among the variety of purposes to which it may be applied may be enumerated the cutting and sinking of recesses of any form and pattern, cutting twisted or circular mouldings of any form; sticking straight or circular sash-bars; moulding, grooving, and rebating straight or circular sash-frames; cutting a moulding round raised door-panels; moulding, chamfering, or edging, to a pattern, flat ornamental balustrades; forming housings in staircase string-boards, &c. The top cutter spindle works in a carriage mounted in slides upon planed faces in the side of the projecting arm, and can thus be made to traverse vertically and horizontally; the slotted disc and adjustable crank pin and connecting rod serve to regulate the amount of horizontal traverse, and the small hand-wheel works the cutter down gradually to the desired depth. By slackening the bolts the upper cutter and the arm carrying it may readily be swung out of the way, for the purpose of using the second or lower cutter, which is mounted on a spindle working below the table, and can be brought up for work by a hand-wheel, being very useful for some kinds of work. The end of the top cutter-spindle is bored, to receive cutters for chasing, recessing, or boring, and is also screwed on the outside to take a small adze-block, with moulding irons attached of any pattern; a small false end, fitting thereon, is furnished with a long slot, taking a small cutter for mouldings round very sharp internal sweeps. The work to be executed in some cases is mounted on a metallic plate, cut to the desired pattern, and swivelled upon a pin or fulcrum fixed in the table, which may be concentric with, or excentric to, the cutter; by this means a radial action is obtained, though the cutter is carried on a fixed arm. The framing of the table forms a tool-chest. The total weight of this machine is 25 cwt., the diameter of driving shaft pulleys is 6 inches, and the speed of the driving shaft is 1,000 revolutions per minute, requiring about 1-horse power.

Messrs. A. Ransome and Co.'s Patent Complete Joiner is shown in Figs. 7 and 8: nine distinct operations can be satisfactorily performed therewith. In sawing and cross-cutting, it will work saws up to 2 feet in diameter, "deep" 9-inch deals, and cross-cut stuff up to 4 inches in thickness; in planing and moulding it

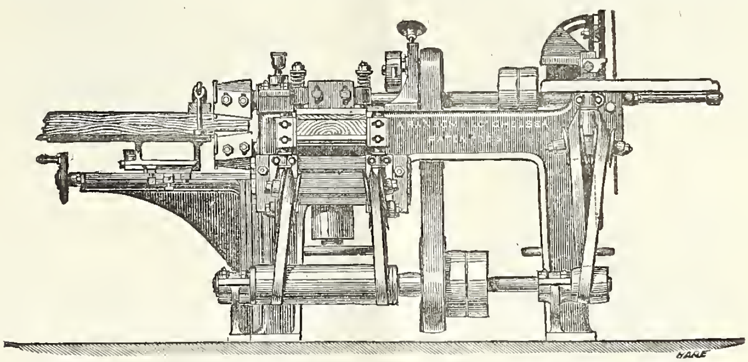


Fig. 7.—Messrs. A. Ransome and Co.'s Complete Joiner.

will, at one operation, plane, groove, tongue, edge, thickness, and bead, boards up to 9 inches in width, stick single or double mouldings, wrought on 4 sides, up to 9 inches in width, of any pattern, or cut any circular mouldings up to 3 inches in width; in grooving, it will cut from ⅛ inch to 1½ inch grooves; in tenoning, it will cut single or double tenons, and scribe the shoulders at one operation; it will bore holes from ¼ inch to 2 inches in diameter, and chase mortises in any kind of wood, from ⅛ inch to 1½ inches in width, and of any length. The construction and framing of the machine are simple and strong; its weight is 27 cwt., the diameter of the pulleys on the bottom shaft and on the saw-spindle is 8 inches, and the speed of the shaft and spindle alike is 1,500 revolutions per minute, the average horse power required being 4-horse. All the cutter-spindles are made of the best mild centred cast steel, running in improved self-lubricating bearings, specially constructed for high speeds and economy of lubrication, as previously described. The saw-spindle is distinct from the spindles carrying the planing and moulding cutters; the saw-table has a vertical traverse for grooving, rebating, &c., and is fitted with an improved fence, adjustable to any angle, and hinged, so as to admit of being turned over the table-end, out of the way, for cross-cutting, squaring-

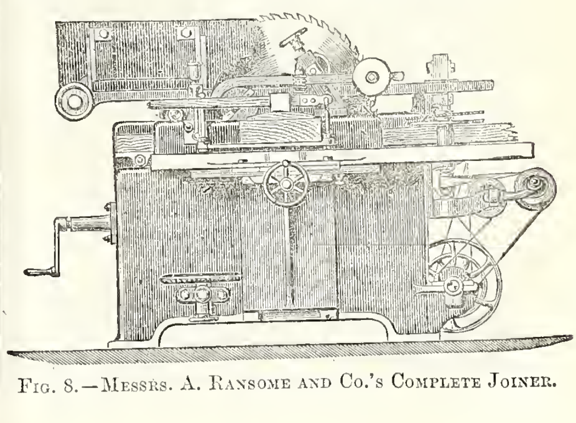


Fig. 8.—Messrs. A. Ransome and Co.'s Complete Joiner.

off, and mitreing. The planing and moulding apparatus is permanent, and always ready for use, independently of and simultaneously with the operations of sawing, boring, or mortising. The top and bottom adze-block spindles run in bearings on each side; the feed motion is variable between the limits of 8 to 16 feet per minute, and both feed-rollers are driven by right and left hand worm-screws, the upper one being arranged and fitted with pressure apparatus, and to rise and fall with inequalities in the wood under operation. Single tenons are formed by cutters (in preference to saws) carried on the ends of the top and bottom planing spindles, the thickness of the tenon being adjusted by raising and lowering the planing table carrying the lower spindle, and the depth of the shoulders is regulated by adjustment in height of the bracket on which the tenoning frame slides. Shoulders of unequal dimensions may be cut if the position of one of the tenoning blocks be varied on its spindle; double tenons are cut, and their shoulders scribed at one and the same time by means of a drunken saw and cutter disc attached to the inner vertical edging spindle of the planing apparatus. For cutting diagonal tenons, a wooden fence is screwed on a sliding frame, against which the piece of wood can be held at the desired angle. For boring and mortising, the augers and twisted bitts are attached to the reverse end of the saw-spindle; the mortising table, with lever and cramp, being laid on the bracket which carries the tenoning slide, which is made to traverse in front of the mortising bitt by the hand lever, while the wood is fed up by hand-wheel till the required depth is attained, adjustable stops being attached to the under side of the table to govern the length, and a square bar stop to regulate the depth, while for boring these stops are so set as not to allow of lateral motion.

In Richard's Patent Mortising Machine, Figs. 9 and 10, Messrs. Ransome exhibit a speciality which presents more than one noteworthy characteristic in regard to the use of a special tool, and the arrangements of the driving mechanism therefor, whereby a high speed of stroke is attained without objectionable vibration. The main standard of the machine is a hollow box-casting, for rigidity, lightness, and strength; and the crank, which operates the chisel-spindle, is fixed at the bottom, near the base-plate, acting by a connecting-rod working in the centre of the standard; thus a rapid reciprocating motion, 600 strokes per minute, is obtained for the chisel. The table on which the wood is laid is adjustable in height by hand-wheel and screw-spindle, so carried on a pedal lever, that the whole may be gradually raised as the chisel enters the wood, working deeper at each stroke, until the total required depth is attained; the form of the chisel is such that chips are extracted at each up stroke, and thus the core is removed in proportion as the mortise is cut. There is a very convenient, simple, and effective automatic motion, governed by a spring stop, for the instantaneous reversal of the chisel. The machine is adapted to take in stuff up to 11 inches in depth, the stroke of the chisel being $4\frac{1}{2}$ inches; the diameter of driving pulley is 12 inches, the average power about 1 horse, and the total weight 15 cwt. In soft wood, and without boring, a perfect mortise can be made in the third of a minute. For use in conjunction with a larger chisel than $\frac{3}{8}$ths. of an inch wide, or in case of mortising in hard wood, and available also as a separate operation, a boring spindle and apparatus is fitted to the machine, as shown, the centres of the augur and chisel being aligned so that the wood requires simply to be traversed from one to the other along the table. The cutting action is effected in this machine without any rending of the fibres, so that mortices may be cut closely adjacent to each other with the thinnest possible partitions between, left uninjured and perfect, and no subsequent core driving is requisite.

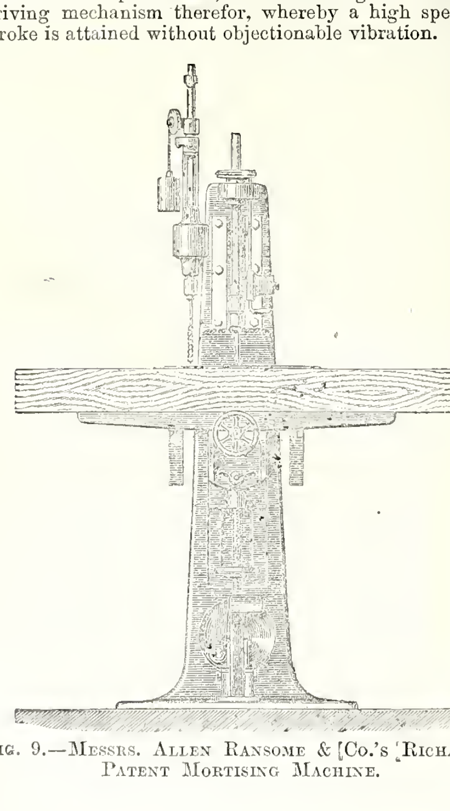


Fig. 9.—Messrs. Allen Ransome & Co.'s Richards' Patent Mortising Machine.

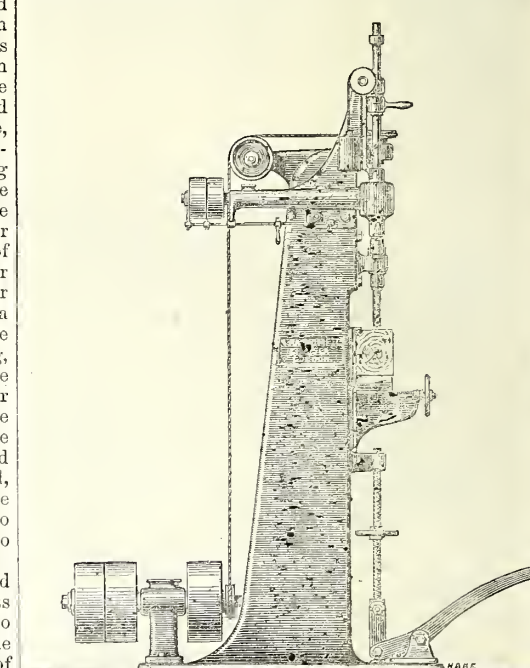


Fig. 10.—Messrs. Allen Ransome & Co.'s Richards' Patent Mortising Machine.

In the series of machine-tools described, all the various parts of a door are severally and separately prepared and finished off to suitable dimensions, and they are then put together and glued up. They then require to be cleaned off and sand-papered to bring them to a smooth, even, and regular finished surface for painting; and these pro-

cesses have hitherto been entirely manual. But Messrs. Ransome have devised, and here exhibit in operation, a special machine for imparting to the work the requisite finish, viz., the Patent Cleaning-off and Sand-papering Machine. The principle of action of the machine is to pass the work to be operated on to and fro beneath a rapidly revolving disc fitted with sand-paper. The door or other piece of work is affixed to a light cast-iron travelling table, fitted with an automatic traversing feed-motion, which is readily controlled by a convenient lever-handle. Above the table, in vertical standards, is arranged a rotating cast-iron disc, driven at 600 revolutions per minute, with raising and lowering adjustments, whereby it can be regulated to suit any thickness of material from $\frac{1}{4}$ inch to 3 inches thick. The disc is framed with sectors on the under side, to which similar shaped pieces of a specially strong kind of glass-paper are affixed. These, passing over the surface of the work, rapidly rub down the inequalities and asperities, leaving a plane and truly-finished smooth surface, equal or superior to anything obtained manually. The disc revolves within a suitable casing, and the dust is removed as fast as made, by a special contrivance, an air current, which keeps the paper cool and promotes its durability. The sector-pieces of glass-paper are readily detached and renewed when worn, at a cost estimated at about 9 per cent., and each setting will last in work some 3 or 4 hours. There are various qualities of glass or sand-paper used with this machine, which is available also for other work, such as shutters, drawing-boards, shelves, stairs, drawer and table tops, counters, &c., and especially for putting a surface on parquetry work. The full-size machine for joiners' work is 3 ft. 3 in. in width, and the travelling table is 8 ft. 6 in. long, with bed of suitable dimensions.

To complete their selection of power machines, Messrs. Ransome also show an Improved Saw-sharpener, which, by means of a rapidly rotating emery disc, tops, gullets, and bevels, both frame, cross-cut, and circular saws, to any form of tooth, entirely superseding the use of a file. The grinding disc works in a counterbalanced swing carriage, brought down by hand, and adjustable to any angle, if requisite, to give any desired amount of lead to the tooth; the same disc being employed for all three operations above specified. Frame-saws are held in a cast-iron vice, traversed under the disc by hand-wheel, rack, and pinion motion; a special vice is provided for circular saws, and both vices are pivoted for any required bevel of the tooth. It is found in practice that the cutting parts of the teeth are hardened, and made more durable by the action of the machine, which is driven at a speed of 700 revolutions per minute for the driving pulleys ($8\frac{1}{2}$ inches diameter), with about half a horse power; total weight 10 cwt.

In the Improved Hand Mortising Machine the chief feature is a vertical sliding adjustment of the table to take in various-sized stuff up to a scantling of 11 inches deep by 6 inches thick. The standard is a hollow casting of strong section, with a broad, firm base; and the machine is fitted with all suitable and necessary traversing motions and other requisite appliances. Another hand machine is the Shute's Patent Mitreing Machine, wherein the moulding or other stuff to be mitred is placed on a level bed, and the cutting chisel is set to slide and operate at an inclined angle of 45 degrees.

Finally, the speciality which particularly characterises the machines of Messrs. A. Ransome and Co.'s series, as exhibited and above described, is their Patent Pneumatic Conductor, whereby all sawdust, chips, and shavings are removed directly from the several machines, so that the woodworking shops are perfectly cleared thereof—a most important and valuable improvement in connection with the machine-conversion of timber of recent introduction, and noteworthy as a sanitary and economical appliance, promoting appearance and convenience, and tending to increased protection against risk of fire. The apparatus consists mainly of an improved blower or blast-fan, with suction and delivery pipes, connected with the machines by suitable hoods, hoppers, or shoots, which, in the case of moulding and similar machines, are arranged so as to rise and fall by means of telescopic slides in the pipes, so that access is readily obtained to the cutters for adjustment or change, &c. Expelled from the fan by the eduction pipe, the wood refuse is delivered into any suitable receptacle, generally placed so as to communicate with the stokehole, so that the whole may be used for combustion in the boiler-furnace.

Various modifications of this effective appliance may be carried out, as, *e.g.*, for keeping sawdust separate from chips and shavings; attaching small independent blowers to each planing or moulding machine, so as only to run when the machine is at work, economising in power, wear and tear; and the like obvious applications, which may be adopted with advantage. In the individual descriptions of the machines, this particular feature was purposely omitted, as coming better here, in the general description applicable to all; but as a particular instance of its utility and effect no better example could be quoted than the Clearing-off and Sand-papering Machine.

(*To be continued.*)

EXHIBITIONS.

International Exhibition in China.—An international exhibition, says the *Academy*, has positively been decided upon in China, and a committee formed at Shanghai for the purpose of organising it, with the English Consul as its president. Messrs. John Bourne and Co., of Mark-lane, have also been chosen as agents, so as to give every guarantee to European exhibitors. All charges of transport will be defrayed by the committee.

TECHNICAL EDUCATION.

The Education of Civil Engineers.

The action taken by the Government in establishing the Indian Civil Engineering College at Cooper's-hill many years after the abolition of Addiscombe, has led to no little discussion among the members of the engineering profession concerning the best method of training a young civil engineer. The revulsion of feeling which has recently taken place in favour of scientific as opposed to merely practical training has met with—if not opposition—at least severe disapprobation from many of the good old school. Advocates of the ancient plan and sticklers for precedent, point to the numerous instances in which men, without preliminary scientific or technical training, have by dogged perseverance blundered on through a practical career to brilliant success. Such instances were indeed common enough in the last generatien, but their *raison d'être* is not very difficult to find. Civil engineering in its extended form is, comparatively speaking, a new thing. Two hundred years ago this country was almost entirely without either roads or canals, and the Marquis of Worcester had only just launched the first crude idea of a steam engine, while the small knot of remarkable men called the Royal Society was busily engaged in investigating those physical laws which have since been applied with increasing success to ameliorating the condition of mankind. *Vixère fortes ante Agamemnona.* There were Roman road-makers before the day of General Wade. Canals were used in China centuries before Brindley was born, and Kublai Khan had a regular postal service long before Louis XI. introduced the system into France and Sir Rowland Hill brought it to perfection in England, but at the period above referred to the triumphs of ancient civilisation were obliterated or forgotten, and

the conquests of the new era were as yet in the "cabinet" stage, the truths of physical science being suspected only by a few advanced philosophers. During the last century, roads, canals, harbours, lighthouses, and tunnels tended to develop a considerable amount of engineering skill, but the world of construction was altogether unprepared for the immense demand created by the sudden and gigantic development of the railway system, steam navigation, iron shipbuilding, and electric telegraphy. These great inventions, which have practically, for all purposes of business or pleasure, reduced the globe to the size of an ancient mediæval empire, were evolved from the attrition of many brains almost at the same instant. Communication was the problem of the epoch and therefore engaged the foremost intellects. Within the decade following the opening of the Liverpool and Manchester Railway the first steamship crossed the Atlantic, the first electric telegraph was laid down, and the successful application of iron to shipbuilding was clearly demonstrated. Without taking into consideration the demand for marine constructors of a new school, and the immense expansion of mining industry, it will be seen that railway, steamboat, and telegraph construction required, not gradually, but immediately, an army of more or less skilled engineers. Inasmuch as in the opinion of experts it requires about a dozen years to convert a promising, well educated youth into a sound engineer, it may be easily imagined that this sudden requirement for a peculiar class of workers could not be at once gratified. The work of the world had for the moment forged ahead of the workmen, who as yet were few and far between. What occurred at this crisis is precisely what might have been expected. Demand created supply. All who had some acquaintance with civil engineering or kindred pursuits rushed to the front at once. Architects and surveyors, marine and mechanical engineers, lawyers, and medical students hastened into the new grooves for which their previous studies had in some measure prepared them. Much of the enormous prodigality of early railway expenditure is to be referred to this cause, and to the tentative nature of every operation. The slowness with which certain fixed principles were arrived at is a standing proof of the empirical spirit which presided over railway construction. Years elapsed, and enormous sums of money were spent, before the battle of the gauges was lost and won. Endless experiments were made in laying down the "permanent way," and for a long while with very slight improvement, for, as Mr. Fowler remarked in his address from the presidental chair of the Institution of Civil Engineers, in 1866, doubts even then remained "as to the best kind of permanent way to be adopted even under similar circumstances." On the Continent the "Vignoles," or flat-bottomed rail had been almost universally applied, while in England the double-headed rail, with its cast-iron chairs and wooden keys, still remained a favourite. So slow had been the application of pure science to railway requirements, that it was not until Mr. Eaton Hodgkinson made his famous experiments, that the comparative resistance of cast and wrought iron to crushing and tensile strains was accurately ascertained. It is also worthy of note that at the comparatively recent date just referred to, but few suspected that steel, both for rails and many other purposes of construction, was about to take the place of iron. Reflection on these important incidents of the century of the straight line, lead infallibly to the conclusion that the success of the great band of English engineers who have knit the world closer together by their stupendous works was due far less to scientific knowledge than to the indomitable energy of the British character, and to that fertility of resource always exhibited by it under trying circumstances. As became a nation remarkable for common sense, England, in default of an army of scientifically-trained engineers, took the best material at hand, and the success of the system, which does not wait for the best possible solution of a problem, but accepts that which happens to be near enough to exactitude to secure a fair working power, has been demonstrated by the excellence of much of the work done. Absolute perfection could not be achieved at once, and the great army of English engineers—with a few memorable exceptions—learnt its profession as it went along, much as the Americans, during their great civil war, fought on till they acquired rare military skill by dint of experience.

In periods of transition this empirical style of work is well enough. When a new force is discovered, he is the best friend of the human race and the best guardian of his own interest who first adapts it to the practical wants of mankind. In this great race of railway, steamboat, and electric telegraph construction, England seized and manfully held the first place. But slightly acquainted with science, her engineers distanced those of other nations by their immense power of work and the promptitude with which they corrected a mistake when they found it out, the practical knowledge acquired in the actual work which was thrust upon them stood them in good stead, and so great was their success that for a long while it was not uncommon to point out the advantage of an English over a foreign engineering education.

During the last few years this opinion has undergone considerable modification. Doubts were entertained whether the "rough and tumble" training which sufficed when the world cried aloud for civil engineers would not be found wanting in these latter days, when youth of the rough and ready school would find employment eagerly competed for by scientifically-educated foreigners. It was felt that as the unhappy victim of a "scratch" education is ever apt to stumble in his "quantities," and become the scorn of a person who, albeit not possessing a tithe of his intellectual vigour, has yet enjoyed the advantage of a regular academical training, so the smart boy taken at the age of sixteen from school, thrown into an engineering shop for two or three years, and afterwards allowed to drift about for a while in the office of a civil engineer, would find himself taken at a disadvantage by a competitor whose practical education had been delayed for some three years in order that his knowledge might be placed upon a thoroughly scientific basis. The difficulty of inducing, and in many cases of enabling, young men to carry on concurrent courses of theoretical and practical study was felt to be very great, and many excellent authorities deemed that the time spent in preliminary scientfic training in subjects involved in the craft would not be wasted by the young civil engineer, whose widened sphere would enable him to bring possibly new lights to bear on his special line of study. A careful comparison of the English and Continental methods of technical instruction revealed that, despite the excellent work done by our own countrymen, indications were not wanting that the foreigner was gradually making up his lost ground, and would ere long be enabled to compete on equal terms with the English engineer.

At the French Polytechnic School, where French engineers, being public servants, are educated in great part at Government expense, admission is secured by competition, and the spectacle is afforded yearly of some eight or nine hundred picked pupils, of eighteen or nineteen years of age, competing for the one hundred and fifty appointments annually made. It is of course hardly fair to call this a matriculation examination, inasmuch as an admission to the Polytechnic School includes—subject to passing subsequent examinations—the certainty of being employed by the Government in some capacity or other. In the opinion of Professor Fleeming Jenkyn, "There exists no competition in Europe comparable with this. The great severity of the examination is so well known, the fact that five out of six must fail is so obvious, that none but young men who have already gained distinction in the great public schools dream of competing. But the select one hundred and fifty are a long way yet from the practical part of

their profession. For two years longer they are employed in purely theoretical studies, that is to say, the higher mathematics, theoretical mathematics, mathematical physics, curious problems in descriptive geometry, with a little drawing and language as recreations. During each of these two years each of the one hundred and fifty is engaged in a daily struggle for about five and twenty highly coveted posts. The three which are at the head of the class list at the end of the two years gain the proud title of engineers of mines, the rest are humble members of the *Ponts et Chaussées*, while the one hundred and twenty-five who fail have to content themselves with looking after the State factories for powder, tobacco, or saltpetre—or, worse still—in their estimation—they sink into mere military engineers or artillerymen; they may even sink as low as the navy or marine artillery, for strange as it may seem with our misconceptions of the French character, the civil appointments rank infinitely higher in the estimation of the competitors than the military posts."

Having at the age of twenty-one not yet got to practical work, the student attends for three years more the school of *Ponts et Chaussées*, where he is taught to apply theoretical knowledge to practical problems, and for six months in the year he is sent into the country to see some practical work, and has henceforth an easy life. Only at the age of four or five and twenty is he sent into the provinces to begin real work, which is after all very much a matter of routine, and the brilliant mathematician is henceforth condemned to the hum-drum life of a Government *employé*, in which he has little scope for the exercise of great or original power.

No two plans can be more opposite than the French system and that till recently prevailing in England, where youths at about the age of eighteen, without preliminary training, and taking their chance of a few months in an engineering workshop, picked up their knowledge as they worked at drawing or surveying. In fact, the old English system closely resembled the plan once pursued by those ambitious to become barristers learned in the law. A graduate of Oxford or Cambridge, after leaving college, came up to London, and read for the law. Whether he read much or little, provided he ate the regular number of dinners in hall, he was in due course admitted to the outer bar. As the young lawyer placed himself under the care of a special pleader, so did the young engineer enter the office of a magnate of his profession. The failure or success of either depended very much on the pupil himself. There were no guarantees against incompetency, such as are supplied by the Matriculation Examinations at the German technical colleges, and the Competitive Examination at the French Polytechnic School. Like the barrister, the young engineer took his chance, and underwent the operation of the laws of natural selection. If clever, he utilised his opportunities, and obtained employment—if incompetent, he was weeded out in the struggle for existence, or rather was quietly left to "blush unseen" in inglorious idleness.

At the great technical schools of Germany and Switzerland a system equally removed from those pursued in England and in France has long been in operation, and has produced the most excellent results. In the opinion of Mr. Scott-Russell—no mean authority—the railways made by natives in the educated countries of Germany and Switzerland have been made far cheaper than those in England. He declares that except in the one important item of speed, their railroad system is far superior to ours, and that their works abound with marks of that method, order, symmetry, and absence of waste which arise from plans well thought out, the judicious application of principles, conscientious parsimony, and a high feeling of professional responsibility. The accurate cutting of their slopes and embankments also exacts high praise from him, but it must not, in justice to English engineers, be forgotten that they were the pioneers who had to make the first railways, and to hew out the principles since so successfully applied in Germany. Nevertheless, taking the world as it stands, it is impossible to regard the technical schools of Zürich and Berlin, Saxony and Bavaria, Austria, Würtemberg, and Baden, without respect and admiration. Differing in minute particulars, they agree in certain main characteristics. A severe matriculation examination protects them against incompetent pupils, and those who are admitted are put through a complete course of scientific and practical instruction, extending over four or five years, during the latter part of which they are allowed to direct their attention—like our own pupils of the School of Mines—to the special walk of life that they intend to follow. From time to time they are examined both in theory and practice, are taught surveying in the field, and allowed, when possible, to take part in actual construction.

This admirable system of relieving the dry severity of purely theoretical study with the interesting practice of actual work combines the advantages of the two adverse methods pursued in England and France, in both of which countries it has been curiously assumed that it is impossible to carry on theoretical and practical instruction at the same time. This singular view was evidently not concurred in by Mr. Fowler, who in the luminous address which appears to have suggested the subsequent inquiry into the "Status and Education of Civil Engineers at Home and Abroad," pursued by the Institution of Civil Engineers, sketched a comprehensive scheme which has been pretty closely followed by subsequent writers on this subject. The work of the civil engineer covered a large area, requiring the application of almost every branch of scientific knowledge. Liable to be called upon at any moment to construct railways, roads, canals, water-works, sewerage, gas-works, docks, and harbours of refuge, and to conduct mines, quarries, iron-works, and generally all large works connected with steam-engines, machinery, and iron shipbuilding, the young engineer was embarked in a profession presenting no common difficulties, and involving from its close connection with commercial enterprises, responsibilities and obligations of no common kind. His mission was not to construct magnificent bridges or stupendous works for the mere purpose of displaying his professional attainments, but his duty was, whatever might be the temptation, not to sacrifice shareholders at the shrine of beauty, but to accomplish the end of his employers by such means as might be found best and most economically adapted to their purpose. To this end he was to render himself master in the first place of the nature of the materials employed. To the proper understanding of the various kinds of stone, a knowledge of chemistry and geology was required, and the neophyte was reminded that Sir Christopher Wren—engineer as well as architect—himself selected the quarries, and sometimes even the individual blocks of which his structures were composed. An exact knowledge of the properties of various kinds of bricks, mortar, and cement was imperatively required—even to the extent of submitting certain kinds of lime to chemical analysis. A perfect acquaintance with the various qualities of iron employed in construction was also needed. In his preliminary studies, the engineer was not to regard specially the branch of the profession to which he proposed ultimately to devote himself, but should make his studies as extensive as possible, in order to embrace every branch of his profession, including even the legal knowledge so useful in contesting cases before a Parliamentary Committee. Subsequent, and only subsequent to a general scientific training, the student might devote himself to a special branch, and after acquiring a special knowledge of the whole range of the profession, concentrate his attention and accumulated knowledge upon the calling of a railway, hydraulic, mining, or telegraph engineer. To carry out this comprehensive programme, the life of the student was to be divided into four parts. Firstly, that of general instruction—a liberal education up to the age of

fourteen. Secondly, of special instruction from fourteen to eighteen, devoted to mixed mathematics, natural philosophy, land surveying and levelling, drawing, chemistry, geology, the strength of materials, mechanical motions, and the principles of hydraulics. The third period was to be passed in acquiring technical knowledge in an engineering shop; and the fourth to preparation in the office of a civil engineer for actual practical work at a period of life—twenty or twenty-one—when under reasonable guidance a young man might work out the details of his profession for himself. To find time for all this work was the problem, and it was suggested that in order to find leisure for all these positive studies and the acquirement of the German and French languages, the student should after the age of fourteen sacrifice to a considerable extent the classics and pure mathematics. Speaking in 1866, before the scientific colleges at Newcastle, Manchester, and Dublin had attained their present proportions, Mr. Fowler hinted that after a course in the workshops, the student might pick up his liberal education, and take a degree at Oxford or Cambridge before entering an engineer's office, a practice which, from the interruption it would occasion in a general course of technical education, would hardly be commended at the present moment.

The importance of a concurrent study of theory and practice has been recognised at the Indian Civil Engineering College at Coopers-hill, whereto pupils between the ages of 17 and 20 years are admitted after a competitive examination, which, although the number of marks given to Greek and Latin (1,000 each) will appear to many positive minds exceptionally high, is very fairly constructed with reference to the plan of education pursued in this country. At the conclusion of a three years course a final examination is held, which, in addition to paper work and *viva voce* questioning, will embrace "exercises in surveying, drawing, designing, and estimating," and Latin, Greek, French, and German will be optional subjects, the "marks" gained in which are included in the aggregate required for qualification, although no instruction is given in them in the college.

The establishment of this college is a step in the right direction, and it is not impossible that many of the principles embodied in its constitution will meet with general acceptance by the profession. For far too long a period theory and practice have been in this country assumed to be in some mysterious way antagonistic, and practical skill has been unduly exalted at the expense of accurate scientific knowledge. The heads of great engineering establishments confess, while they deplore, the difficulty of carrying on simultaneously practical and theoretical instruction. During the period of probation passed in the workshop, the pupil is apt to be a source of annoyance to his master and of loathing to those who are, for the time being, his fellow-workmen. The articled pupil is apt to "run loose," and by his inconsequent behaviour become a stumbling-block unto the regular worker. Day classes only add one more element of disorder to an already incongruous state of things, which leads many great masters to decline pupils altogether.

The solution of the difficulty appears to lie in the encouragement and multiplication of scientific colleges holding evening classes in the great centres of manufacturing industry, so as to afford the English student opportunities of carrying on his theoretical education during the interval which it is generally agreed must be devoted to working in the engineering shop, and thus acquiring that practical knowledge of mechanical engineering which is indispensable in every branch of the craft.

The value of money coined by the mint of the German Empire up to the present day amounts to 1,044,300,440 marks, of which 841,348,680 marks are in pieces of the value of 20 marks, and 202,953,620 marks in 10-mark pieces. The silver coinage amounts to a sum of 21,491,185 marks, of which 21,109,602 marks are in 1-mark pieces. The value of the German mark is about one shilling.

GENERAL NOTES.

The Channel Passage.—A French journal describes a new means for diminishing the horrors of the Channel passage, which has been devised by M. Tellier, and may be regarded as a development of the system of Captain Dicey on an extended scale. Instead of two, M. Tellier joins together four large vessels, 250 metres (820 feet) long, by 45 metres (147 feet) wide. These vessels, constructed in a substantial manner and divided into water-tight compartments, are united by a common deck, forming an immense raft, on which are arranged all the appliances necessary for the passengers and merchandise. M. Tellier intends even to lay down a line of rails on this deck, so that a whole train may run on to it for being carried across the channel. The vessels will serve as floats, carrying nothing but their engines, their coal, and the necessary machinery for working them. In order to avoid, or rather to lessen the impact of the waves, the inventor fixes firmly to each side of the vessel, and forming with it an angle of about 45°, an iron plate 12 millimetres (less than ½ inch) thick, hoping that the waves will break upon this surface as they do upon the shore, and thus have less effect upon the raft.

Mechanical Vibration Retarding Rust.—At a recent meeting of the American Association for the Advancement of Science, Professor S. S. Haldeman, of Harrisburg, read a paper with the above title, of which the following is a brief abstract:—When railroad bars are piled beside a road they soon become rusted, while those forming the track are but little subject to oxidation; and when a rain of some hours' duration falls upon rails when in a state of rest, as upon Sundays, when trains do not run, they soon exhibit rust. This would seem to indicate that in chemical combination mechanical vibrations may interfere with the molecular arrangement of the elements. The accuracy of these casual observations should, however, be submitted to the test of experiment. In the discussion which followed this brief communication it was suggested that possibly the oil employed upon locomotives might be more or less spread in a thin film over the rails in use, and thus prevent their oxidation. This view was earnestly combated by other speakers. Professor Van der Weyde was quite certain that the suggestion of Professor Haldeman bore reference to a fact in physics. Molecular vibrations tended to prevent rust. A saw hung up, unused, would soon become rusty; if used, would keep bright. This was a general experience with tools.

Cornish Sardines.—An attempt is now being made to establish a new industry in Cornwall by the preservation of the smaller pilchards in the same way as sardines are prepared. It appears that, notwithstanding the great abundance of pilchards, and the enormous captures which are made, very few of these fish find their way into the English market. The fresh fish are too delicate to bear land carriage, and those that are preserved are cured in a manner which finds no favour in this country, and are exported to Italy. In 1871 as many as 45,682 hogsheads of pilchards, or more than 135,000,000 fish, were sent abroad; but probably not more than 1,000,000 cured fish were consumed at home. The price of pilchards when fresh varies from 5s. to 25s. per 1,260, and when cured they have been sold at from 26s. to 102s. per hogshead, the oil extracted from them being worth from £25 to £40 per ton. The cost of curing varies from 15s. to 25s. per hogshead. The fact that this trade only partially utilises the larger fish and entirely ignores the immense quantities of small delicate pilchards frequenting our shores, together with the great fluctuations in the value of the fish when cured, acts as a discouragement to enterprise on the part of the fisherman, and involves a loss to the nation of a valuable source of food supply. In many instances when large shoals of small pilchards have been enclosed in seine nets, they have either been sold for manure or liberated as not being worth the cost of curing. The identity of the pilchard of Cornwall with the sardine of France seems now undisputed by naturalists, and there seems no reason why a similar trade to that now carried on in France should not be established in Cornwall.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Mon. ...Society of Engineers, 6, Westminster-chambers, 7½. Mr. Perry F. Nursey on "Mechanical Puddling."

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The fourth lecture of the third course of Cantor Lectures for the past Session, "On Carbon and Certain Compounds of Carbon," was delivered by Professor Barff, on Monday, May 4th, 1874, as follows:—

Lecture IV.

In my last lecture I spoke about the combining volumes of those elements that we have to consider in this course of lectures, but it appears from what I have since heard that my method of stating the matter was not so clear as it ought to have been, and I have therefore brought this evening some models which will give you, I think, a very good idea of the actual volumes which I then spoke of. In order, however, to make the matter perfectly plain to all, it is necessary that I should for one moment detain you to speak of the conditions under which we measure gases, because I am quite sure that many of you, who probably on the last occasion for the first time heard this subject mentioned, will be in some doubt as to how substances which you know do not exist as vapour or gases at the temperature at which they are measured, can be so estimated as to volume. If you take a bladder or an indiarubber air-ball, and partly fill it with air, and put it under the receiver of an air-pump and exhaust the air in the receiver from around the outside of the bladder, then the air-ball or bladder will expand and become full of air. It is quite certain that no air has got into it, that there is the same weight of air in it as there was when the experiment commenced. Now if the bladder be full it is certain that the particles of air inside it must be at a greater distance from one another than they were when the bladder was only partially filled, so that any quantity of air within the bladder taken by measure will weigh less, than the same quantity of the air taken out of the bladder before the air about it was exhausted, that is to say, a cubic inch of the air will weigh less than a cubic inch of the air before the exhausting process commenced. Now, inasmuch as the density of the air in this room, or the density of the air in any common elastic vessel in this room, depends upon the density of the column of air which is pressing upon it above the surface of the earth, it is quite certain that when a column of air weighs less, and when the barometer stands low, the weight of a cubic inch of air in any elastic vessel will be less than when the column of air weighs heavy, and the barometer stands high. Now 760 millimetres of mercury, or 30 inches, is said to be the normal height of the barometer, and when air is under a pressure of 760 millimetres, you can easily calculate the density of the air if you take the pressure under which your own observations were made. Now suppose the air-ball to be taken out of the receiver of the air-pump, and to be put before a fire or into some chamber where it can be warmed, then the bladder will expand, for the air expands as its temperature rises, and therefore when the air-ball is tight in this case, as in that where the air about it was exhausted, a given volume will weigh less than the same volume would weigh if the air were not heated. It is quite certain then that when we measure our gases, we must measure them at a fixed pressure, and at a fixed temperature, and the fixed temperature is that of 0° (zero) Centigrade, the temperature at which water freezes and ice melts. If we want to get a volume of a substance which is not volatile at so low a temperature as this, say for instance the density of steam, we have to heat a known weight of that substance up to a higher temperature than that at which it exists as a gas, and then having ascertained the volume at that particular temperature we have to reduce it by a system of calculation to the volume which it would occupy at 0° C. under a pressure of 760 millimetres of mercury, if it were a fixed permanent gas. This is done by a very simple calculation. It is found if a gas be heated from 0° C. to 1° C. above that temperature, its volume increases by $\frac{1}{273}$ of what it was at 0°. If, therefore, it is heated up to 273° C., its volume will become doubled, so that if a gas is taken at 273°, and you begin to reduce that temperature, then it loses $\frac{1}{273}$ of its volume for every degree, and gradually it comes down; until at last if you cool it down to 0°, it occupies the same volume as it did when you started. Suppose then you wanted to determine the volume of a gas at a certain temperature above 0°, you have only to take this ratio—273° volumes at 0° become 274° at 1°, and at 273° they become doubled. Then if you have, say 5 litres of a good gas at 0° C., and you want to determine their volume at 10°, then 273° at 0° C. would become 283° at 10°, and you have this ratio, 273 : 283 : : 5 litres : X, or what you determine as the result of your calculation. I have mentioned this to you briefly this evening, because it may help some of you when you are reading books of chemistry to understand the processes which chemists apply. If I take a known weight of water, and find its volume as steam at 110° C., it is quite certain that by that calculation I can find out what its volume would be at 0° C., as if it were a permanent gas.

When we speak of a definite weight of a gas occupying a definite volume, we mean that it always does so at 0° C., and under a pressure of 30 inches, or 760 millimetres of mercury. Now, two of these cubes on the table represent each a measure of 11·2 litres, that means that a vessel the cubical contents of which is equal to this box, would contain 1 gramme of hydrogen gas at 0° C., and 760 millimetres of mercury pressure. Of oxygen it would contain 16 grammes, and of nitrogen 14. We shall have to speak of nitrogen in our next lecture. Here we have four of these cubes, and they will contain 4 × 11·2 litres, or 4 grammes of hydrogen. Now, suppose we could vaporise carbon, which we cannot do, 12 grammes of carbon in the state of vapour would occupy the volume of this box, or 11·2 litres. So what we have here then are 11·2 litres of carbon vapour and 4 × 11·2 of hydrogen, and these uniting together form 2 (11·2) litres of the substance of which I described the properties to you last week, viz., marsh gas. Therefore, when this volume of marsh gas, 2 (11·2) litres, is decomposed, it is resolved into, not this volume of vapour of carbon, because it cannot exist as vapour, but into 12 grammes by weight of solid carbon, and 4 (11·2) litres of hydrogen. Therefore the volume of hydrogen is double the volume of the marsh gas from which the hydrogen is obtained. I hope now I have been able by these models to make the subject of volumes clear.

Now we pass on to consider fuel, the formation and composition of coal. Most of you know that coal was originally wood, *i.e.*, vegetable matter; wood which, under excessive pressure in the presence of moisture and at a suitable temperature has become slowly converted into the substance which we call coal; and

what are the changes which wood undergoes when it is put under these conditions. No doubt you remember the experiment which I performed the other evening when I had a bottle of sawdust, and we led the products of its slow decomposition when moistened through materials which could absorb the carbonic acid that was formed, and we proved after that, by passing the residual gas through hydrate of baryta in solution, that no carbonic acid was present. We then passed the other products of decomposition over heated black oxide of copper, which gave up some of its oxygen to the gas passing over, and carbonic acid was formed. In that instance you saw that a gas, which I explained to you contained carbon and hydrogen, was formed by the slow decomposition of that sawdust. But what physical changes took place in that sawdust? Of course, in the short space of time during which the experiment lasted, no apparent physical changes took place, but I dare say many of you noticed that the sawdust looked like coffee grounds; it was not white, it was not light-coloured like this fresh sawdust; it was becoming what is commonly called carbonised, it was losing certain of its constituents, carbonic acid and marsh gas, and it was losing the elements of water. There are various ways in which the formation of coal is accounted for—first, by the elements of water leaving the vegetable matter, then by the carbonic acid, and then by the marsh gas being given off. It is most probably formed by the loss of all these. Now see what would be the result of wood or vegetable matter losing the elements of water? The composition of cellulose, the principal constituent of vegetable matter, is $C_6 H_{10} O_5$. C means 12 parts by weight of carbon, and of course C_6 means 6×12 parts. H_{10} means 10 parts by weight of hydrogren, and O_5 means 5×16 parts by weight of oxygen. Cotton is a fair representative of cellulose or woody fibre, but you have so lately heard from Dr. Graham all about woody fibre, and certain of the changes which take place in it under certain conditions, that I need not repeat them to you this evening. The changes that I am going to notice are somewhat different. Suppose I take this quantity twice, that will be $C_{12} H_{20}$, and O_{10}. We will call the first a molecule of woody fibre, and we will call these two molecules. Now, suppose I take from these two molecules the one molecule of water, we shall then have remaining $C_{12} H_{18} O_9$. Now it must be manifest to every one here that this compound contains more carbon than the other does in proportion to its other constituents, and if we go on doing the same thing, doubling the formula of the new substance, and taking away the elements of water from it, we shall get a substance containing more carbon still, and at last we can go on until we can get a substance known under the name of anthracite coal, which contains about 94 per cent. of carbon, and we could even imagine the process going on so far that eventually pure, or nearly pure graphite would be left. Here, then, it is quite easy to conceive how such changes as these effect the decomposition of woody fibre, and convert it into that substance which we call coal; again, we have had an experimental illustration of this fact, that carbonic acid and marsh gas are given off during the process, so that the loss of these two would change the composition of the woody matter, and produce a substance which would be rich in carbon compared to the substances from which it was originally formed. We may, then, imagine this to be the chemical method in which coal is formed. That it is of vegetable origin there can be no doubt. More than 500 different amples of plants have been found in coal, and 250 ferns of the most beautiful structure. There is no question about that. That it was once submerged beneath the ocean is not only not improbable, but it is almost absolutely certain, for we find in the coal traces of a substance which must have come into it in some such way as this. We find sulphur there, and we find iron pyrites there. From whence could the sulphur come? From the sulphates of the sea—from the sulphate of calcium which gets reduced by the action of marsh gas, for marsh gas, like hydrogen, is what is call a a reducing agent. That means, that it takes away oxygen, so that at last, in the presence of the iron which was there, sulphide of iron or iron pyrites would be formed, which is seen in masses as a beautiful chimney ornament, sometimes said to be the result of thunder, and therefore called bolts. When it is broken it shows a radiated structure with a bright metallic lustre. That substance, which contains 56 parts by weight of iron, and 64 parts by weight of sulphur, is called bisulphide of iron, or pyrites. I mentioned this because it is in this way that this substance, which is a trouble to the ironmaster and iron-founder, comes into the coal; and it is a matter of great importance to all who have delicate chemical operations to carry on by the aid of heat from coal, where the presence of sulphur is injurious. We know perfectly well that, although the ironmaster may select his iron ores as free from pyrites as possible, if he use coal containing sulphur, sulphur will be present in the iron, and it is a most injurious substance to have in iron, so that the presence of sulphur in iron, as regards arts and manufactures, is one of considerable importance; and it holds out to you who have inventive genius the desirability of turning your attention, having made yourself sure upon the scientific part of the question, to means by which sulphur can be eliminated from fuel. There is a fine opening to anyone if he can succeed in doing that for making a gigantic fortune.

Coal is of different kinds; we have good coal and bad coal. We have coal that will cake, and coal that will not cake. Those coals which will cake are usually what are called bituminous. We have many kinds of substances which we get from the earth under the name of coal, from bituminous shale down to substances which are very little better than fire-clay. Householders can form an opinion as to the quality of coal from the appearance of it. Some coals are brittle and break readily, and have a shining surface. These appearances are promising, and generally denote that the coal will burn well. Then there are those which have a slatey appearance and break in *laminæ*. Those, as a rule, are not such good coals, and not such economical ones for use. They are generally found to contain a large percentage of ash or cinders, not that cinders are the ash of coal really, because in cinders there is a large portion of combustible matter very often thrown away. The coal which contains most of this bituminous matter is the Boghead cannel coal. It is found in the neighbourhood of Wigan, and in small quantities in some other places. It is known to be a very bright burning coal, and people often put it on their fires in winter when it is desired to produce a bright blaze and a cheery light. Those of you who have used it know that it crackles and the pieces fly about, not out of the grate, but in the fire. This is the peculiarity of it, that its fracture is square and laminated if broken in one way, but concoidal if broken in another. There are some samples of it on the table; it is a coal which may be polished, and which is used for making ornaments in imitation of jet; the difference being, however, that they are heavy, whilst those made of jet are light. Now we come to anthracite coals, which vary in their composition and in their usefulness for household purposes. Anthracite, as I mentioned just now, contains about 90 or 94 per cent. of carbon, that is the South Wales anthracite; the coal obtained in Munster, Carlow, and other provinces of Ireland contains a very large quantity of sulphur. The better kinds of anthracite contain about ·9 per cent. of sulphur, or nearly 1 per cent., but there are many varieties which contain a much larger per centage, even as high as $2\frac{1}{2}$ or 3 per cent. It is quite manifest that for any purposes, such as I have mentioned, metallurgical and others of that class, coals containing sulphur must be very injurious; and also for making gas.

What I have more especially to call your attention to now is the heating property of coal, for that is what

we have to do with practically, and how to determine that heating property. If you take several samples of coal and burn them perfectly, so as to burn away every trace of carbon, hydrogen, and oxygen from them, and leave nothing but ash behind—which contains a silicate of alumina, some oxide of iron, some have found traces of oxide of lead, but the principal constituents of the ashy matter are silicate of alumina and oxide of iron—and if you first of all weigh the coal, and then weigh the ash, you get the relation between the weight of the coal and the weight of the ash obtained from it. I have been told that a gentleman has been experimenting on this subject, and has come to results which lead him to believe that the heating powers of average coal are inversely in proportion to the ash—the less ash the greater heating power. If this be true, and there is no reason to doubt it, it would be very easy to determine the heating power of coal. Persons in private life could easily have an apparatus made by which they could burn away the coal and weigh the ash. All you want is a fire-clay cylinder open at both ends, through which a current of air would pass, then put the coal in a porcelain dish, after having weighed it with accuracy, and allowing the air to pass through while at a red heat, the whole carbon, oxygen, and hydrogen would go away, and you would have nothing left but the mineral residue, which can be weighed.

But there is another method of determining the heating power of coal, which is an extremely interesting one. In this glass vessel I have a known volume of water—two litres. In this small copper cylinder there is a known weight of coal, which is mixed with certain substances, which at a high temperature will give up their oxygen to it, and will burn it; for it is not necessary in all cases that we should have air, or the gases of air, to burn such substances as coal; we can put with it substances containing oxygen which will part with their oxygen readily, and thus, at the proper temperature, carbonic acid gas and water are formed, and a perfect combustion of the coal takes place, as perfect as in atmospheric air. We have a known weight of coal here, and we have a powder containing enough oxygen to burn that coal, and when that coal has been burned it will have given out all the heat which it can give out. I may mix it with chalk or with lime, or with anything else, but it will not make it give out any more heat. There is a certain quality of carbon which on burning will give out a certain quantity of heat, and a certain quantity of hydrogen which will give out a certain quantity of heat, and no more. Around the bottom of this cylinder there are holes to allow the escape of the gases generated in the combustion of the coal, and the whole of the heat will be communicated to the water. There are, however, certain sources of loss of heat, which have been tested, and it has been found by experiment that these losses, by radiation from the vessel, &c., amount to 10 per cent. Therefore, when we have determined the heating power of the coal according to the best of our ability by this apparatus, we have to add to it 10 per cent. The first process is to take the temperature of the two litres of water in this vessel, which appears to be 16° C. Then the coal is ignited by means of a piece of tinder at the top of the cylinder, and it is then lowered into the water, and you notice there is immediately a violent action going on under the water. The whole of the heat, minus the 10 per cent., which will be lost, will be transferred to the water, and on removing the cylinder and again inserting a thermometer, we shall find the rise of temperature in the water. Although this experiment gives very satisfactory results, it would be much better if we could determine the heating power of coal by simply burning it down to an ash and weighing the residue. If any one is inclined to use one of these apparatuses, he will find there is a mark upon it, showing the quantity of water to be used, viz., 2,900 grammes, and the thermometer sold with the apparatus is one marked according to the degrees of Fahrenheit. I am using a Centigrade thermometer and French measures, because it is more easy to make the calculations. The temperature is now 24°, so that there has been a rise of 8° in the temperature of the water. Now, how are we to determine the quantity of heat? I must detain you for a moment while I explain to you what we call a unit of heat, which I hope I shall be able to make intelligible to you in a few words. Mr. Lewis will put one measure of boiling water into one of these glass vessels, and two measures of water at the same temperature, 212° F., or 100° C., into the other. It will be perfectly manifest that the temperature of both will be the same; but now, suppose he adds to each of these vessels one measure of cold water, then the temperature of the water in the two vessels will not be the same. It is evident, then, that temperature and quantity of heat are not the same, for we must have twice as much heat in this vessel, which contained twice as much hot water at the same temperature as in the other vessel. Temperature is intensity, that power which heat has of making itself manifest to our senses, or to thermometers which assist our senses. It is true, and you will not doubt it, that when this vessel full of water is at 100° C., it contains a certain quantity of heat; and it always will contain the same quantity of heat, provided the same material be heated, viz., water. Now, suppose I take this vessel full of water at 0° C. that is, at the temperature of melting ice, and then were to heat it one degree, and suppose I were to say that is our measure of heat, and suppose I was then to heat it two degrees, it would have the power of doing more work, or of heating more water than it had when it was heated to only one degree; in fact, it would have twice the power, and we should say there were two measures of heat or units. If I raised it three degrees, there would be three units of heat. I am taking that vessel full of water at 10° C., as my unit of heat, or I may take the other large vessel, or any quantity I like; it does not matter what it is which I call my unit of heat provided I adhere to it, then I can measure heat in other bodies by it, or according to it, as a standard. We are accustomed to take as a unit of heat the amount of heat which will raise the kilogramme of water 1°C. In some books you will find taken as the unit of heat the amount of heat required to raise a gramme of water one degree. It is quite certain that if you can take as the unit of heat the amount required to raise one gramme of water one degree, then the amount of heat required to heat a kilogramme would be 1,000 times as much. It does not matter what unit we take so long as we keep to it and use it consistently. Suppose I take a unit of heat here to be that amount of heat which will raise one kilogramme of water 1° C., I have two kilogrammes here. Now it is clear we have raised the temperature of this water 8°. If I had a kilogramme raised 1°, that is one thermal unit; if two are raised 1°, that is two thermal units; and if I have 8, that is 8 thermal units. Then I have here as much heat as will raise 16 kilogrammes of water from zero to 1° C. In that way you see how easy it is to determine the heating property of coal, or any other substance. I need not go through the calculation on the board. If you were to take as the thermal unit the amount of heat which was necessary to raise the gramme of water 1° C., then it is simply to multiply our result by 1,000, and then you will have 1,000 thermal units in your kilogramme raised 1°. If Mr. Lewis will add an equal quantity of cold water to each of these, you will find the one that contains the most hot water will be the hottest, or be at the higher temperature. Thus I have been able to show you a practical mode by which you may determine the heating property of your coal, and those who are engaged in scientific investigations upon the subject of combustion will find this a useful mode of trying the experiment; and I should advise them to try the other process, by making a combustion of coal and weighing the ash to see if they get similar results.

There are other fuels used besides coal. Peat is used

as fuel; and there are some specimens on the table lent me by Mr. Dodd, who has an office in Park-street, Regent's-park. There are specimens of peat in the ordinary form and in the compressed form. The difficulty that has been met with in introducing peat as a commercial article, at such a price that people will purchase it and use it, is that it occupies so much bulk, and there is a difficulty in compressing it. The water contained in bog peat is in little cysts, as it were, and if you submit it to pressure you have, in fact, to fight against incompressible water. The only way is to cut it up, and I believe that is now being done by rotating knives, and when so cut up it can be compressed, and you see some specimens of it on the table. Of course there would be an advantage in using peat fuel for certain purposes, because it does not contain sulphur as coal does.

Here is a little experiment to show the effect of abstracting the elements of water from a body. There is a piece of white wood, and here is a liquid which will take away the elements of water from wood. If I immerse the wood in this substance, you will see it immediately turns brown, and if I pour some of it on some sawdust it will become black almost immediately. In the same way, you know, when you turn over heaps of decaying leaves in a shrubbery you find the leaves inside the heaps are generally quite black. The leaves are gradually approaching to the constitution of coal, and assuming this dark black appearance.

Now what are the effects produced by sulphur in coal? If you go into any of the country villages in Carlow you will find they burn anthracite coal there, and if you ask them whether they like it, they will tell you it gives a very hot fire when it is lighted, but it is very difficult to light, and that they cannot use iron fire-bars, because the sulphur burns away the iron. The effect of sulphur in coal is to destroy iron or copper. The effect will therefore be to corrode the metal, pipes and small fastenings in connection with the engines through which the vapours pass; and it is therefore most desirable that sulphur in coal should be got rid of. Another effect which it produces, and which we have all, no doubt, often experienced when travelling in railway tunnels, is the offensive odour that it gives off. That offensive odour is not always owing to sulphurous acid, but sometimes to sulphurretted hydrogen; but in railways where they are obliged to condense their steam during their passage through the tunnels, and when the products of combustion pass out dry from the chimney into the tunnel, then you get the sulphurous acid in all its vigour. It comes out mixed with a large proportion of carbonic acid. Is this substance injurious to health? It certainly is most offensive, but is it injurious? Before I came here this evening I opened a chemical treatise, to see whether anything was said about the action of sulphurous acid on the human subject, and I found it stated that when it is breathed in large quantities it perfectly stops a person's breathing, and produces asphyxia; when breathed in small quantities it is said to produce catarrh. I did not go to a medical source for this, but to a chemical treatise, and there it mentions this injurious effect. Now we know that catarrh is not pleasant to have; it is an affection of the membranes lining the nose and the fauces, and the back of the mouth. This is called simple catarrh; but then there is a form of catarrh which is worse, because the lining membranes of the nose and the mouth, and of the fauces, are exactly the same membranes as those which line the windpipe or trachea, and it is the same membrane which lines not only the windpipe but the branches of the windpipe, or bronchial tubes, the disease of which is called bronchitis. The bronchial tubes branch off from the windpipe and ramify into the structure of the lungs, forming excessively fine capillary tubes. These are all lined with a membrane of the same kind as that which lines the mouth and the nose, and they are all connected together, so that what affects one may, under certain circumstances, pass on to affect the others. It is true that the lining membranes of the mouth are exposed to the direct action of the air, whereas the others are not so exposed, because the air gets warmed in its passage to them, but they are liable to be affected, and in a person out of health very liable to be affected. You have seen persons who are somewhat advanced in life—not very much advanced either—breathing with considerable difficulty. Such a person perhaps has bronchitis, but there is something else the matter with his lungs, and something for which there is no remedy whatever. He has had bronchitis, he had to breathe hard, and in doing that he has distended certain minute cells in his lungs, and those are from that time forth of no use to him. And if he goes on and has repeated attacks, a portion of the lungs become just as useless to him as the diseased lung does in what is ordinarily called consumption. It is quite certain that the perpetual irritation of the mucous surfaces in persons who have a tendency to disease of the lungs must be most injurious. I cannot speak on this subject without deep feeling. I see people on the Underground Railway suffering manifestly from the inconvenience produced by the inhalation of this most injurious gas, and I myself have suffered from it continually. I have to go early in the morning to give lectures in the City twice a week, and sometimes I am so affected by it that it takes me some time before I can recover myself to give my lecture with ease and freedom. Such a thing as this is shocking. We are compelled to travel by that line; ought we not, by our opinion manifested here, and by public opinion generally, to compel the directors of it to do their best to remedy this—not nuisance only, but this serious evil? I have received a communication from a neighbourhood where manufacturing processes are carried on by which means this gas is evolved, and I am told in that neighbourhood that, although diseases which are called epidemic are generally absent, yet diseases of the lungs increase wonderfully, and they are very serious in their results. There is no doubt about it. I know very well that you might get persons to say that there is no very great harm in it; that a little of it can do no harm. But a little of it can do harm; and there are many medical men, I am perfectly certain, who would be willing to come forward and state their opinions that disease might not perhaps be originated by it, but when produced would be increased by the inhalation of this gas.

I should not speak so strongly about it as I do if it were not possible to remedy it. But the thing which has made me feel most strongly about it is this, that when ways and means for remedying it have been suggested to the directors of the company, they would not even try an experiment. Five years ago I repeated an experiment in the presence of Mr. Burnett, their then engineer, which I will repeat for you to-night. I burnt in his presence, in a small room, a vessel full of pure brimstone, and he was unable to detect the smell of sulphurous acid. Now after that, when the means are very simple, when the scientific principle is not a complicated one, would you not imagine that at least the company would give directions that some experiments should be tried to see whether it was successful? But as far as I know none have been tried; in fact, I am sure, none were tried, for I saw some of the directors two years after, and I knew from one of them that none had been tried.

Here is a vessel full of brimstone. If I were to burn one-tenth of it you would all of you leave the room at once, but I will put it over the lamp here; it will soon catch fire, and we will put this sort of extinguisher over it, and then it will go on burning, and you will not smell the brimstone at all; because, inside the extinguisher there is something which will absorb the sulphurous acid formed. Sulphurous acid is a gas formed of oxygen and sulphur, and this gas readily unites with certain substances which are termed bases,

forming salts called sulphites. Sulphurous acid is a strong-smelling substance, but sulphites have no smell of sulphur. In this tube there are lumps of coke which are saturated with a substance called caustic soda or sodic hydrate. The coke is dipped into this solution, and the chimney is then filled with lumps of the coke. The sulphurous acid unites with the hydrate of soda and forms sulphite of soda. The experiment is going on, and even now the quantity of sulphur that has been burnt would be enough to send an odour to the other end of the room, but it has been absorbed, so that you do not notice it. Here is a tube containing a milky substance. Mr. Lewis took this tube, which contains baryta water, and travelled from Gower-street to Baker-street and back on the Underground Railway. He had it concealed in a pocket handkerchief, and he kept sucking the air through it by means of a tube, very much to the astonishment, I believe, of his fellow travellers. However, the gases in this way were drawn through the solution and here is the result, carbonate of baryta is precipitated there and sulphite of baryta. Both these substances are soluble in hydrochloric acid, and if I add hydrochloric acid to the liquid it will dissolve the precipitate. You notice that the liquid becomes clear. I have spoken to you about oxidising processes. Chlorine gas is a powerful oxidising agent in the presence of water, and sulphurous acid can be oxidised into sulphuric acid by the action of chlorine water. Sulphite of baryta is soluble in hydrochloric acid, but sulphate of baryta is insoluble in hydrohcloric acid. The consequence is that if I add to this solution some chlorine water I shall oxidise the dissolved sulphite into sulphate, and you will see a white precipitate, and that white precipitate will show the amount of sulphurous acid that was collected in this underground journey. Already there is a precipitate. Here is another test-tube which has been treated in the same way and submitted to the same operation, which contains a deposit, which when I shake it up makes the liquid quite milky; that is a measure of the sulphurous acid which is brought into contact with the baryta water. If then so small a quantity of sulphurous acid as would pass through that tube in that short time will produce this effect, what must be the result of the quantity of sulphurous acid that is produced and inhaled during a long journey through those tunnels? Coke contains at least one-half per cent. of sulphur, which is somewhere about 10 lbs. per ton. If those 10 lbs. weight of sulphur are burnt, they form a very large quantity of sulphurous acid, and that large quantity must without doubt work an injurious effect upon the health of railway passengers who suffer from weakness in the lungs; at all events, it produces considerable discomfort to all travellers, and if it only did this, it is the duty of the managers of that railway to try and remedy the evil. There is not the slightest doubt they can do it if they take the proper means; the means already tried only very partially remedy it.

M. de Lesseps' plan of joining the Mediterranean with the string of lakes leading to the south of Algeria is likely to drop. A French engineer reports that the lakes are higher than the sea, and a canal would simply drain them; furthermore, if the plan were feasible, it would cost £12,000,000 sterling, on which there would be no adequate return.

Within six years, on the coast of Canada, ninety-eight new lighthouses have been built, four new lightships established, and ten new steam fog-alarms; forty-eight more lighthouses, eight fog-alarms, and two lightships are in process of construction.

An American paper says that a large quantity of old iron from the scene of the Crimean war is being converted into plough shares by a New Jersey foundry.

ANNUAL INTERNATIONAL EXHIBITIONS.

[The offices of the Commissioners are at the Royal Albert Hall (east side), Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.]

LEATHER AND MANUFACTURES OF LEATHER.

By P. L. Simmonds.

The field of description, "On the Manufactures of Leather," is a wide and fertile one, opening up a variety of interesting appliances, full details of which would however occupy too much space. Even the definition of "what is leather" would cause much discussion, and, like the definition of "what is paper," prove a stumbling-block to many experts and officials. The hides and skins of almost all animals are now made to undergo some preparation which fits them for certain economical uses, and one or other of the many applications of leather. Animals of the sea and land, mammals, reptiles, snakes, and even fishes contribute something towards the requirements of the tanner and the currier, and not only the domesticated animals, the ox, the sheep, the goat, the horse, and the hog, but wild animals are hunted down, and the chase of the seal, the kangaroo, the rabbit, the hippopotamus, and dozens of other animals provide skins by thousands to supply the wants of commerce. The preparation of leather in its various forms and qualities, and its conversion into articles of general use, has now grown into a most important branch of our national industry, and it is one that is still necessarily largely dependent on the pastoral interests, home and foreign, for the principal portion of the raw material.

It may be stated that in Great Britain alone there are now about 800 tanneries, and the value even of the tanning substances employed to convert the hides and skins into leather exceeds £4,500,000 annually. The value of the imported hides and skins is nearly £7,000,000, while those obtained at home must reach about the same amount. We export annually leather goods worth about £3,700,000, and we use at home probably three times that quantity, so that, adding the plants of the tanneries and the foreign leather goods imported, the aggregate annual value of the leather trade and its appliances in the kingdom cannot be less than £33,000,000. When it is also considered that nearly half a million persons are directly or indirectly interested in the leather trade and its manufactures, the whole question assumes a high degree of technical interest. The home slaughter of domestic animals would scarcely supply half our requirements for leather, hence the growing importance of the import trade in hides, and our large dependence on India, Australia, and the River Plate districts. The hides from South America are especially esteemed, because the skins of wild cattle, or those roaming at large over extensive pasturages, are found to be stouter and stronger than those obtained from domestic animals. In 1872, out of a total of 1,436,000 cwts. of foreign hides received, 580,000 cwts. came from India and our colonies, and 434,000 cwts. from the South American States.

There are about 200 exhibitors of leather and leather manufactures, and saddlery and harness, but the exhibition can scarcely be considered an efficient or thorough representation of the leather trade. One reason for this is that manufacturers are fatigued and wearied with the numerous calls that have of late years been made upon them to exhibit, and this year's display also comes too soon after the special exhibition of leather work and machinery connected with the leather trade, held at Northampton, the head-quarters of this trade, in the close of 1873.

Articles for personal wear, such as boots and shoes,

gloves, &c., are shut out on this occasion, and they form a most important part of the leather trade; kid, grain, calf, and chevrette gloves, chiefly of Continental make, and dogskin, buckskin, doeskin, and other makes of English gloves are absent; leather coats, breeches, vests, and braces are also not shown. Unfortunately, one of the largest applications of leather is unrepresented, and yet there are few departments of industry in which a greater amount of taste and ingenuity has been expended than on the essential article of boots and shoes. Shreds and patches of this manufacture are, however, scattered over the cases in boot-fronts, shoe-lifts or heels, and other parts, and a few sandals. Evans and Co., of Bristol, show ordinary sole-leather, a large quantity of which they supply for the army; M. Bergman and Co., Austria (6,256), boot-uppers; E. Colson, Belgium (6,263), leather for shoe soles; the Copenhagen Leather Manufactory (6,265), boot soles and heel-pieces; J. Williams, Northampton (6,307), calf bottoms; D. Treitner and Sons, Austria (6,285), brown upper leather for soldiers' boots.

The value of belting straps for the transmission of power in machines, depends much more on the quality of the raw material than on the process of manufacture. The quality of the leather may be superficially ascertained by a transverse section, but this is not always sufficient, and may give rise to erroneous impressions. A more precise method of determining the quality is the following, which depends on the action of acids on the leather:—If a small section of the leather be placed in a glass tube and strong vinegar poured on it, a short time will suffice to determine if the leather is of good quality or not. If it has been well tanned, it will remain months in the acid without alteration or change. If, however, it has been badly prepared, it will immediately assume a dark colour on the surface, the fibres will swell, and it will ultimately become a transparent gelatinous mass, in which only large elastic fibres can be distinguished, and on the borders of the slice will be seen dull opaque rays, formed by the thickness of the leather that has been effectually tanned. When the leather, without being thoroughly tanned, is not very defective, it only assumes a dark colour, accompanied by a partial swelling, which may appear after about 24 hours. It is by the intensity and rapidity of these changes that the quality of the tannage of the leather is determined.

Among the exhibitors of belting or machine bands are J. Hughes and Sons, Great Dover-street (6,281), single and double mill bands and laces; W. Lincolne, Ludgate-hill (6,288), waterproof leather belting; Clarke and Dunham, Mark-lane (6,262), driving bands; Prakke Brothers, Holland (6,293), double glazed and rivetted leather straps and bands; C. A. Preller, Borough (6,294), single and double machine bands, and straps of brown and yellow leather for binding, laces, &c.; the Society of Quatrecht, near Ghent (6,298), leather of various kinds for straps; the Tanned Leather Company, Greenfield (6,300), improved tanned leather driving straps for machinery. Webb and Son, of the Combs Tannery, near Stowmarket (6,304), have a fine case illustrating many of the applications of leather in machine bands or belting leather, delivery hoses, suction pipes, leather buckets, laces and band fasteners, wrung tan leather, grains and common tans, English sole and strap butts, tanned calf skins, and leather buttons. In portmanteaus, valises, and other articles for use in travelling, considerable ingenuity in arrangement is often shown. The workmanship and finish of the best class of goods are unexceptionable, and even in the cheaper and lower qualities the style in appearance is a matter of much consideration, and displays a decided advantage in point of taste upon the unsightly character of the cheaper kind of travelling conveniences often seen. The various kinds of leather made show, in a most favourable light, the ability of our tanners and finishers of leather in nearly all its most useful forms; in fancy varnished leathers, and in morocco, the surface, finish, and elasticity are generally of a high character.

For bags and trunks leather is much used. Messrs. Hoe and Sons, of Leadenhall-street (6,279), show a great variety, comprising morocco and cow-hide bottle bags, brief bags, coat bags, ladies' bags, Oxford bags, cash bags, cow hide hand-bags, &c. Trunks and portmanteaus again are innumerable in shape, style, and fitting. Thus Hoe and Sons have elephant-hide trunks, folding trunks, overland trunks, ladies' trunks, and double hat cases. John Pound and Co., Leadenhall-street (6,292), have a handsome case of bags, portmanteaus, hat cases, &c. H. Bryant and Co., of Brompton-road (6,298), are also extensive exhibitors of the enamelled and brown leather bags, hat boxes, and ladies' trunks.

There are some creditable exhibits from Russia. Paul Kourikoff, of St. Petersburg, shows some capital tanned hides and black youft leather, for various purposes, such as boots and shoes, and the black saddles of Cossacks and Boyards. W. Nissen, St. Petersburg and Moscow, send Russia leather bags and portmanteaus. Michel Sidnoff (629) white chamois, reindeer, and dressed kids for gloves and cavalry.

The Japanese Government make a very fine display in about five cases, of deer skins prepared in coloured fancy stamped leathers, rich green and gilded and perforated leathers, with the blocks with which they are prepared.

Certain nations still excel in peculiar manufactures. We cannot touch the Japanese in the manufacture of shagreen, and even their imitations of leather are of wonderful beauty and varied application. Russia still keeps the monopoly of the manufacture of a class of leather which we cannot produce for want of a knowledge of the essential oil, believed to be birch oil, which imparts the characteristic and lasting odour.

F. Cooper, of Bermondsey (6,264), shows a good collection of moroccos and fancy calf, goat and other skins for upholstery, bookbinding, and coach work, of bright graining, and well dyed.

The necessity for a certain amount of chemical knowledge in the trade is manifest. Very few curriers can explain how by certain chemical actions and mechanical operations skins are transformed from harsh horny substances into smooth, shining, pliable leather. Again, how few can explain the reason why patent leather, after being worked into various perfected articles, will be sometimes found on the following day cracked in all directions; again, why cannot a number of hog or any other skins be stained of a uniform shade when the same stain is applied? And lastly, why cannot we always obtain a good black colour on our harness leather?

The time required to effectually tan thick skins is shown in a box made of hippopotamus hide, in the case of Evans and Co., of Bristol, which was four years in the process of tanning. The thick hides of the elephant, rhinoceros, hippopotamus, and buffalo, always require a long time to convert them into leather.

Sheepskins form an important article of commerce. Large quantities are received dried with their wool adhering, and when dyed much used for rugs and door mats; but a larger quantity are imported in the form of basils, and employed in numerous branches of the leather manufacture. When finished and dyed they assume many elegant forms, and become suitable for the purposes of the bookbinder, the coachmaker, the cabinetmaker, the purse and pocket-book manufacturer. Goat skins are sometimes worked up abroad with the hair on, for mats, rugs, and the like.

There do not appear to be any specimens of the use of waste leather, &c., for balls, such as for cricket, football, tennis, &c.; nor are there any leather tankards, black-jacks, or leather bottles, although some of these were shown last year in the collection of drinking vessels. There are several exhibitors of miscellaneous articles,

such as tobacco-pouches, leather purses, portmonnaies, pocket-books, cigar cases, card cases, sample cases, letter cases, writing folios, &c. The Austrians excel in many of these, both in the dyes given and the taste in which they are finished and ornamented. Jacob Muller (6,452) has a good case, illustrative of plaited or twisted leather, in handsome riding whips, dog whips, walking sticks, and leather caskets.

Edwin Frost, of Upper Thames-street (6,273), exhibits the various stages of manufacture of doeskin and chamois leather. Amongst the miscellaneous products shown are the stages of progress in preparing goldbeaters' skin, which can hardly, however, come under leather in any sense, whether regard be had to the material of which it is composed, or the preparation to which it is submitted. It is, however, a useful and important manufacture, in its results and uses, and one in which we have hitherto excelled and had the monopoly, although the French have recently detected the secret of our success in adding durability to the delicate material, which has to undergo such subsequent rough usage. C. Arundell, of Bow (6,253), also exhibits.

Buff leather is another useful preparation, of which examples are shown by J. J. Sukell, Prussia; and by Charles Topham, of Coleman-street (6,301). Its employment for buffsticks or glazers is extensive, as polishing wheels, for knife boards, razor strops, polishing stoves and fenders, plate, spoons, and forks, sword belts, bits, and stirrups, and metal burnishing. This buff leather is a strong oil leather prepared from the skins of the ox, buffalo, elk, &c.

Another use for leather, although now chiefly confined to savage tribes, is for shields. Of these there are many examples, as South African ox-hide shields in the ethnological collection. Messrs. Evans and Co., of Bristol (6,271) show hippopotamus-hide shields, buffalo-hide and walrus-hide shields, and an ox-hide shield as used by the Highlanders at the Battle of Culloden in the rising of 1745.

There are several further illustrations of the uses of leather by the Africans, which may be seen among the late Coomassie war trophies in the South Kensington Museum collection, such as a leather hat with plaited leather fringe, decorated with gold and silver ornaments, which belonged to King Koffee, and leather sandals embroidered with leather stripes in various colours, with velvet straps and gold and silver ornaments. Many leather articles, in the shape of bottles, books, &c., are shown by the writer of this article in the ethnological section. Drums, tambourines, whips, and other applications of parchment and leather are common. Jester's and other caps of leather were formerly much worn.

There do not appear to be any compressed solid leather sheets made from split fleshings, leather roundings, &c., in various substances suitable for in-soles, lifting, clumping, and stiffners, which is a cheap and good substitute for leather in the manufacture of boots and shoes.

With the exception of a fauteuil or arm chair, leather-covered, from Malines, apparently there are not shown any ornamental upholstery or applications of leather for hangings, covering tables, chairs, &c.

Of imitation leather there are many samples. The Anglo-American Leather Cloth Company (6,251) has a great variety. P. A. Knitz, of Gratz, Austria (6,286), had various articles in imitation leather for upholstery, linings, &c. Strangely enough, although there are many cases of handsome illustrations of the beautiful or ornamented leather of the Japanese, they have not sent any of their imitation leather, which was, however, well represented last year in the Japanese court.

The simply ornamental applications of leather work shown are not numerous. At one time leather work was a fashionable amusement with ladies, for mirror and picture frames, ornamental brackets, flowers, &c., but it has gone out. Miss Harvey (6,277) shows, however, a pier-glass frame in leather work, priced at 85 guineas; and Mrs. Martha Farey, Regent-street (6,272) a garniture of leather leaves, comprising dress trimmings and head-dress. Among the bookbinding exhibits is a leather mirror frame, in the style known as "Grolier" binding. This, however, is of quite a different description to the above mentioned.

Cuff and Son show a case of leather medallions, one of which is a portrait of William III. There are also one or two exhibitors of old leather caskets. Mr. T. O. Barlow, of Kensington, shows two of 15th century make; Mr. J. W. Spread, of Bayswater (6,299), caskets of the 16th century, leather powder-flask of the same period, and a leather-case formerly belonging to the Society of Goldsmiths, dated 1573.

The only exhibitor of tanning substances is Mr. Cleeve Hooper, of Bermondsey (6,280), and even this case is imperfect, and only represents the ordinary materials in use, whilst many substances which have been introduced or are in use in other countries are absent. The collection comprises the following:—Sumach, the dried and chopped leaves and shoots of the *Rhus coriaria*, a shrub growing in Southern Europe. When ground to powder in a mill, sumach is largely used for dyeing and tanning. Cutch or catechu, an inspissated extract from the wood, &c., of the Areca palm and the *Acacia Catechu* from Pegu and Burmah. Gambier, an extract from *Uncaria gambir*, from Singapore, in free cubes, blocks, and balls. Myrobalans, the astringent fruit of several species of *Terminalia*, imported from Calcutta and Madras. Hemlock bark, the concentrated extract from the hemlock spruce (*Abies Canadensis*) of North America. English and Belgian oak bark, price £6 to £7 per ton, patched and ground. Larch bark from Scotland. Cork-tree bark from Sardinia. Mimosa bark (*Acacia decurrens*) from Adelaide and Melbourne. Tanekaka bark (*Phyllocladus trichomanoides*) from New Zealand. Valonia, camata, and camatina, the acorn cups, mature and immature, of *Quercus ægilops* from the Levant. Divi-divi, the leguminous pods of *Cæsalpinia coriaria*, from Central America. Although much desultory information has been published on the subject of tanning materials, yet there is a great lack of any condensed practical notes on the comparative value of these substances, for the analyses and details given differ materially. Oak bark is the mainstay of the English tanneries, and its value is shown in an English butt tanned entirely with oak bark, weighing 37 lbs., shown by Messrs. Bacon and Sons, Bermondsey (6,254).

The manufacture of leather into saddlery and harness and other articles, is carried on in almost every principal town in the kingdom, although there are a few large and principal centres where it is concentrated. At all the great national exhibitions the specimens of English saddlery have been the admiration of foreigners; and certainly no other nation can compare with us for excellence, cheapness, and serviceable articles in this class of manufacture. They command favour alike in Europe, America, India, and our colonies. The French, in their official reports on the Exhibition, are forced to admit that in the preparation of skins for saddlery we are far their superiors, as is evidenced in the following extract:—"The hogskins for saddles, the cowskins and calfskins for saddlery, leave nothing to desire, their suppleness, whiteness, and brilliancy, far excel the products of other countries, and are perfectly treated by the English curriers." This is high praise from a rival manufacturing nation which excels in most manufactures.

There is very much to admire in the many handsome show cases filled with hunting, riding, military, and other saddles, and trappings, harness, whips, horse clothing, &c. And although the collection can scarcely be called a general one, yet the brilliant display made by those who do exhibit proves how important is the manufacture—how extensive the trade in those specialities, in which, as an equestrian nation and great lovers of horseflesh, we so greatly excel. The occupiers

of land alone in the kingdom own nearly 2,000,000 horses, besides the large number kept for pleasure and those employed in the carrying trade. Our exports of saddlery average about £350,000, although they have occasionally exceeded half-a-million.

The home use of saddlery and harness must be enormous, looking at the great traffic in large towns for cabs, omnibuses, tramways, carts, and private vehicles, to say nothing of the agricultural demands on our farms. Last year carts and carriages and other vehicles were extensively shown at the Exhibition, and therefore it is much to be regretted that a more general display has not been made this year of ordinary and useful saddlery and harness for cart and other draught horses, as well as handsome carriage harness, &c. Some of the saddlery factories are so important that they come under the supervision of the inspectors of factories. Ten at least, with nearly 1,400 hands, employ steam-power. In England and Wales alone, according to the last census, there were upwards of 23,000 persons employed as workers and dealers in saddlery, harness, and whip-making.

W. Leman and Son, of Dublin (6,419), have three cases of harness and saddlery. J. Holloway, Knightsbridge (6,415), shows several good saddles of different kinds. H. Rymer, Northallerton (6,432), has three cases filled with handsome horse clothing, saddles, and harness. Swaine and Adeney, Piccadilly (6,438), exhibit a choice variety of whips, canes, and hunting caps. H. Urch and Co., Long Acre, show two large cases filled with handsome examples of the choicest harness and saddlery. Maxwell and Co., Piccadilly (6,422), have a case with all kinds of spurs. J. E. Bridges, Finsbury (6,407), fill two cases with well-made saddles, whips, &c. Indeed, the London saddlers and harness makers are well represented, and make an effective display. In the handsome and ornamental line his Grace the Duke of Buccleuch (6,408) shows a gorgeous set of horse furniture, formerly the property of the Duke of Monmouth, which was used at her Majesty's coronation in 1838. Then there is a handsome saddle and fittings used by the Knight Grand Cross of the Order of the Star of India. Whippy, Steggall and Co., of North Audley-street (6,444), who exhibit a case of harness, and two cases of saddles and bridles, show State harness.

There are comparatively few articles of foreign manufacture, or of those especially adapted for use in foreign countries, except white India saddles, and saddles for Australia. Mr. R. H. Bland, of Belfast (6,405), shows, however, some of the characteristic horsegear of the Gauchos and others of South America, consisting of the bridles and tethering halters; a belt with Spanish pillar dollar buttons, native skin boots, Rebenque or Gaucho whips, native Gaucho saddle with large silver stirrups, head-stalls of plaited hide, a lasso and bolas and girth complete, with ring to which the lasso is attached, a bridle from the Sandwich Isles (6,434), and a few Spanish stirrups and bits, are all worth particularising in the foreign articles.

At the recent Vienna Exhibition there were some specimens of paper made from several materials which have not hitherto been utilised for that purpose. Among these was paper from the mulberry-tree bark, from the stinging nettle, and from potato stalks. In districts of European countries where mulberry leaves are used for feeding silk-worms, the remaining twigs have served only for fuel. But now, in Austria and parts of Italy, the bark is peeled off by a very simple arrangement, and from it a material prepared from which a good quality of paper is made. In Hungary the nettle is used with rags for making fine sketching and copying paper, and in Bohemia wrapping paper is made from potato stalks.

An attempt is being made to resuscitate the ancient iron works of Sussex, which were carried on until the exhaustion of the supplies of wood used for fuel.

EXHIBITIONS.

AMERICAN CENTENNIAL EXHIBITION.

The commissioners appointed for holding the above exhibition, in 1876, in Fairmount-park, Philadelphia, have issued their regulations, of which the following are the most important relating to foreign exhibitors:—

Products brought into the United States, at the ports of Boston, New York, Philadelphia, Baltimore, Portland, Maine, Port Huron, New Orleans, or San Francisco, intended for display at the international exhibition, will be allowed to go forward to the exhibition buildings, under proper supervision of customs officers, without examination at such ports of original entry, and at the close of the exhibition will be allowed to go forward to the port from which they are to be exported. No duties will be levied upon such goods, unless entered for consumption in the United States. The general reception of articles at the exhibition buildings will commence on January 1st, 1876, and no articles will be received after March 31st, 1876. Space assigned to foreign commissions and not occupied on the 1st April, 1876, will revert to the director-general.

The ten departments of the classification which will determine the relative location of articles in the exhibition are as follows:—1. Raw materials—mineral, vegetable, and animal. 2. Materials and manufactures used for food, or in the arts, the result of extractive or combining processes. 3. Textile and felted fabrics; apparel, costumes, and ornaments for the person. 4. Furniture and manufactures of general use in construction and in dwellings. 5. Tools, implements, machines, and processes. 6. Motors and transportation. 7. Apparatus and methods for the increase and diffusion of knowledge. 8. Engineering, public works, architecture, &c. 9. Plastic and graphic arts. 10. Objects illustrating efforts for the improvement of the physical, intellectual, and moral condition of man.

Exhibitors will not be charged for space. A limited quantity of steam and water-power will be supplied gratuitously. The quantity of each will be definitely settled at the time of allotment of space. Any power required by the exhibitor in excess of that allowed will be furnished by the Centennial Commission at a fixed price. Exhibitors must provide, at their own cost, all show-cases, shelving, counters, fittings, &c., which they may require; and all counter-shafts, with their pulleys, belting, &c., for the transmission of power from the main shafts in the machinery hall. The Centennial Commission will take precautions for the safe preservation of all objects in the exhibition; but it will in no way be responsible for loss or damage of any kind, or for accidents by fire or otherwise, however originating. Foreign commissions may employ watchmen of their own choice to guard their goods during the hours the exhibition is open to the public.

Each package must be addressed "To the Commission for [*Name of country*] at the International Exhibition of 1876, Philadelphia, United States of America," and should have at least two labels affixed to different, but not opposite sides of each case, and giving the following information:—(1) The country from which it comes; (2) name or firm of the exhibitor; (3) residence of the exhibitor; (4) department to which objects belong; (5) total number of packages sent by that exhibitor; (6) serial number of that particular package. Within each package should be a list of all objects it contains.

If no authorised person is at hand to receive goods on their arrival at the exhibition buildings, they will be removed without delay, and stored at the cost and risk of whomsoever it may concern.

Communications concerning the exhibition should be addressed to "The Director-General, International Exhibition, 1876, Philadelphia, Pennsylvania, U.S.A."

THE MANUFACTURE OF BORACIC ACID IN TUSCANY.

By P. Le Neve Foster, Jun., C.E.

The production of boracic acid in Tuscany from the hot boiling springs and jets of vapour called *soffioni* is certainly one of the most important branches of chemical industry in Italy. The curious phenomenon of jets of vapour issuing naturally from the ground is met with over an area of comparatively limited extent, situated between Massa Marittima and Volterra. The hill sides in many of the valleys of the tributaries of the River Cecina are studded with such *soffioni*, and numerous *lagoni*, or ponds of muddy blue water boiling vehemently, have been formed by the natural springs, acted on by these vents of vapour.

Towards the close of the last century (between 1770 and 1780) boracic acid was discovered in the springs of Monte Rotondo and Castelnuovo, by Hœffer, the chemist to the Grand Duke of Tuscany, and by Professor Mascagin, but no steps of any importance for utilising these springs for making boracic acid appear to have been taken until 1818, when Mr. François Lardarel, a Frenchman, established works on a small scale for the collection and extraction of this substance from the waters of the *lagoni* in the neighbourhood of Castelnuovo. At first his efforts were unattended with success, and, in a commercial point of view, may be said to have proved a failure, owing to the great expense in obtaining fuel for evaporating the water. At length the brilliant idea struck M. Lardarel of employing the heat of the natural steam jets to evaporate the weak solution from the *lagoni*, and this was the turning point in his fortunes. This method, which was first applied in 1827, had the effect of converting an unprofitable branch of industry into one of the most successful in Italy. At the present time there are no less than seven separate establishments belonging to Count Lardarel, all situated within a few miles of the little town of Castelnuovo, which may be said to be the centre of the boracic acid industry in Italy. These establishments are as follows:—

1. Lardarello, or Lagoni, of Monte Cerboli.
2. Castelnuovo, Val di Cecina.
3. Serrazeano, or the "Lagoni Solforei."
4. Lustignano, or the "Lagoni Rossi."
5. Sasso, or the "Lagoni di Acquavita."
6. Monte Rotondo, or the "Lagoni della Pianacce."
7. "Il Lago," where the works of San Federigo, San Eduardo, and La Collacchia are situated.

The works at Lardarello are the most important of all, and it is there that all the products of the other establishments are sent. The processes by which the acid is extracted being precisely the same at each, it will only be necessary to describe in detail those carried out at Lardarello. This little colony, which was founded by the late Count, is situated at a short distance from the village of Monte Cerboli, on the torrent Possera, and shows what might be done in other parts of Italy for improving the social condition of the working-classes. There is a neat square, "La Piazza dell' Industria," surrounded by blocks of buildings, which on one side include the offices, church, museum of mineralogy, and schools, and on the other, the model lodging-houses for the workmen, stores, workshops for various tradesmen, such as tailors, shoemakers, &c., and a weaving establishment for giving employment to the wives and daughters of the workmen.

The *lagoni* are situated to the south of this little village, and consist of artificial basins constructed of coarse masonry, large enough to contain several *soffioni*. At the present time most of these *soffioni* are obtained artificially by boring, and are lined with sheet iron tubes from 25 to 30 centimetres (10 to 12 inches) in diameter. These borings are found more manageable, besides giving out more vapour than those formed naturally. The basins, or *lagoni* are situated at different levels on the hill-side, and the uppermost is supplied with water conducted by a canal from near the Bagno del Norbo. After remaining in this basin for twenty-four hours, during which time it has been kept in constant agitation by the subterranean vapours, and has become of a slate blue colour, the water passes into a canal, and is conducted to another basin at a lower level, where it remains another twenty-four hours, and in consequence takes up an additional quantity of boracic acid.

The water, after passing through a chain of *lagoni*, where it is brought up to a strength of about 0·50 per cent. of boracic acid, is then conducted to a large tank, about 20 metres (66 feet) square and ½ a metre (1 foot 6 inches) deep, covered by a tiled roof supported on brick columns. Here it is allowed to settle, the impurities held in suspension are precipitated to the bottom, and the water leaves the tank in a perfectly clean state.

The next operation is to concentrate this weak solution of acid. This is effected by evaporating it in long lead pans, ingeniously heated with steam from the dry *soffioni*. These pans are about 60 metres (200 feet) in length by 2·50 to 3 metres (8 feet 4 inches to 10 feet) in breadth, arranged usually in three parallel lines under one roof, supported on columns, the sides being open so as not to impede the evaporation. The pans are supported on beams over low steam passages, into which the vapour is conducted by pipes from the *soffioni*. Formerly a masonry arch was built over one of the natural springs, and the steam collected in this manner, but these buildings were liable to be undermined and attacked by the corroding influence of the vapours, and it is now found far more convenient to connect the pipes to the tube of an artificial boring, to say nothing of making a neater job and the arrangement being more under control. The pans have a number of divisions placed transversely across them, usually from 80 cent. to 1 metre (2 feet 7 inches to 3 feet 4 inches) apart. These divisions are 0·05 metres (2 inches) in height, and the pans are arranged so as to have a slight inclination from the end where the water is admitted towards the other, where there is a large and deep reservoir. The water is allowed to enter in a regulated quantity from the precipitating tank, and following from one division to another, it gradually evaporates, and after having passed over 50 to 60 divisions, it assumes a bright yellow hue, increasing in intensity as it approaches the end, where it runs into the tank or boiler. Every 24 hours this boiler is emptied, and its contents pumped up to the crystallising house, in which a series of vats about a metre (3 feet 4 inches) in diameter are placed. These vats being filled, the liquor is allowed to remain four days, during which time the boracic acid is deposited in crystals at the bottom and sides to a depth of a few inches, and the liquid that then remains is drawn off by removing a plug at the bottom, and conducted away by a drain to the evaporating house. Fresh liquid is then introduced into the water, and the same process is repeated until they are completely filled with crystals of boracic acid. As these crystals retain a large amount of water, they are, when removed from the vats, placed in large wicker baskets to drain, and are afterwards taken to the drying-house, where the contents are spread in thin layers on the floor, and stirred constantly with a wooden rake. It is then packed in barrels containing about 600 kilos. each (12 cwt.), and sent to Leghorn, where it is shipped chiefly for England.

The boracic acid manufactured in this manner contains about thirteen per cent. of impurities, chiefly sulphate of lime, ammonia, alumina, and magnesia.

At the Lardarello Works there are 12 evaporating sheds, containing 35 evaporators. The average daily production is about 3,000 kilos. (3 tons), though some days as much as 4,200 kilos. (4 tons) have been made. The Castelnuovo establishment averages 26,700 kilos. (27 tons) per month, and the production of the other works is still less. The total annual production of the

whole of the establishments belonging to Count Lardarel is estimated at 3,000 tons.

Notwithstanding the extreme simplicity of the whole process, it is a matter of surprise to many who have visited these works, and it is much to be regretted in the interest of science, that Count Lardarel (whose method evidently is "rest and be thankful," instead of "progress") has not thought fit to employ a chemist at his establishment, and up to the present no progress has been made in this manufacture since the first application of steam by the late Count in 1827, although it is highly probable that, under the management of a scientific man, considerable improvements might be introduced.

M. Durval has an establishment for the manufacture of boracic acid at the Lake of Monte Rotondo, called also "Il Lago Solforei di Vecchiena," which has an area of about 18 acres. The water contains about 0·002 of acid. The produce of these works is sent chiefly to France.

At Travale, an Italian company, called the Società Anomonia Borica Travalese, have an establishment for extracting the boracic acid which is found there, though in a far more diluted state than at the *lagoni* of Count Lardarel, and although the process by which it is extracted does not differ in principle from that previously described, certain very important modifications and improvements have been introduced. These springs, which are called "I Lagoni delle Galleraje," are situated at a short distance from the village of Travale, in the valley of the Sajo, a little stream flowing into the Feccia and Merse tributaries of the Ombrone. Here the boracic acid is associated with sulphate of ammonia, which is extracted from the waters of a series of *lagoni* by evaporating apparatus, heated by the natural vapours of the *soffioni*, but as the sulphate of ammonia is worth only 35 francs per quintal (14s. 7d. per cwt.), whilst that of the boracic acid is 50 francs (£3 per cwt.), and the cost of production is almost equal, there is very little profit attendant upon its manufacture. The water of these *lagoni* contain about 500 milligrammes (about 7 grains) per litre (1¾ pint) of sulphate of ammonia. All the *soffioni* at this place have been obtained by boring, and this company are possessed of excellent tools for this purpose, by means of which they are enabled to bore to a diameter of 40 centimetres (16 inches). These borings usually meet water at a depth of from 15 to 20 metres (50 to 70 feet), though in one place a depth of 168 metres (560 feet) was reached before tapping these subterraneous sources of heat, viz., in a boring called "Il foro Pietro."

Another boring ("Il foro Carlo"), 73 metres (240 feet) deep, furnishes a supply of water holding boracic acid in solution, which rises to the level of the ground, as in an artesian well, its supply being equal to 600,000 litres (132,144 gallons) per 24 hours, of which only one-sixth part is at present utilised. This solution contains only 260 milligrammes (about 4 grains) per litre (1¾ pint) of boracic acid, which is given off at a temperature of 96° Cent. (205° Fah.). Here there is no basin, as at Lardarello, the water being led away direct by cast-iron pipes from the bore-hole to the precipitating tank, which is 18·50 metres (60 feet) in length, by 13·50 metres (45 feet) in width, and 0·50 metres (1 foot 8 inches) in depth. The improvement that has been introduced here consists in heating the water in this tank by pipes, through which the vapour from a dry *soffioni* ("Il foro Filippo") passes, and by this means a certain amount of water is evaporated in the precipitating tank, and thus brings up the degree of concentration of the solution to 400 milligrammes (6 grains) per litre (1¾ pint). The boring that furnishes the steam is 63 metres (210 feet) in depth, and the temperature of the water in the tank is maintained at 94° Cent. (202° Fah.). This solution, which has a specific gravity of 11° of Baumé's areometer, is conducted in the usual manner to the evaporators, which are constructed in a similar manner to those at Lardarello, the water being kept at a temperature of 76° Cent. (169° Fah.), by the steam from "Il foro Filippo," and having traversed the entire length of the pans is received into the boiler at the lower end with a specific gravity of from 12° to 50° Baumé, and is crystallised, dried, and packed in the usual manner. The evaporating shed contains three rows of evaporators, 64 metres (207 feet) in length by 3 metres (10 feet) in width. The production is about 26 kilos. 200 grammes per day (57·64 lbs.).

WATER SUPPLY AND SEWERS OF PARIS.

Of all the measures carried out of late years in the capital of France, none are so unquestionably valuable as the increase of the water supply and the construction of the sewers. The debates and reports of the municipal authorities set forth the extent and value of these important works.

The water service and the sewers have been, and still are, under the direction of M. Belgrand, Inspector-General of Ponts et Chaussées, and member of the Academy of Sciences.

The sum required for the water service next year is equal to £250,049, being £9,600 less than the expense in the current year.

The potable water of Paris is derived from the Seine and two other sources, while the watering of the streets, the supply of the public fountains, and the general cleansing, are effected by means of the waters of the Ourc, which are totally unfit for drinking or cooking.

Another source is that of the artesian wells, but their cost is found to be so great that their further adoption is questionable. There are, however, at present in hand one at the Place Hébert, another at La Chapelle, and the third at the Butte-aux-Cailles.

The two sources of pure water for the use of Paris are those of the little streams of the valleys of the Dhuys and of the Vanne. The waters of the former have now for some years been received in an enormous reservoir, and the canal and reservoir of the Vanne are approaching completion.

The reservoir of the Vanne at Mont Souris, just completed, is an enormous structure of two stages, arched over and covered with turf. The cost of these canals and reservoirs has been very large, but the water supply brings in a considerable revenue, and will shortly bring in more. The income from subscriptions within the city, and from a company formed to supply water in the communes without the wells, is estimated to produce £280,000 in 1875, while certain other items add £20,000 more to the amount, and gradually as the supply of water to the houses becomes general, and as cesspools give way to water-closets in connection with the sewers, the income from this source will increase largely.

Much more remains to be done before the system of sewers is complete. The great *egout collecteur*, or main sewer, was one of the sights of the empire, and the work has been pursued, though not continuously, for twenty years. Still many small streets in the old parts of Paris have connection with the new system of sewers, and most of the secondary streets of the suburbs have no other sewer but the gutter. Each year adds some miles to the length of the sewers, but the work cannot at present be pushed on rapidly on account of the heavy demands on the finances of the city. The budget for the coming year includes no important sewer work, but the sum required for the maintenance of existing sewers is £100,000. This also includes the maintenance of a small stream, which curiously represents that of the Fleet in London, namely, the Bièvre, which has been converted into a sewer. The products which do not find their way into the sewers are carried away to La Villette and Bondy, and, with payments on account of public and private sewers, &c., produce £50,000. This service

includes also the application of a considerable amount of the sewage of Paris to the cultivation of the market gardens of the plain of Gennevilliers.

THE COINAGES OF FOREIGN COUNTRIES.

At the conclusion of the account given upon the operations of the Royal Mint for the year 1873, the Deputy Master, Mr. Freemantle, reviews the condition of the foreign coinages. Commencing with the United States, he states that no changes of importance have taken place since the final adoption of the single gold standard by that country. The "Coinage Act" passed by Congress, which became law on the 1st of April, 1873, had, by constituting the gold one-dollar piece the unit of value, and omitting all mention of the silver dollar, which had up to that time in theory held its place as a standard coin, definitely abolished the double standard, and fairly placed the United States in the category of nations which have followed the example originally set by this country in 1816, in the adoption of a single measure of valuo, and of gold as that measure. The annual report of the Director of the United States Mint contains much valuable information as to the measures taken under the Act, and its probable effects, and on questions connected with coinage generally. In Germany, a gold pieee of the value of five marks, as well as a silver piece of the same value, were added to the coinage. The adoption by the Reichstag of this supplementary addition to the previous law made in 1871 was only passed by a narrow majority, owing to the apprehension that it might lead to the importation of a large amount of Austrian florins into Germany. The Federal Ccuncil, in pursuance of this law, gave directions for proceeding in the first instance with the coinage of marks, and of pieces of 20, 10, 2, and 1 pfennings, in addition to the 20 mark and 10 mark gold pieces, the coinage of which had been in progress since 1871.

The attention of the nations which were parties to the Monetary Convention of 1865, namely, France, Belgium, Italy, and Switzerland, has been forcibly directed, by the change which has taken place during the year in the relative value of the precious metals, to the position in which they are placed by the use of the double standard of gold and silver, and by the other conditions imposed upon them by the terms of the Convention; and the controversy between the advocates of the single and double standard in France and Belgium has been renewed with much vigour. It is stipulated that another Conference shall be held in Paris in the month of January, 1875, the contracting parties binding themselves not to coin or permit to be coined during the year 1874 a larger number of silver five-franc pieces than were agreed upon. It will be seen, therefore, that the result has been to suspend, in an important particular, the arrangements made in 1865, and the decision arrived at would appear to point to the probability that, when the position of France and Italy renders such a step possible, the adoption of the single gold standard throughout the territories of the Convention will not be long delayed. In Holland, a Commission appointed by the Government, and consisting of Chevalier A. D. van Riemsdijk, one of the Commissioners of the Mint, M. Taddel, Director of the Mint, and M. Reyke, Engineer, visited the mints of this and other European countries, to inquire into the system under which the coinage of gold is conducted, and have issued a valuable report. The Netherlands Government have rejected the proposals in favour of the adoption of the single gold standard; it is, however, probable that before the close of the present year the subject will be again brought before the Chambers. The Scandinavian Monetary Convention, signed at Copenhagen on the 18tb December, 1872, was only ratified by two out of the three countries concerned, namely, Sweden and Denmark, the Norwegian Storthing having withheld its assent. New coinage laws were, however, passed in Sweden and Denmark, establishing a single gold standard, with subsidiary silver token coinage, all the coins being metrical in diameter and weight, decimal in subdivision, and current reciprocally in the two countries. In June, a new coinage law was also passed in Norway, establishing a single gold standard, with precisely the same gold coins as those adopted by Sweden and Denmark. As regards silver coins, the Norwegian two-crown and one-crown pieces are identical with the same pieces in the Swedish and Danish systems, but it has been resolved, instead of adopting the decimal subdivision of the crown, to maintain the old arrangement of dividing it into 30 skillings, and to coin pieces of 24, 15, 12, and 3 skillings. It is feared that this resolution will lead to much inconvenience as precluding the free international circulation of Norwegian coins with those of Sweden and Denmark, but it may be hoped that the Storthing will eventually join the Convention, and thus complete the establishment of a monetary system common to all three countries. In Japan, the operations of coinage continue to progress satisfactorily. In September last, portions of "pyx" coins of gold and silver, and pieces from "test ingots," were tested by the Royal Mint in London, and the results prove the accuracy of the work performed by the Japanese Mint under the direction of Majir Kinder.

In the course of the past year an International Monetary Conference was held in Vienna, at which resolntions were passed in favour of a single gold standard, and of an international piece of $7\frac{1}{2}$ grammes of fine gold, with an international unit of a metrical dollar of $1\frac{1}{2}$ gramme divided into 100 cents. The Conference also resolved that monetary treaties are not necessary to provide for the adoption of the piece in question, and that it is sufficient that each Government should bind itself, through its own legislative acts, to release by new pieces such coins as have lost their legal weight, and to redeem its token coinings at their full nominal values. This Conference would appear to be one of a series of meetings which have been held in European countries during the last few years, by persons interested in the question of coinage, and which, though hitherto not in all cases attended with practical results, may perhaps be considered useful as preparing the way for the discussion of a comprehensive scheme of international coinage; but it is necessary to point out that, while the principlo of the single gold standard has been in force in this country since the year 1816, and that of renewing the token coinage at the expense of the State is also fully recognised, it would not appear possible that nations should give currency to the proposed new coin, without such complete change in their systems of coinage as would involve careful consideration by representatives authorised to enter into engagements on behalf of their respective Governments.

The St. Louis *Republican* says that for some five or six years past small quantities of camel's hair have been shipped to America, and it has been utilised in several ways. Camel's hair consists of several grades or qualities, from the wool that lies close to the animal's hide to the long, shaggy hair which covers portions of his body. Heretofore all this material has come from Western Asia, Arabia, and Persia, from whence it was sent westward through Russia to the Baltic ports, and there shipped, mostly to Liverpool and London, from whence it found its way to all parts of the world. Tho fibre, though long, is coarse and strong, and makes dress goods for winter wear of a somewhat rough and shaggy appearance. It is only woven into cloth, with a wool body, as its texture would not admit of its being used alone. The corser hair and the wool that accompanies it are used in the manufacture of carpets. The importations heretofore through Russia have been expensive, but recently large quantities have been obtained from China.

TOBACCO CULTIVATION IN GERMANY.

The aggregate area of land cultivated with tobacco in the States of the German Customs Union has not varied considerably during the last ten years, being 21,509 hectares in 1863, and 20,918 in 1872, to which must be added the newly annexed provinces of Alsace and Lorraine, which bring up the total to 24,745 hectares. It appears that, with particular regard to the year 1872, the cultivation was carried on in 4,067 different localities, by 94,916 taxable growers, and by 83,675 smaller growers, whose production, owing to its limited extent, was exempt from taxation. By far the larger number were small growers, the area cultivated by each not exceeding an average of ten ares. In Prussia the aggregate of land cultivated during the year 1871 amounted to 5,925 hectares, or 26 per cent. of the entire territory of the kingdom; the aggregate yield of the harvest in the same year was 198,890 centners. It appears that the extent of tobacco-growing land has, during the last fifty years, been gradually diminishing in Prussia, and that accordingly the expectations entertained in the beginning of that period of a great future development of this branch of agriculture have not been realised. The reasons for the gradual decline are considered to be, on the one hand, the growing competition of the South German growers, and the increase in the importations of American tobacco; on the other hand, the fact that the cultivation of beetroot for sugar, and of potatoes for distilling purposes, has proved to be a more profitable business than tobacco production. It has, moreover, been found by many years' experience, that whilst the quality of the tobacco cultivated in most parts of Prussia is not such as to enable the growers to compete successfully with the importers of foreign, particularly North American sorts, the labour attending its cultivation and its preparation for the market, as well as the uncertainty of only an average crop, are out of proportion, as a rule, to the average profits arising therefrom. The cultivation of the plant has consequently gradually become restricted chiefly to those districts of the country where either the soil is peculiarly adapted for the purpose, or where it is carried on for the private use of the producer.

In Bavaria, as is well known, tobacco is cultivated very extensively, particularly in the Palatinate and in Franconia, viz, the districts around Nüremberg and Erlangen. The area of land in 1871 was 4,721 hectares, which produced 144,153 centners. In Saxony but little tobacco. is grown, the total area planted therewith in 1871 not having exceeded six hectares, upon which 130 centners were produced. Although in parts of Wirtemberg the soil and climate are said to bo very favourable to the growth of the plant, the area of land cultivated is, upon the whole, a very limited one, and did not exceed 178 hectares. The yield of the harvest is given at 5,571 centners. In the year 1858 the extent of production in Wirtemburg is stated to have been four times as great as it is at present. The Grand Duchy of Baden has at all times been the chief tobacco-growing part of Germany, and as far back as the end of the seventeenth century special laws for regulating the cultivation, preparation, and warehousing of this article were in force. The great importance accordingly attaching to this branch of agriculture and industry for so large a proportion of the inhabitants of Baden, renders it but natural that any project of increasing the tobacco tax should meet with very strong opposition amongst most classes of the Grand Duchy. The most prominent tobacco-growing districts of Baden are those of Carlsruhe, Mannheim, Heidelberg, Badenburg, Schwitzingen, and Lahr; the quality of the plant grown in these parts being a very inferior one. The produce of the districts mentioned is therefore applied chiefly to the manufacture of "cigar wrappers," and is exported in considerable quantities to Bremen, Hamburg, Switzerland, Holland, and even to America, for the use of the cigar makers. The prices of the best kinds of Baden tobacco are consequently also, on an average, much higher than those realised by other German growers. The area in Hesse was 979 hectares, the chief district being around the town of Darmstadt; the production was 31,311 centners. The most prominent amongst the Thuringian States as regards tobacco production, is the Duchy of Saxe-Menningen, the land cultivated in 1871 in all of them put together was 202 hectares, the yield of the harvest in that year having been 4,806 centners. In the two German states of Mecklenburg, 6,106 centners were raised from 165 hectares of land. The most important district is that of Neu-Brandenburg, in Mecklenburgh-Strelitz. Only a small extent of land, viz., 68 hectares, is used for tobacco in the Duchy of Brunswick, the same being situated near the town of Helmstadt; the amount raised was 2,391 centners.

In the recently acquired provinces of Alsace-Lorraine, tobacco cultivation has been extensively carried on for many years, more especially in the country around Strasburg, Mülhausen, Schirmeck, and Münster, and to a smaller extent near Metz and Thionville. The aggregate area of land cultivated in 1871 in both provinces is given at 3,159 hectares, upon which 115,518 centners of tobacco were raised. According to the statistics and information furnished by Consul Ward, the quantity of tobacco produced in Germany in the year 1871 amounted to 713,845 centners, the whole being estimated in value at 60,284,210 dols., or about £9,042,613 sterling.

JOHN LEAVERS.

Mrs. Clara Seymour, dating from Nottingham, writes to give emphatic contradiction to the extract in the Society's *Journal* of September 18th, taken from Felkin's "History of the Lace Trade," in which the character of John Leavers, the inventor of the lace machine, is severely reflected upon. She sends a printed contradiction, which appeared in the *Nottingham Journal*, May 10, 1867, and is given below as follows:—

"As an attached sister to my late brother, John Leavers, I feel it my duty to give the most unqualified denial of the truthfulness of those aspersions upon his fair fame.

"My father died when my brother John, who was the eldest of the family, was in his twenty-fifth year, the younger branches of a large family depending upon him for occupation and provision. In this position he discharged his duties with parental kindness and fidelity towards them, and, though not affluent, he never was in indigent circumstances.

"He was a good husband, and carefully provided for the education and maintenance of his family.

"The imputations on his want of sobriety are entirely unfounded.

"I am in possession of letters from his family and friends which will also fully confirm these statements, and persons now residing in this town, who were in his employment, will bear similar testimony to his worth.

"Mr. Felkin says, 'we cannot ascertain in what year or in what circumstances he died.'

"The following extract is from the *Nottingham Review* of October 6th, 1848:—'On the 24th of September last, at Grand Couronne, near Rouen, France, Mr. John Leavers, aged 62. He was sole inventor of the Leavers Machine, and resided formerly on Sion-hill, New Radford. He was band-master to the National Guard (a volunteer corps), and was attended with military honours to his grave, by the Mayor and National Guard of his regiment, and was honoured and respected by all who knew him.' (Signed)

"Elizabeth Leavers Greenwood."

CORRESPONDENCE.

TRANS-HIMALAYAN ROUTES.

Sir,—Along the vast mountain ranges of Northern India, from the Karakoram to the extreme east, where the highlands dip into the plains of Assam, there are a number of passes practicable for traffic from November to April inclusive. The two-humped camel of the elevated plateaus of the West and Bhootea, or native horses toward the East, are the safest, thriftiest, and most enduring carriers; and when mules can be procured at a reasonable cost, they are also very suitable for mountain travel. Some of these passes have been temporarily used for communicating with Thibet from Nepaul, Sikkim, and Bhootan, but the traffic has not been duly systematised and protected, nor ever will be, until our Government assumes the initiative. The treaty of Yarkand has inaugurated trade with Northern Asia on the West, and it now remains to open trade with Thibet on the Eastern side by a commercial treaty, for which the Thibetans are, and always have been, anxious. The promotion of the inland commerce of Asia is potentially vested in British India and Russia, the two greatest Asiatic powers, and a high political and moral responsibility rests upon both Governments, whether jointly or separately, to protect trade where it is established, and introduce it where it is invited by the settled and nomadic communities north of the Himalayas. There ought to be no antagonism in commerce apart from the legitimate emulation of industry; indeed, our line of action hitherto tacitly implies this policy. But has not the opportune occasion now arrived for declaratively confirming it by definitive treaty, and thereby opening up half a continent to Anglo-Indian commerce, which has been so long arrested in its normal development by the stolid and short-sighted exclusiveness of the Chinese Government? Trade once opened with Thibet, Sezchuen and Yunnan will soon follow suit; for Chinese officialism must eventually strike to the popular wish for trade with India. The establishment of annual fairs at suitable frontier sites, such as that at Sudiya, and in the west the fair lately established by Forsyth at Palampur, is the most feasible method of initiating and encouraging the development of trade, both local and trans-Himalayan.

The exploration of trade routes can only be efficiently accomplished when organised under the direct sanction and instructions of the Government, who should commission agents well qualified for such enterprises by their tastes, habits, and educational training. Statesmen, merchants, and mercantile travellers do not want narratives of picturesque description and amusing adventure—ephemeral books for men of leisure—but carefully arranged statistics of practical information, with maps and other useful instructions, forming a guide-book for the traveller. The leadership should not be entrusted to a single person, with only native followers. There should be two or more principals, friends in council, to meet dangers and overcome difficulties, to relieve (by dividing) the depressing sense of responsibility, and encourage each other in the arduous struggle for success. The isolated traveller, perpetually worried by the prying inquisitiveness, mendacity, superstition, and cowardice of native followers, often in some weak and unguarded moment vacillates, loses judgment and decision, and turns back, when perhaps a resolute advance would involve less real danger, while ensuring entire success. It must always be borne in mind that an unsuccessful enterprise is not only so much time and money thrown away, but likewise aggravates the dangers, obstructions, and expense of any subsequent expedition. The increasing and impulsive inferior races deem only success courage—failure always cowardice, under whatever circumstances either occurs; and the traveller accordingly is met with unmitigated contempt and vexatious opposition upon a renewal of the enterprise. Then, again, supposing the judgment and decision to be fixed and sane, the isolated explorer may be disabled by illness, and even life itself may succumb apart from the ministering aid and sympathy of a kindred companion. If Livingstone had only submitted to work in double harness, it is more than probable that humanity and science would not now be deploring his almost irreparable loss; and even dying he would have left a trained associate to follow up his researches, and consummate his written and oral instructions for completion of the grand design of establishing a through communication of great water highways between Central Africa, with its degraded and secluded myriads of populations, and the Christian civilisation of the outer world.

One of the leaders of the expedition should be an engineer, and both should be familiar with mechanical and other useful knowledge, quick in discernment, fertile in resource, and knowing what to observe and how to observe. The code of instructions should include geological structure, mineral resources, elevations, meteorological observations, continuous contour sketches of the mountains on the right and left, and a map of the route, with symbols to indicate landmarks and sites suitable for constructions of stations, rudely built, but sufficiently convenient for temporary stowage of goods, and for rest and refreshment of men and cattle, as well as for shelter from the snow-storms, which sometimes occur even in the fine season in these elevated regions. All this may seem to involve much difficult labour and delay; but a cursive survey is quick and easy work for the practised eye and hand, and he who runs and reads, may run and sketch, and measure too. These statistics, together with brief notices of the mountain tribes, which may be sparsely incident upon the traveller's route, would constitute a valuable Blue-book for information of the Government, and, in more compact and concise form, a useful guide for the trader and the courier. The Himalayan Fauna and Flora are attractive subjects of study, but not essential for the practical requirements of imperial and commercial routes across the northern mountain boundaries of British India.

With respect to intervenient populations, it may be observed, that the mountaineers duly appreciate, after their own simple fashion, the advantages of trade, and if treated frankly (yet not too familiarly) rather incline to help than molest or obstruct the traveller. Such is my experience of the hill tribes bordering our eastern frontier station at Sudiya, where I was stationed in the Public Works Service some years ago. Had duty required me to enter the hill fastnesses of the Mishmees, or other tribes, I would have dwelt amongst them in hut or tent, not only without fear of molestation, but in full assurance of cheerful aid and service, and generous hospitality in supplying all my wants. These wild tribes have a worse name than they deserve, and are not half so unscrupulous, truculent, and vindictive as the Highland clans of Christian Scotland were a few hundred years since. A raid into Assam is generally traceable to some private act of oppression, or to some fraudulent trick in barter by the native pedlar of the plains. These unsophisticated children of the mountains are suspicious and resentful, and even a fancied insult or injury may give rise to a feud, and provoke an indiscriminate reprisal. Inflexible justice and determination are the surest palliatives for their fitful moods, and judicious kindness will always win their hearts; but the Sahib must maintain his natural ascendancy, otherwise he will compromise not only his personal safety, but all opportunities of benefitting the inferior race.

The route to Thibet and South-Western China lies through these tribal territories, and the traveller's safety depends mainly on his courage, energy, and presence of mind. The same qualities will enable him to set his face

as a flint to penetrate into Thibet, notwithstanding the specious display of forcible prevention by Chinese mandarins, who are as pusillanimous as they are cunning; and, well knowing that popular sympathy sides with the trader and the traveller, would become a friendly escort, instead of barring the way, if an inflexible resolution to push ahead at all risks was unmistakably shown. The natives of Thibet of all classes, and the great majority of the Chinese of the South-Western states, are favourable to Indian trade. The Thibetans eagerly smuggle our tea, the strong and full-flavoured Assam tea, whether brick or leaf, being more grateful to the rough palates of the natives of Thibet and Tartary, than the weaker and usually adulterated article forced into their markets by Chinese officials; and if trade was once authoritatively opened, all the available tea soils of Assam would be under culture in a few years. I shall not refer to other exchangeable commodities in this letter.

My statements, such as they are, are drawn from my own observation and inquiry during a seven years' residence in various districts, chiefly in northern Bengal, and I shall feel honoured if I have made any suggestion worthy consideration of the statesmen and merchants of Calcutta and Bombay.—I am, &c.,

R. Langford Locke, C.E.,
Honorary Corresponding Member.

133, Leinster-road, Dublin, Oct. 1874.

NOTES ON BOOKS.

Roman Imperial Profiles. By J. E. Lee, F.S.A., &c. (*Longmans*, 1874.)

In this book is given a series of sketches representing the profiles of the Roman Emperors and others related to the various imperial families, whose features have been preserved by the figures on coins, &c. The sketches are taken from the coins, and reproduced by means of lithography. The series commences rather before the time of the establishment of the Empire, for the first head given is that of the elder Pompey; Julius Cæsar, Brutus, Lepidus, Mark Antony, and Cleopatra are also included. The last of the series is Romulus Augustus, whose only title to remembrance is the fact that he was the absolute last of the Western Emperors. He was deposed in A.D. 475. His portrait, however, is only added as a curiosity, and it may be considered that the series really concludes with Julian the Apostate and his wife Helena (A.D. 360). Besides the portraits, which number 160, a brief notice of each individual is given.

GENERAL NOTES.

The St. Gothard Tunnel.—The following progress was made at the St. Gothard Tunnel during the month of August:—North side (Goeschenan), 120·40 metres; South side (Airolo), 60·68 metres; total advancement, 181·000 metres. The position of these works on the 31st of August was as follows:—North side (Goeschenan), 1246·20 metres; South side (Airolo), 1048·60 metres; total length driven, 2294·80 metres.

Mineral Statistics of Saxony.—According to the latest returns it appears that in 1872 there were 630 mines, with mineral rights extending over 39,100 hectares (96,577 English acres); of these 312 were metalliferous, 217 lignite, and 101 coal mines. The number of mines opened in the previous year amounted to 569, embracing 36,095 hectares (89,154½ English acres) of mineral rights. The mines appear to be well officered, for it seems that in the metalliferous mines there is one officer for each 17 men employed, whilst, taking mines of all classes, there are 22 workmen to each officer. The number of accidents appears to be comparatively small.

Sericiculture in Italy.—Some of the Italian papers announce that the Government have offered for sale 1,500 grammes of silkworm grain produced on the cellular system at the convict establishment of the Island of Pianosa (a small island situated a few miles south of Elba, in the Tuscan Archipelago), which place has never been visited by the silkworm disease. This lot of grain will be distributed to the various agricultural societies in the principal silk-producing provinces throughout the kingdom, to be sold at 15 francs per ounce of 25 grammes, a price far inferior to that usually charged for grain produced in the cellular system and guaranteed. Should this experiment prove successful, it is intended that the whole production of cocoons of this island, which at the present time is sold for the manufacture of silk, shall be reserved next year for the production of grain.

Suspended Railway Carriages.—The French scientific journals report trials of a suspended railway carriage body on the Lille and Valenciennes Railway. The invention is by M. Giffard, the inventor of the injector. The body of the carriage is suspended by means of horizontal springs attached to brackets on the frame. These springs are made to work with great smoothness by the interposition of small bronze friction rollers between the several leaves of the spring, so that when a heavy shock occurs the plates move over each other without touching and with an easy rolling motion. This is the first time, it is said, that friction rollers have been introduced between the plates of springs The reports on these new suspended carriages are favourable, the effect of sudden shocks and the unpleasant zig-zag movement are entirely obviated, or rather they are converted into different motions of a much milder description. The new carriages, in fact, when any disturbing cause appears, have the pitching and rolling motions of a vessel at sea, but to a very slight extent: enough, however, to be disagreeable to those who suffer much from such motions. On the whole, M. Giffard is considered to have hit upon a happy idea, and he is not likely to abandon it if he sees a chance of success. In addition to the comfort of passengers, there is another consideration, namely, the wear and tear of the rails caused by transverse oscillations, which have a tendency to wear the tires and flanges of the wheels, and to cause the rails to be pressed outward. It remains to be seen whether the suspension of a portion of the weight of the rolling stock will prevent this destructive action.

NOTICES.

THE LIBRARY.

The following works have been presented to the Library:—

London International Exhibition, 1871 and 1872: Printed Documents and Forms, and "The Key." Presented by Her Majesty's Commissioners.

Visite à l'Exposition de Vienne, par M. Bernardin. Presented by the Author.

A Practical Treatise on the Manufacture of Colours for Painting, by MM. Riffault, Vergnand, and Toussaint, translated from the French by A. A. Fesquet.

Transactions of the Institution of Engineers and Shipbuilders in Scotland. Vol. 17. Edited by the Secretary. Presented by the Institution.

Notes on Waves and Rolling, by M. Emile Bertin. Presented by the Author.

Roman Imperial Profiles; being a series of more than 160 lithographic profiles, enlarged from coins, arranged by J. E. Lee, F.S.A. Presented by the Publishers, Messrs. Longmans.

Homes and Homesteads in the Land of Plenty; a Handbook of Victoria. Illustrated by the Rev. James Ballantyne. Presented by S. H. Roberts.

Census of Victoria, 1871. General Report and Appendices.

Statistics of the Colony of Victoria for the year 1873. Part 6. Law, Crime, &c.; and Part 7. Religious, Moral, and Intellectual Progress.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,143. Vol. XXII.

FRIDAY, OCTOBER 16, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The fifth lecture of the third course of Cantor Lectures for the past Session, "On Carbon and Certain Compounds of Carbon," was delivered by Professor Barff, on Monday, May 11th, 1874, as follows:—

Lecture V.

In my last lecture I showed how sulphurous acid gas could be absorbed in its passage from a locomotive engine. It would not be difficult, I have been assured, to adapt an apparatus, at a very low cost, to the locomotives on the Metropolitan Railway. I have stated the matter to Mr. Ramsbotham, as great an authority on the subject as any in existence. I have, however, little hope that any experiments will be tried by the authorities of the metropolitan railways; all they have hitherto done has only very partially remedied the evil. Portland-road, Gower-street, and Baker-street stations, and the spaces between them are, now always nearly as unpleasant, and often quite as much so, as ever.*

I now pass on to liquid hydrocarbons. Here we have a lump of paraffine, and here is a bottle of petroleum oil. At our last lecture but one I showed you a bottle full of marsh gas. Now all those three substances are of the same family. We might, chemically speaking, say, here is solid marsh gas, and if I had a bottle of it here I might say this is gaseous marsh gas. If you remember, our symbol for the molecule of marsh gas is CH_4, or 12 parts by weight of carbon, and 4 parts by weight of hydrogen. This weight taken in grains, at the normal temperature and pressure, occupies twice 11·2 litres, or the size of that double cube which I showed you last week. Suppose we added to this CH_2, that will give us C_2H_6; then add to this again CH_2, that will give us C_3H_8; then if we add another CH_2, that will be C_4H_{10}; the addition of another will make C_5H_{12}. Now C_5H_{12} is one of the most important hydrocarbons in this ordinary petroleum oil. But there is still one more important than that, which is obtained by the addition of one more CH_2, namely, C_6H_{14}. This is what is called by chemists an homologous series. You see to each term of it we add CH_2, or 12 parts by weight of carbon, and 2 parts by weight of hydrogren, and it makes a new body, but still one of the same series. For some time the hydrocarbons of this class, paraffines, &c., were considered to belong to the olefiant gas series, to that gas which burns with a luminous flame. The molecule of that is C_2H_4, and you will also remember that when I treated that gas with some bromine vapour I got a new substance formed, bromine Dutch liquid. To-night I shall show you the result of acting on coal gas with chlorine, and I will show you the action of coal gas upon bromine, by which experiment we shall extract from the coal gas the olefiant gas, which olefiant gas will unite with the bromine or chlorine and form this liquid. Now chlorine and bromine unite directly with olefiant gas, so that if I take a volume of chlorine, and put to it an equal volume of olefiant gas, and get the two to unite together, there is no substitution product formed, but the two unite together and form this oily Dutch liquid. Now suppose I act on this substance, marsh gas, with chlorine, then I do not get the chlorine or bromine to unite directly with the marsh gas, but if the chlorine acts upon the marsh gas, a substitution product is formed, CH_4, which represents twice 11·2 litres, or we may call it two volumes, and Cl_2 will also represent two volumes of chlorine, Cl representing one volume of chlorine, or by weight 35½ parts, in comparison with the weight of hydrogen or of marsh gas. Now see how these will act together. CH_3H is the same as CH_4, then I will put one half of chlorine under the CH_3, and the other half under the H, and draw a line between them $\frac{CH_3}{Cl}\Big|\frac{H}{Cl}$ The body on the right of the line is hydrochloric acid. When these petroleum oils were acted upon with chlorine gas by a friend of mine, the result was that hydrochloric acid was formed, which gave a perfect denial to the assertion that these paraffines belonged to the olefiant gas series; for if the hydrochloric acid is formed, it is quite certain that chlorine must be added in the place of the hydrogen which comes out to form the hydrochloric acid. You see then that that is a very conclusive proof that these substances belong to the marsh gas series.

What is the importance of this? It is a very important thing that we should know the class of compounds to which those substances belong upon which we wish to experiment for applied science. We ought to know that, because their actions on other bodies are different. Marsh gas must be heated to a white heat, in order to cause a deposit of its carbon; but olefiant gas, when heated to a red heat, gives up half its carbon, and marsh gas is formed. All these are points of considerable importance for those to understand who are going to practice upon these things for the purpose of applying their knowledge to useful purposes. To-night I shall show you some experiments on the absorption of vapours by gases, and how that affects the illuminating property and the heating property of some substances. You will see now, I think, without my going far to explain it to you, how it is that we ought to know the nature of these substances which are the absorbents of these liquids in the state of vapour. We ought to know them, and we ought to know all about their illuminating properties. You have a mixture of gases to analyse. Suppose you want to see whether you have olefiant gas in a mixture of gases or not, you know how to do it. You pass that mixture of gases through a vessel containing bromine, the bromine will absorb the olefiant gas, and you will get globules of the Dutch liquid formed at the bottom. Here is a bottle which was prepared by a young gentleman in this room, a pupil of mine at the City Middle-class School. He prepared this himself, and here is a very considerable quantity of Dutch liquid, formed from olefiant gas and chlorine by the passage of common coal gas through a solution of chlorine in water. You cannot all see it at a distance, but you may examine it after the lecture.

Petroleum oil, or, as some call it, rock oil, comes from various sources. It is found in America and in different parts of the world, but we get the same substances, or nearly the same, from coal tar and wood tar. This substance here, solid paraffine, is obtained from wood tar or coal tar, or from some of these petroleum oils, by treating them in a particular way. Now I must call your attention to an apparatus which is on the table, arranged to show you how it is done. Here we have a retort with a thermometer in it, and a vessel containing water or any other substance we may choose to put into it, in which the retort stands. Here we have a Liebig's condenser, a tube through which water is continually

* The remark is equally true at the present date, October 16.

passing from the lower portion of the tube to the upper, in order that it may cool and condense any vapour that is passing through this inner tube. Here, again, is a receiver, which stands in water also to assist us in condensing. Suppose I heat up to a certain temperature the liquid I have here in the retort, a portion of it comes over and is received in this receiver and condensed, and the temperature told by the thermometer is 50° C., and has not risen above 50° C. That shows that the liquid boils at 50° C., or becomes vaporised at 50°. Suppose I get off all that can be got off at that temperature, and then put on another receiver, and then raise the temperature above 50° C., I find I get a liquid condensed at a temperature above 50°, say 60°. Then that liquid does not boil at 50°, but it boils at 60°. I remove that and try again, and so get another that boils at 70°. Then I have three liquids, one which boils at 50°, one which boils at 60°, and another at 70°. That is a method of separating one substance from another, and this process is called fractional distillation. I have described it very briefly, but that is how we separate volatile bodies from one another, which are of different degrees of volatility. Suppose then I take some of that crude paraffine oil in that bottle and heat it, I should find a hydrocarbon would come over at 50°, probably another at 86°; for there is one which comes over at 68°, the hydride of hexyl, $C_6 H_{14}$, and that is a principal constituent of all these paraffine oils; there is more of it in the paraffine oil than of any other. Then I have a residue left behind in the retort; what will happen to it? I may go on heating it up to 280°, and I shall get volatile matters coming off, but then at last I shall have a residue left, and if I leave it to cool, I find that white crystals will separate out, and those are crystals of paraffine. Thus we get our paraffine, and that can be purified by subsequent treatment. For instance you may dissolve it with hot alcohol, and then when the alcohol gets cool, the paraffine will crystallise and deposit in scales such as I have in a test-tube here. Here is some paraffine and alcohol, and here is another sample with less paraffine and less alcohol. Those will be put into boiling water, when the paraffine will melt, and on cooling again you will find the paraffine will be again precipitated. Then you can take the paraffine scales, when you get them, and clean them by pressing them with blotting-paper to absorb the liquid about them; or you may treat the paraffine with strong sulphuric acid. If the paraffine belonged to the olefiant gas series, you would not be able to treat it with this strong sulphuric acid, because if you remember I told you that strong Northausen sulphuric acid, the formula of which is $H_2 S_2 O_7$, will absorb the olefiant gas, but the marsh gas you may treat with a strong sulphuric acid readily, so that by heating the paraffine and strong sulphuric acid up to 100° C., the temperature of boiling water, and then leaving the mixture to cool, the sulphuric acid will remain at the bottom and the paraffines will come to the top, where you can get them in a state of considerable purity. Here is a very good specimen of crystals of paraffine, and here is some cast into a mould. This is the substance of which paraffine candles are made, and it is called "paraffine," because it has no affinity for anything else; it is very difficult to oxidise or to affect in any way chemically, therefore it is called *par affine*, without any affinity. Some of these oils, as they are called, will vaporise at a low temperature, and some will vaporise as low as 4° C., namely that whose molecule is $C_4 H_{10}$, which is a very low temperature indeed. Now suppose you had to experiment on a mixture of these oils, some very light and some very heavy, and you wanted to use them for illuminating purposes. If you heated the mixture in an ordinary lamp for burning paraffine oil, those which vaporise at a low temperature would be vaporised before you light your lamp. Suppose the temperature of the air to be somewere about 18° or 19° C., all the oils that vaporise below that will vaporise, so that you will have the chamber full of vapour and air mixed, and then you will get an explosion when you apply a light; for all these oils when mixed with atmospheric air produce very explosive compounds. You will remember I lighted a small quantity of marsh gas mixed with air, and it produced a tolerably loud explosion, and all these oils containing carbon and hydrogen in a state of vapour when mixed with atmospheric air will produce a very loud explosion if the quantity be large. But it is not so much the explosion that is dangerous, for when we apply a light the worst which would happen probably would be that it would cut the person on the face. Those explosions do not produce much damage usually; but what is more serious, the whole of the paraffine oil will catch fire, and it will run about all alight, and how will you put it out? If ever such a calamity should happen, do not go and throw water upon it, but put a mat upon it, or anything to keep the air away from it. Thati sthe way to put out a sudden fire, particularly when produced by the burning of such oils as these. I do not want to frighten you about paraffine lamps at all; I would rather encourage their use, but I do want to make a suggestion; and I am sure those who are engaged in the sale of these lamps will not think I am trying to injure them if I make a suggestion how they could be made more safe. These lamps are now being used on railways for burning paraffine oils. Consider what would happen suppose a collision took place which caused the lamp to be fractured. The oil would catch fire and run down alight on the people in the carriage, and that would be a considerable addition to the calamity. Therefore I would suggest to those who are engaged in promoting the use of these paraffine lamps instead of gas, that they should turn their attention to some method to prevent a catastrophe of that kind happening. It never has happened yet, but that is no reason why it never should. The reservoir of oil is above the lamp, and if that gets broken the paraffine will have to run down in contact with the flame, and if it does so it will catch fire, and if it runs down over the people you know what would happen, there would be no putting it out unless a person had presence of mind to put something upon it to keep away the air.

I have an experiment arranged here to show you the different volatilities of these oils. Some hot water will be put into this basin, and these two flasks will be put down into the hot water. They contain two paraffine oils of different boiling points. If this experiment succeeds, I shall be able to light the vapour of one oil at the orifice at the end of the tube, whereas I shall not be able to light that at the orifice of the other, and that will demonstrate by experiment the different volatilities of these oils. These were obtained, I believe, from this very sample of oil here, or one similar to it, by fractional distillation. Mr. Lewis distilled them, and has tested their volatility. We plunge them into the hot water, and you see the difference which I mentioned. The temperature of the water is 50° C. Thus you see one oil vaporises readily at that temperature, whilst the other does not. That property of vaporising on the part of these oils is very useful for some things, but very objectionable for other purposes. For burning in rooms, you should have an oil which is heavy, and that will not volatilise at any temperature to which it is likely to be submitted; but when you want to apply the hydrocarbons to other purposes, such as illuminating purposes, in lieu of coal gas, or to increase the illuminating property of coal gas, then the lighter oils are better. For heating purposes, the heavy ones do as well as the light ones, or rather better. Some time ago there was a scheme for making air gas, and I will show you a series of experiments presently for explaining it to you. Here is some hydrocarbon. The coloured liquid is right at the top of the tube; that is owing to the temperature of the room, which is causing a certain amount of the vapour to volatilise. Now Mr. Lewis is pumping some air through this hydrocarbon, and causing it to volatilise, when you see that the red liquid is descending. That is

owing to the fact that the bulb in the hydrocarbon is getting colder, and the air of this air thermometer is getting condensed, therefore the little drop of coloured liquid is descending, because the volume of air is less, owing to its condensation, that condensation resulting from the evaporation of the hydrocarbon producing cold. Here is a still more striking experiment. Here is a tube containing ether. I will dip this into another containing liquid, and you notice it comes out without anything sticking to it. This ether is considerably more volatile than the hydrocarbon which was in that bottle. Now air is being pumped through the ether, producing volatilisation of the ether, and that abstracts heat from the liquid in the test-tube, into which I inserted the tube containing ether, and when I take the tube out presently you will see it covered with a coating of ice. I have surrounded the whole apparatus with cotton wool, because it is a bad conductor of heat. Here then is a very striking illustration of the fact that when vaporisation takes place, heat is absorbed from some source. Now suppose you are passing air through a liquid hydrocarbon in order to charge it with its vapour. It is quite certain that in its passage the liquid hydrocarbon to become vapour must take up heat from the air, must be cooled, and the cool air cannot hold in suspension so much vapour, either of water or any other liquid, as warm air can. Here then, in passing air through hydrocarbons in order to charge it with their vapours, we have this difficulty to encounter at the first start, namely, that the vaporising of the hydrocarbon causes absorption of heat, and therefore prevents so great a saturation of the air as might be obtained if this did not happen. But, however, we can make our hydrocarbon warm, and then we can charge our air with a large quantity of it.

I now take out this tube containing the ether, and you see there is a lump of pink ice sticking to it; the liquid was coloured in order that you might be able readily to see it. But suppose a gas so composed be passed through a series of mains, through a large town, when the weather is cold, the gas or air would take up a certain quantity of the hydrocarbon at a certain temperature, so as to make it fairly luminous when it was burnt; but if that hydrocarbon gets deposited by cold, as it will, and as I will show you here by experiment it does get deposited, then the thing must be a partial failure. I believe it has been found that when air gas was tried it did fail, and I believe that is still the case, but that is no reason why some modification of it should not be used. Suppose you had a reservoir in your house containing some hydrocarbon. Supposing air were forced through mains to it, and the hydrocarbon was taken up upon the premises, it might be then used, but you would still have this other difficulty to overcome, there is vaporisation, and there is absorption of heat, and therefore some appliance must be added to the apparatus, in order that the hydrocarbon may be kept at a sufficient temperature to be taken up in sufficient quantity by the air passing through it, in order that you may get out of it the proper quantity of illumination. I do not despair yet of seeing this method employed.

But there is another method of which I have heard to-night from a gentleman, who informs me that he had heard from his own gas engineer's report that it was doing very fairly at Chichester. The apparatus is standing on the table. Superheated steam will be passed over red hot carbon in a tube in the furnace. To begin with, steam will be generated in a tin botttle; it will then be passed into a fire-clay retort, which will be heated, so that the steam will become superheated. It will then pass over carbon, which will be heated in that iron tube, and by-and-bye it will be lighted. It takes some time doing, and I will call your attention to it again when it is completed. We shall get the gas burning at that little orifice with a non-luminous flame; it will be a mixture of hydrogen and carbonic oxide, and afterwards, if we have time, it shall be passed through a liquid hydrocarbon, when it will take up some of the liquid hydrocarbon, and then it will burn with a luminous flame. I believe that is the principle of the manufacture which is now being carried on at Chichester.

Now let me call your attention to another experiment. Hydrogen gas is being generated here, and it is burning at the end of this first tube with a now luminous flamo. But then it passes into this bottle containing cotton wool, which cotton wool has upon it a few drops of petroleum oil; the petroleum oil is taken up by the hydrogen gas, and here you see we have a luminous flame, which gives a large quantity of smoke. Then again the hydrogen gas so charged is passing here through a bent tube (called a U tube) which is immersed in a mixture of ice and salt. It will be taken out of this mixture presently, and you will then see that a considerable quantity of the liquid hydrocarbon is deposited from the gas by passing through this cooling medium. That experiment is to illustrate what I said just now, that if the air charged with the hydrocarbon is submitted to a low temperature, a certain amount of hydrocarbon oil is sure to be deposited. Here is a large deposit of ice and snow from the moisture of the room on the outside of this vessel. It illustrates what I said just now that when air is cold it will not hold so much water vapour in suspension as when it is warm. Everybody who has been in a laundry or a hot-house knows this; and it is the same with other liquids as with water. Here is a Bunsen burner. At the bottom of this, where my fingers are, there is a small orifice for coal gas to pass up, and above that there are two holes to allow air to pass in and mix with it. On lighting it you see we get a luminous flame. It gives light. Now I will change its course, and pass the coal gas through a bottle containing a hydrocarbon—some petroleum oil. On lighting it you notice the flame is much more luminous, and it deposits a very large quantity of soot on a saucer held in the flame. Now I will let the air pass up and mix with the gas, and you see it becomes non-luminous, and there is no deposit of soot. That is a very important subject, and I am certain very important results can be got from studying this action. In the first case we have gas containing carbon, hydrogen, carbonic oxide, and olefiant gas—that is coal gas. That passes through the tube, and burns with a luminous flame. When we add to it a hydrocarbon it takes up some of this hydrocarbon in suspension, and the flame becomes more luminous and smoky, showing there is a very large quantity of carbon in the material burnt, which carbon cannot be fully burnt, or anything like fully burnt. But directly we let the air go in at the bottom there is a more perfect combustion of the carbon of the coal gas, and of the carbon of the hydrocarbon with which the coal gas got charged. Experiments were performed some time ago with hydrocarbons for the purpose of making coal gas more luminous, but they so far failed that the material has never been brought into general use. But I do not myself see why it should not be, and I do think if any of you gentlemen who are inventors will turn your attention to it, there is a very large field for you to work upon, in giving greater luminosity to coal gas. I am speaking of London coal gas, particularly in the district where I live, at Kilburn, for the gas there is abominable.

Now we come to another point. It is quite certain that if a certain quantity of the carbon and hydrogen of coal gas burn for a certain space of time, the carbon and hydrogen in burning must give out a certain amount of heat, and no more; and if you put more carbon to it, and more hydrogen, then that carbon and that hydrogen which is burnt must give out an additional quantity of heat. Now, whether the presence of hydrocarbon oil in this burning gas produces a greater amount of heat in a given amount of time I say nothing, but that in the end it must do so is quite certain. You have noticed, no doubt, that those paraffine lamps, the Silber lamps, and Mr. Dietz's lamps, are very suc-

cessful and good lamps, so far as the light goes, but if you put your head near them they are excessively hot; there is an enormous amount of heat given out in the combustion, because the hydrocarbon oils are very rich in carbon. You have also seen those fires that are arranged with lumps of asbestos, or fire-clay. You turn on the gas and you have a fire in a very short time; it is a very convenient and very agreeable substitute for, though it is not so good as, an ordinary fire; but they have certain merits. In these you burn coal gas, and I am sure if any gentleman present here is connected with the manufacture of these fire-places it would be well for him to turn his attention to this fact, that the proportion of air and coal gas in most of those stoves that I have seen is not properly regulated, for upon the lumps of asbestos you get a considerable deposit of unburnt carbon. This ought not to be. People will tell you that you are saving the smoke that goes up the chimney and so on, but you are not saving it. You are losing a certain amount of heat by the deposit of carbon on the fire-clay. If you were to pass your coal gas, prior to its being burnt, through some of these liquid hydrocarbons heated in a vessel at the side, then you would give more fuel to be burnt, and project it upon this fire-clay, and if it were properly apportioned to the quantity of atmospheric air allowed to pass in with it, you would get a very high heating power, and the advantage of it would be this, that your heat would be stored up in the fire-clay, and would then be given out again into the room gradually. I am speaking advisedly, because I made an experiment this week which did not turn out at all to my satisfaction, for it proved quite the contrary to what I wanted. It proved that by adding hydrocarbons you do not intensify the heat of the flame at any given moment. Yet in the combustion of the coal gas, together with the hydrocarbon, you do produce a larger amount of heat, and if the heat be stored up in such a reservoir as I have mentioned, &c., lumps of fire-clay—which I shall have to say more about another time—you get that heat given out in the room, and I think you would thereby get a very economical use of fuel. This leads me to say a few words on two very admirable papers which I have been reading this week, written by Captain Selwyn, which he read before the Society of Naval Architects. He has been engaged largely on a most important application of these hydrocarbons, viz., to the heating of water in steam engines, particularly in ships. I cannot go into these papers this evening, and I have no doubt all of you who are interested in the subject will be able to get them and study them, but I may refer to one point mentioned by Captain Selwyn, viz., that when this hydrocarbon is projected into a fire-clay furnace, he has noticed that a very large amount of black carbon deposit formed. I believe that black deposit is simply analogous to the deposit you get in a gas retort. I have no doubt that in that deposit you have a large quantity of carbon in the form of graphite. I believe the remedy for that, and the utilisation of that material in the heating of water in those boilers, would be found in introducing a larger quantity of air and by reducing pressure. I shall allude to this again. I believe in nearly all these experiments the mistake is that a sufficient quantity of air is not projected along with the hydrocarbon. People allow the natural draught to do it, but the natural draught is not always sufficient, therefore some kind of blowers should be used. Again, if the air be sent in cold its effect will not be nearly so great as if the air be sent in at a higher temperature, so that when it comes in contact with this hydrocarbon it will be at a temperature somewhat approaching that at which they are burning. Here is an experiment which shows the effect of the projection of oxygen into the smoky flame. There is the hydrocarbon burning with a very smoky flame, but on projecting some oxygen into it you see what a magnificent light we get. There is no smoke at all here, because we get a more perfect combustion, but the smoke returns as soon as we cease forcing the oxygen into the flame.

One word or two about the luminosity of flame. You noticed that the flame of hydrogen gave no light, but directly we added a hydrocarbon to it, it did give light, but the flame was very smoky. If you examine the flame of a candle carefully, you will find the yellow portion of the centre, with the little blue portion below, and if you look very carefully you will see a sort of halo all around, which I can hardly call luminous, but it is a flickering sort of halo; that halo is where the most perfect combustion in the flame of carbon takes place. In the centre of the flame you have imperfect combustion of the carbon, and the carbon gets set free. The carbon which is set free in the centre of the flame (from the marsh gas it may be, or most certainly from the olefiant gas, and from the hydrocarbons in the gas), that carbon in a state of very fine division becomes incandescent, and so gives light. You have all seen the oxyhydrogen light, but the oxyhydrogen light does not give so much light as the flame I showed you just now; but if you put a piece of lime into it you get a brilliant light, because the lime becomes incandescent. If you take a piece of iron it gives no light, but if you put it into the fire and heat it to a white heat it gives a light. In a smithy you know you can read by the light emitted by a piece of white hot iron, and when the smith strikes that the heat is intensified with the blow, and you get flashes of light given off by which you can see to read. The presence of solid matter therefore appears to be essential to the light-giving properties of our ordinary illuminating flames. There have been experiments performed by Professor Frankland from which he says that the presence of solid matter is not absolutely essential, but I do not suppose he or any one else would at all doubt the fact that the luminosity of ordinary flames is owing to the presence of solid particles heated to incandescence. What we want to do to make our flames give a proper light, and to economise our fuel to the fullest extent, is to add a proper portion of the oxygen of the air to the quantity of the hydrocarbon being burnt. When we come to speak about lamps, which I shall do in the last lecture, I shall have to speak about this more fully.

This evening I want to commence the subject of coal gas. It is made from coal, but that is not the only source from which we can obtain gas. We can obtain a luminous gas from any animal or any vegetable substance. Any organic substance containing carbon and hydrogen, when heated out of contact with atmospheric air, will give off a gas similar to coal gas. When I was a boy, London was lighted with oil, but I remember at Haggerstone there were two gas factories erected, one an oil gas factory and the other a coal gas factory. The oil was tried as a source for obtaining illuminating gas, and it answered very well in one respect, but I suppose it was not successful commercially, and therefore the oil gas factory was turned into a coal gas factory. But you may easily try the experiment. If you put a little oil into a test-tube and put into the end of it a small tube brought to a point, and then heat the end of the tube containing the oil, you will find after a time the oil will char, and on applying a light to the orifice at the end you will find the gas will burn there. From whatever source we get gas, its main constituents are the same. Coal gas contains certain gases which are useful for illuminating purposes, and also certain gases which are not useful, but, on the contrary, hinder the illuminating power of those which should give light, or contribute to give light. First of all, coal gas contains hydrogen; it also contains marsh gas, olefiant gas, and carbonic oxide gas. All these four gases are useful for illuminating purposes. If you light hydrogen by itself it gives no light, and carbonic oxide, which I burnt one night here, gives no light, and marsh gas gives no light, but

olefiant gas gives a light, owing to its containing a large quantity of carbon. Of what use then are those other three gases? One use is that they hold in suspension the hydrocarbons, for coal gas, if it has good illuminating power, especially that which is made from cannel coal, contains a very large quantity of hydrocarbons. It contains a hydrocarbon called butylene and also napthaline, a solid hydrocarbon, and other hydrocarbons. You have seen this evening that gas can take up hydrocarbons. Coal gas takes up these hydrocarbons in small quantity, and keeps them in suspension in spite of any freezing mixture through which you might pass it. And those hydrocarbons assist in giving light. Gases that take them up in suspension assist in giving heat, for the carbonic oxide and the marsh gas flame and the hydrogen flame are all very hot, and they also decompose the hydrocarbons and deposit the carbon in the flame, and the carbon becoming incandescent gives light. Then there are certain impurities in coal gas, impurities which do not exist in gases made from such substances as oil. One of the greatest impurities in coal gas is sulphuretted hydrogen. There is a considerable quantity of sulphur, as I have told you before, in all coals, so that when coal is decomposed by heat—and I shall make some coal gas at our next lecture—some of the hydrogen of the coal unites with carbon to form marsh gas, and with some of the carbon to form olefiant gas, and some of the oxygen and carbon to form carbonic oxide, and some of the hydrogen unites with the sulphur and forms sulphuretted hydrogen, and some sulphur unites with some of the carbon to form a liquid called bisulphide of carbon. The impurities, then, in coal gas, are very numerous, and among them is ammonia. I shall speak to you about the formation of these, and the method of purifying gas next time. Those are the principal gaseous impurities, but besides that there is bisulphide of carbon and also a small quantity of carbonic acid, and with that I will leave the subject of coal gas for the present.

I must now call your attention to the experiment which we set going just now. You see that superheated steam is being passed over the charcoal, and has formed carbonic oxide; the carbonic oxide is passing through a hydrocarbon there, and you notice the luminous flame that we get. It is not only luminous, but highly smoky, owing to the large quantity of hydrocarbon which is taken up. That is, I believe, the principle of the method by which the town of Chichester is now illuminated. Whether it will continue to answer or not I cannot say, as there are certain difficulties to be overcome, which I have already mentioned to you.

It is stated by the *Athenæum* that a vein of coal has been discovered in Colorado, which contains the trunks and limbs of trees resembling red cedar, transformed into bright hard coal resembling jet. If this is confirmed by further observations, and the metamorphosed wood does not prove to be a lignite or brown coal, some light will be thrown on an important question connected with coal formation.

Swedish Branvin (brandy from grain, potatoes, &c.) is chiefly distilled on farming estates under the control of Government excise officers. The quantity of this spirit, containing 50 per cent. alcohol, distilled in 1873, at 287 distilleries, was about 13,898,700 gallons, against 10,526,200 gallons distilled in 1872. The quantity brought to Stockholm was 2,800,000 gallons.

Messrs. Bentley and Sons will shortly publish the works of Thomas Love Peacock, including his novels, poems, fugitive pieces, criticisms, &c., with a preface by Lord Houghton, and a biographical notice by his granddaughter, Edith Nicolls, edited by Henry Cole, C.B.

The Statistical Society has changed its quarters, and its address now is Somerset-house-terrace (King's-college entrance), Strand.

ANNUAL INTERNATIONAL EXHIBITIONS.

The Board of Management being desirous of extending to the greatest numbers of the public the advantages of the technical instruction afforded by the International Exhibition before its close on 31st October, have decided to reduce the charge of admission to one penny daily, except Wednesdays, when the charge will remain one shilling. The reduction will commence on Monday, the 19th October.

The following is the return of admissions for the week ending October 10th:—Season tickets, 809; payment, 10,867; total 11,676.

EXHIBITIONS.

Philadelphia Exhibition.—The French Government has appointed its representatives for the Centenary American Exhibition; they are M. Lacathon de la Forest, Consul-General of France at New York, who is appointed Commissioner, and M. d'Epleux, Vice-Consul, who is to fill the office of Special Joint Commissioner at Philadelphia.

Maritime and River Industries Exhibition.—It is proposed to hold next year in Paris a general exhibition of all kinds of machinery, apparatus, implements, and other articles employed on board ship, in fisheries, and all other trades pursued at sea or on fresh waters, to which is to be added a collection of the principal articles of French exports. It will be remembered that such an exhibition was held at Havre in 1868, but with only moderate success, in consequence of its following so closely on the great International Exhibition of Paris. The proposal is warmly supported by the Chambers of Commerce, and especially by those of the seaports of France; and the greater attention which is now being given to trade, commerce, and navigation will doubtless render such an exhibition highly successful. Moreover it is one in which this country has an especial interest.

BIRMINGHAM MUSEUM OF ARMS.

This museum was formally opened to the public at the end of last month, after a considerable time spent in classification and arrangements. The nucleus of the collection was formed some years ago, by an Italian gentleman, and it has been recently purchased and enlarged by the wardens of the Birmingham Proof-house. It includes specimens of weapons of all kinds, ancient and modern, as well as swords, rapiers, daggers, &c., besides guns. In the latter class are numerous examples of the early match-locks and similar weapons. The guns in one rack illustrate the various systems which have been used in the English service from the first introduction of portable arms to the present day. They include match-lock guns, 1471; wheel, 1529; flint, 1670; rifles, 1794; Prussian lock guns, 1839; rifles with conical expanding bullet, 1853; breech-loaders, 1861. In another part of the room is arranged what is called the Enfield case, showing the whole process of manufacture of all the parts of a musket, going up from a flat piece of iron to the last process of polishing a barrel.

At the opening ceremony there were present, the Mayor (Mr. J. Chamberlain), Mr. Aitken, Mr. Buckley, Mr. Goodman, Mr. Ryland, and many others, representatives of Birmingham commerce and industry, and in the speeches delivered several remarks were made as to the desirability of obtaining Government aid towards the establishment of such provincial museums.

THE EDUCATIONAL AND ECONOMIC VALUE OF MUSEUMS AND EXHIBITIONS.

The following was the introductory lecture delivered by Professor Leoni Levi in King's College, London, at the opening of the session :—

I am glad that public attention has of late been closely directed to the importance of extending and utilising museums and exhibitions of every description, for it is well to familiarise the eye and mind of the people with whatever is good, true, and beautiful. How much should we desire that in all our great centres of population there should rise not only the church and the school to stem the tide of ignorance and crime, but well appointed museums for the illustration of the analogies and affinities of organised and inorganised objects, galleries with good examples of art and design, libraries well stored with intellectual wealth, and may I add parks and gardens where pure oxygen may be breathed, and the gorgeous beauty of flowers admired. Truly museums and galleries go hand in hand with the school and the library, for whilst literature is exhausting its utmost power in beauty of illustration and vividness of language to depict to our mind the doings and manners of ancient and modern people, museums and exhibitions are laying before us with all the truthfulness of reality the wonders of nature, and the splendid works of human skill and ingenuity. In some elements, indeed, a museum is even better than a book, object teaching being always striking, impressive, and deeply instructive. The lesson derived from it is always real, and because real, permanent.

Collections of works of art in ancient times found their place in the peristyles of temples, and in palaces of kings and princes. The temples of Diana at Ephesus, of Jupiter Olympius at Athens, of Apollo at Delphi, were rich with statues and monuments of great value. The palace of Ptolemy at Alexandria was the parent of modern museums. But as temples were despoiled, and palaces ransacked, separate collections began to be formed of coins, gems, busts, and other rarities. With the progress of travel specimens were collected in foreign parts of whatever seemed interesting and curious. Men of science, too, formed collections of scientific instruments and inventions, and thus museums were instituted dedicated to the muses, to literature, to philosophy, and to the preservation of rare articles, which have ministered and do minister largely to the interests of civilisation. The Ashmolean Museum at Oxford is an exhibition of natural and artificial curiosities brought together by Sir John Tradescant, who travelled over a considerable portion of the globe, with the distinct object of improving himself in natural science. The British Museum was formed of the aggregate of many collections made by *dilettanti* and students in the pursuit of knowledge. Of course, as their origin was different, so their contents exhibited great variety. The Dresden Museum, a monument of the riches and taste of the Saxon princes of former days, is full of rarities in objects in bronze and ivory, in cabinets of florentine and mosaic intaglios, and jewels. The Hermitage, founded by Catherine the Great of Russia, to serve as a refuge from the cares and duties of Government, is wonderfully rich in paintings, in numismatic collections, and works of art. The Vatican luxuriates in the works of Raphael and Michael Angelo; the Louvre, in Paris, the National Museum of Berlin, and the British Museum abound in objects of untold value to literature, science, and the fine arts. We may lament the removal of statues and monuments of antiquity from the places for which they were originally designed, and which they so well adorned. Why rob the temples and palaces of Carthage, Nineveh, and Greece to enrich the museums of London, Paris, and Berlin? For the simplest of all economic reasons—that thereby the benefit of the largest number is best promoted. The marble slabs of Assyrian temples, the obelisks of Egypt, and the bas-reliefs from the ancient Halicarnassus, were, in their day, the objects of admiration of millions of eastern people. Now, they are the glories of the western world. It is comparatively a new feature of the museum to contain a systematic collection of natural or human products for purposes of public instruction. But whatever be its contents, whatever its intentions, none can fail to derive instruction from a musuem, one of the best schools we can establish for the education of the observing faculties.

We may well regard a museum as not only a place of elevating entertainment, but as a school of the highest order. To the casual visitor, to the earnest student, to all of us, a museum is a perennial source of instruction, for it imparts the knowledge of articles which might seldom otherwise cross our path; it brings into contact objects which have close affinity with one another, but which are found scattered in different parts of the globe, thus affording means of classification, otherwise never imagined or indeed possible; it makes nature and art minister to one another, often to the advantage of both; and it affords us means of comparison, whereby we may discern merit wherever it exists. It is only when we see side by side the remains of Etruscan, Assyrian, Roman, Greek, and Mediæval antiquities, that we can attempt to fathom the wonders of archeology and ancient art. It is when brilliant examples of the Italian, Dutch, Flemish, French, Spanish, and English schools of painting are all before us, that we can best appreciate the peculiar æsthetic qualities of those who carried the art to the highest pitch. It is when we see in perfect succession the various families of the animal kingdom, when thence we pass, by almost insensible gradations, to the vegetable kingdom, and when from the vegetable we imperceptibly enter into the mineral kingdom, that we can best realise the beauty, order, and symmetry which obtain in all created things.

In many ways a museum contributes to the advancement of instruction and science. It is in connection with the Jardin des Plantes, in Paris, that Buffon and Cuvier rendered such noble services to natural history. At Oxford, Professor Phillips made the museum a practical expositor of his lectures on geology. At Kew, Dr. Hooker is constantly at work studying the wonders of vegetable life, and experimenting on the growth of plants of every clime. At Jermyn-street, Professor Huxley is popularising the principles of natural history. At the British Museum, Professor Owen has become the foremost expositor of comparative anatomy. As curators of our museums, we have a body of men of the highest order, who by constant analysis and classification are rendering enormous service to science; and though they do not teach the sciences which they labour to develop by way of lectures, the students who visit the museums with a view of pursuing the highest branches of knowledge benefit by their guidance. The value of a museum for purposes of scientific instruction was well set forth by Sir Henry de la Beche in his inaugural discourse delivered at the opening of the School of Mines, when he said :—"We propose to instruct by means of our collections, our laboratories, our mining record-office, our lectures, and the geological survey, thus teaching as well in the fields as in this building, and so that the pupils can become practically acquainted with mining in our various mineral districts, be able to study geology on the ground itself, and so unite, in a manner not hitherto attempted, and yet in one for which our opportunities amply provide, a sound combination of science and practice—a combination also kept steadily in view in our laboratories, and in all branches of the instruction upon which it is now proposed to enter. The objects collected are not intended to be mere assemblages of specimens, striking either for their brilliancy, colour, or form. In whatever department they may be found, they are intended to be instructive with reference to the especial object proposed in that

department, and to be employed in illustration of the teaching by lectures or other means adopted by those in charge of the different departments confided to them."

I am satisfied, also, that museums and exhibitions greatly subserve the economic interests of the country. Do not imagine that the only way of increasing national wealth is by promoting trade and commerce. Whatsoever tends to refine the taste, to cultivate the intellect, and to extend the faculties of the people, has also an immediate tendency to increase its productive power. Some thirty million visits have been paid to the five International Exhibitions already held in London, Paris, and Vienna. Millions have already visited the Kensington Museum, and it would be all but impossible to number those who visit from year to year the Louvre and the British Museum, the Vatican Gallery, and the Berlin Museum. Doubtless the amount of instruction acquired by such visits will differ in proportion to the receptive power of the visitor, the object of the visit, and the amount of attention bestowed; yet I venture to say, not one such visit is absolutely lost in the way of rendering the visitor better able to take his part in the great work of production.

But look at the special instruction which museums and exhibitions afford. How often difficulties which seemed insuperable have been seen there effectively surmounted; how often a link yet required for a great and useful discovery was there suddenly discovered; and in how many instances obstacles which stood in the way of great achievements have been there almost by magic removed. We might wish that more information were given with the objects exhibited, but even without any fact in explanation, the simple ocular evidence of what has been accomplished is an enormous advantage. And I do not think that the time has come when we can dispense with any extraordinary method for becoming acquainted with the production and resources of other countries. For upwards of one hundred years there has been a close and continuous intercourse between Britain and India, yet to this moment our knowledge of the capacity of her soil and of the habits, manners, and wants of the many races that inhabit the country is most imperfect; and Dr. Forbes Watson could not render a greater service to India than by the reorganisation of the India Museum in London, so that it shall exhibit in miniature all the varied characteristics of the land and people of that vast empire. Turkestan is one of the latest acquisitions of Russia. How could even a faint knowledge of the value of such a far-off province be spread among the people of European Russia? The Moscow Industrial Exhibition offered an excellent opportunity for the purpose; and it was interesting to see in a special department of that exhibition a full and palpable illustration of Turkestan, its mountain scenery, its flora, its fauna, its races, with their bazaars and industries brought before the eyes of the thousand visitors from every part of Russia.

It would be difficult to estimate to what an extent we are indebted for the enormous development of commerce within the last twenty years to the recent International Exhibitions as a distinct element, side by side with a better commercial policy, the introduction of railways, and other agencies, but doubtless the influence of exhibitions on commercial intercourse has been very considerable. It was not in vain that an opportunity was afforded to all nations to exhibit their resources in the most effective manner possible to the gaze of the whole world. And what a stimulus did such exhibitions afford, especially to the improvement of art manufacture! What masterpieces of industry have been achieved! What sharpening of skill! What attention to detail! What inventiveness of novelties in view of the great competition? And the current of improvement once set running it is not arrested. A marvellous advance was exhibited in various industries in 1862 and 1867 over what had been seen in 1851 and 1855. The agricultural machinery of America revolutionised agricultural industry all over the world. The sewing machine suddenly became universal. By the introduction of caoutchouc the whole world was united by telegraphic lines. The bright anticipations that universal exhibitions would inaugurate a new era of peace and good will among nations were, alas, sadly disappointed. Yet much has been done to unite together the families of the earth by bonds of interest and friendship. And we trust that sooner or later the diffusion of religion and morals, the perfectionment of the arts of civilisation, the softening of manners, the spread of science and education, will tell sensibly on international relations. From whatever aspect we regard them, whether in relation to education and science or to commerce and productive industry, I am convinced that museums and exhibitions confer incalculable benefits.

Of her leading national museums Britain may well be proud. The British Museum with its natural industry department, including zoology, botany, geology, and mineralogy, the department of antiquities, and the famous library, probably the largest working library in the world; the South Kensington Museum, one of the most brilliant exhibitions in the kingdom; Kew-gardens, the Museum of Practical Geology, the Patent Museum, so rich in illustration of the germ and progress of modern discoveries and inventions; the Soane Museum, the Edinburgh Museum, and the Dublin Museum of Natural History, to say nothing of Windsor Castle and Hampton Court, are one and all institutions of the greatest possible value. Nor must we forget such museums as have been founded by noble benefactions, and the libraries and museums founded by local rates under Mr. Ewart's practical statutes. I am not prepared, however, to say that such museums are either as elegant as we might wish, or sufficient in number or well distributed over the kingdom. Compare the national museums of London, Paris, Rome, Turin, Florence, Berlin, and Dresden. If we take into account space, and still more the population, I venture to say London is less provided with museums than any other capital in Europe. Nor should we forget that whilst abroad all public museums are free, and even the palaces and galleries of private individuals are open to the public, in London the Tower can only be seen on payment of a fee, and not a single private gallery is available either for study or entertainment. All honour to Sir Richard Wallace for his munificent liberality, and for the noble use he makes of his splendid paintings and works of art.

In this huge metroplis we have upwards of three millions of persons spread over some twenty or thirty square miles of space. It is true that the railway and the omnibus render every part of London easily accessible to one and all, yet there is reason to fear that the inhabitants of the extremities of the metropolis are really wide asunder, and that unless means of elevation are provided in the very centre of the different districts, the people in one quarter benefit but little from the advantages offered to them in another. How are the museums located? The British Museum and the National Gallery are in the very centre of the metropolis, but the South Kensington Museum is too far west. Yet there seems to be a disposition to constitute of that district a city of museums. I fear such an arrangement, however desirable on many grounds, will not prove altogether satisfactory to other districts of the metropolis. I rejoice that Bethnal-green has a beautiful museum, and that the City of London has been also endowed with a most interesting museum and library which the clerks in the City fully value. But nothing has yet been done in the north of London, and the effort made for the southern district has as yet borne no result. And as for the provinces, whilst Birmingham, Liverpool, Manchester, Dover, Ipswich, Blackburn, Leicester, Nottingham, and several other towns have either adopted the Public Libraries and Museums' Act, or provided libraries and museums by other means, there are at least some 200 cities and

boroughs which have taken no step whatever to secure so great a boon.

Much, I am convinced, might be done by the trustees of our metropolitan museums to encourage the formation of local and provincial museums and libraries. In 1860, a committee of the House of Commons was appointed to inquire whether it was in the power of Parliament to provide, and of the House to recommend, further facilities for promoting the healthful recreation and improvement of the people, by placing institutions supported by general taxation within the reach of the largest section of taxpayers. And the recommendation of the committee was, that the British Museum should follow the same course with surplus works of arts and duplicate specimens as has been tried with so much success in the Government schools of design throughout the country, viz., that there should be loans of such works of art and objects of curiosity under proper regulations, wherever responsible parties should provide suitable premises for their exhibition. So that, instead of our national collections being virtually entombed as at present, or becoming so vast as to bewilder, and yet so crowded as to be hidden, profitable recreation might be provided in the various crowded districts of the metropolis which would successfully compete with places of demoralising amusement. And quite recently the Royal Commissioners on Scientific Instruction have recommended that in connection with the Science and Art section of the Education Department, qualified naturalists be appointed to direct the collection of specimens, in order to supply whatever deficiencies exist in the more important provincial museums, and also in order to organise typical museums to be sent by the Department of Science and Art into the provinces to such science schools as may be reported to be likely to make them efficient instruments of scientific instruction. The Kensington Museum has for many years pursued the excellent plan of lending its surplus treasures to local museums. I do trust that an object so important will not be allowed to lay dormant, and that museums may be formed in all our chief towns ready to receive such aid from the national museums, and that they will be urgent in their demand that the trustees of such may make proper regulations for the purpose of facilitating the desired loans.

But another object engaged the attention of the committee of the House of Commons, and that was, whether facilities can be afforded to the people at large for visiting public institutions on week-day evenings. And the committee came to the conclusion that institutions such as the British Museum and National Gallery should be open on week-day evenings to the public. There was no doubt that whenever it had been tried, the opening of museums in the evening had proved a great success. Since, therefore, the opportunity is afforded of bringing the instruction and pleasure to be derived from visiting them within the reach of those who are occupied during ordinary working hours, it is most desirable that such museums and galleries should be opened, under due regulations, within the hours of seven and ten in the evening at least three days in the week. Unfortunately, however, the British Museum cannot, it seems, be safely lighted by gas. Soon after the publication of the report of the committee, the trustees made careful inquiry on the subject, but on finding that gas desiccates everything within its reach, especially all ceiling, roofs, &c., thus rendering them more inflammable, and that the heat and fumes evolved by the combustion of gas are against the preservation of any vegetable or animal substance, and tend to discolour stone, marble, &c., the trustees came to a unanimous opinion that they would not be justified in allowing the collections of the British Museum to be open at any hour which would require gas-light. Hence they contented themselves by opening it during the four summer months, from May to August, from six to eight o'clock, and by so doing they attracted to the museum some 2,000 visits a-year during those hours. As for the National Gallery, no step whatever that I know of has been taken on the subject. I do not think, however, that the question should be allowed to remain at rest. Surely we may anticipate that the new Natural History Museum at Kensington will be constructed in a manner to admit without danger of its being lighted at night. And once that large department is removed from the British Museum, it may yet be possible so to isolate the library as to allow the department of antiquities and other portions of the museums to be so lighted at night. Nor can I conceive why paintings cannot be safely preserved under glass at the National Gallery, while they may be so preserved at South Kensington. It is much to be hoped that with the enlargement of the National Gallery provision may be made for the opening of that institution at night, a measure which I am certain will prove most popular.

I think, moreover, that oral instruction should be provided in connection with our museums and galleries, not, indeed, for the numerous visitors who flock into them without a purpose and out of mere curiosity, but for such as might be willing to take advantage of instruction afforded in a manner at once practical and agreeable. I have always thought that, where possible, we should endeavour to illustrate our lectures by reference to things material and visible. When I lectured on the commerce of different countries, I visited with my class the contributions of each of them to the International Exhibition. When I lectured on the textile manufactures, I had with me here samples of the raw materials from every country of production. When I lectured on the coinage, I went with my class to the Royal Mint. When I lectured on banking, we went together to the Bank of England and the Clearing-house. What a splendid opportunity is afforded to our museums for teaching at once by lectures and by ocular demonstrations. It seems unpardonable not to use it to the fullest possible extent. I thoroughly concur, therefore, in the recommendation of the Royal Commissioners on Scientific Instruction, that courses of lectures should be given in connection with the collections of physical and mechanical instruments to be formed; that lectures on science, accessible to all classes on payment of a small fee, should be promoted by the Government in the great centres of population, and that such lectures should be partly of an elementary character, on the general principles and most important facts of science, and partly of a character specially intended for the working classes, on the application of science to the arts and industries of the country. An excellent collection of specimens of the products of the animal kingdom is now exhibited at the Bethnal-green Museum. They are not objects of attraction as articles of vertu and art; they seem by themselves purposeless. Let courses of lectures be delivered on the history and uses of such articles, the places where they are grown, and the commerce which they create, and the utility of the collection will be immensely increased.

A library must ever be the handmaid of a museum. Wherever a special museum is founded for the illustration of any department of science, there a special library should be established also. In this light I cannot help thinking that the severance of the department of natural history of the British Museum from the great library, so rich in works of biology, will prove most inconvenient to students, and will, eventually, lead to the formation at South Kensington of a special library for the purpose. That, however, will not be a calamity, for I fear the central library at the British Museum scarcely suffices for the wants of the people—not, indeed, from want of books, but probably from a superabundance of them, and from the consequent difficulty of rendering them available. Central as the museum is, the time spent in going and coming to and from it, and above all in obtaining the books required in the library, varying as it does from half an hour to an hour, is a considerable tax on readers; whilst from the want of a classified catalogue, many a

visit proves altogether fruitless. The practical results are, that notwithstanding the great progress of the last twenty years in education and science, whilst in 1851 there were paid to the reading-room 22 visits per every 1,000 of the inhabitants of the metropolis, in 1871 the proportion was only 27 per 1,000. It would be a boon to the museum if it could dispose in subsidiary or local libraries some portions of its surplus works, especially where works have passed through many editions with little or no variation. And if, besides the central-room, special rooms were open to students with collections of the best books on any branch of science, which they could use as freely as the works now in the reference room, much valuable time would be saved, and great advantage would result to science and literature.

A word now upon international exhibitions, which, after a season of unparalleled triumphs, seem to be waning in public favour. An international exhibition is in some aspects an international museum. Although, however, an exhibition, whether national or international, partakes to a large extent of the character of a museum, it is, nevertheless, distinguished from it in many important particulars. A museum is a collection of articles ordinarily belonging to the State or a private individual. An exhibition is a collection of articles belonging to the producers or manufacturers who exhibit them. A museum is a permanent institution. An exhibition exists only for a limited time. A museum consists of choice imperishable articles. An exhibition comprises articles both perishable and imperishable, and is not always restricted to the choicest. The intent of a museum is to afford pleasure and instruction. The intent of an exhibition is to promote commerce and art industry. The history of international exhibitions is short but very suggestive. The Exhibition in 1851, so bright in all its associations, so distinguished for the combination of the æsthetic and the philanthropic with the economic and commercial, was absolutely unequalled, and stood alone, in the words of the late H.R.H. the Prince Consort, as an effort to give a true test and a living picture of the point of development at which the whole of mankind had arrived, so as to form a new starting point from which all nations would be able to direct their future exertions. But the success which attended it could not fail to embolden France, which for a considerable time had held quinquennial exhibitions of French industry, to repeat the attempt; and so another international exhibition was held, which included, besides industrial products, agriculture and the fine arts. And although the aerial structure of the Crystal Palace was not there to lend its charm to the beautiful collections, and the hymn of peace which echoed through the first industrial *fête* was no longer heard, there is no doubt that the Paris Universal Exhibition of 1855 did honour to the skill and genius of France. Yet the question whether or not international exhibitions, quite apart from any æsthetic or philanthropic considerations, were likely to be successful, was still open for consideration when the Council of the Society of Arts, in April, 1861, decided, "That the institution of decennial exhibitions in London, for the purpose of showing the progress made in industry and art during each period of ten years, would tend greatly to the encouragement of Art, Manufactures, and Commerce. That the first of these exhibitions ought not to a repetition of the Exhibition of 1851, which must be considered an exceptional event, but should be an exhibition of works selected for excellence, illustrating especially the progress of industrial art." Upon this decision the Exhibition of 1862 was held, and for a time quite a mania for exhibitions was manifested in this and other countries. But, alas, just in proportion as they multiplied so their character became lowered. The Paris Exhibition of 1867 exceeded all bounds when it attempted to combine prehistoric monuments with the pastimes of modern nations; and the Royal Commissioners of the London International Exhibition of 1873 made a great mistake when they allowed sales to be made in a contiguous building of the articles exhibited, thus converting the Exhibition practically into a bazaar; and when they attempted to court public favour by permitting the delivery of lectures on cookery. The Royal Commissioners strove to make an International Exhibition a permanent institution, by reducing the various industries into groups, and taking certain of those each year. But they forgot that the first condition for its permanency was a jealous maintenance of its high character. It is needless, however, to murmur. Experience shows that public interest in international exhibitions is declining, that producers and manufacturers do not care to exhibit, that the number of visitors is insignificant, that the receipts are falling off, and that financially they bid fair to become disastrous; and we cannot feel disappointment if, with such facts before them, the Royal Commissioners have resolved to discontinue the series altogether, and to appropriate the building to other purposes. For the present, therefore, a check has certainly been given to the progress of international exhibitions.

Still, the principle adopted by the Council of the Society of Arts, that the institution of periodical exhibitions would tend to the encouragement of art, manufactures, and commerce, is sound, and we must not think of abandoning such exhibitions altogether. The only question for future consideration must rather be, whether they should be confined to a certain class of articles, or extended to every class as heretofore; whether the competition should be open to the whole world, or limited to a certain number of countries. There are elements of weakness in such exhibitions, on the large scale in which they have been hitherto attempted, which, I fear, will ever endanger their success. Much difficulty will always be experienced in securing the concurrence of producers and manufacturers, especially of those whose reputation has long been established. Not a few are unwilling to make known what they deem the sources of their special advantage over their competitors. To allow the exhibitors to select what they will send, is certain to encumber the exhibition with objects of doubtful value. If a choice be attempted by committees of selection or juries, the invidious task is as sure to restrict the concurrence, and reduce the popularity of the undertaking. The number of countries, moreover, capable of contributing to the exhibition is becoming larger every year, and the number and variety of articles of industry is increasing at an enormous pace; all demanding extensive buildings, and considerable expenditure. It may probably ill befit this age of great undertakings to stand aghast at the largeness of an effort of such world-wide benefit, yet these elements of difficulty must necessarily have their weight, especially when the recurrence of the exhibition in this or other countries becomes too frequent. The probability, however, is that no international exhibition will be attempted in London till 1881, and by that time we may safely anticipate that all the various problems whether of principle or practice will have been solved.

Whatever be the future destinies of international exhibitions, let us utilise as much as possible our metropolitan and local museums. For the maintenance of the leading national museum the State pays £170,000 a year. From their commencement to this day £7,000,000 have been expended on the British Museum, National Gallery, South Kensington Museum, and National Portrait Museum. What amount may be expended for the local museums it is difficult to ascertain. But the expense is really no consideration provided a corresponding benefit is derived from them. Our aim should be to possess the very best museums which the influence and wealth of Britain can procure. They should illustrate, as effectively as possible, natural history and natural philosophy, the arts, science, and inventions. They should exhibit the productions and resources of the Indian Empire and of all British colonies, and they should be used for educational purposes by means of

lectures and demonstrations. True, the museum is itself, as Professor Huxley called it, a consultative library of objects, but though the books are open to all, their language is not universally understood. Unite in all cases the library with the museum, and give them freshness by constant acquisitions and changes. Much, I am persuaded, may be done to commend our museums and public institutions to the sympathies and favour of every class of the community. Let us strive to render them a perpetual spring of instruction and pleasure. The first museum at Alexandria was set apart for the muses and the study of science. Let the museums of our day be places of solid instruction as well as of elevating enjoyment for the whole people.

THE INDUSTRIES OF POLAND.

The industries of Poland are making a very considerable stride, and the statistics collected by Consul-General Mansfeld, although drawn from official sources, do not overstate the industrial development of the country. Polish fabrics of every description are gradually driving out of the market, both for the kingdom of Poland and the empire in general, a vast number of articles of inferior quality hitherto imported from Germany, and the industrial production for exportation into Russia is assuming most important proportions. Polish sugar, textile fabrics, agricultural implements, glass, plated goods, furniture, clothes, boots and shoes, and a variety of other items are much in demand for Central and Southern Russia, and in many cases the contractors can hardly meet the demands. Labour has risen in price in the same ratio, and active intelligent hands find ready employment, and at a remuneration quite out of proportion with the price of living. In the year 1871, the number of factories in operation was 17,009, the workmen employed 70,593, and the value of the produce amounted to 69,640,000 roubles, being 4,297,000 roubles in excess of the former year. The consumption of linen and textile fabrics in Poland has for some time made immense progress. Notwithstanding the large quantity of linen made in the factory of Zyrardov, 20,000,000 ells are annually imported from abroad to the value of about 2,000,000 roubles. Mr. Maringe has established a linen company with a capital chiefly drawn from abroad, while the Brothers Guisburg are founding a linen factory at Zaviercie with their own money, and which will employ no less than 1,200 hands. There is every indication that building in the principle towns, which for the last five years has been at a complete standstill, will shortly be resumed to a very great extent. House rent has increased beyond example when the very indifferent house accommodation is taken into consideration, and it may fairly be said that, for all classes, house rent in the towns of Poland is as high as in the most expensive capitals of Europe. Considerable progress is being made in respect of paving and lighting, and the manner in which the cleanliness of the towns is conducted, but up to the present moment, no effort is being made towards town drainage; the latter is entirely on the surface, and in excessive drought, or during continued frost, their condition is most pestilential. accompanied with the obvious result that typhus and cholera becomes the rule and not the exception.

The export and import movement of the United Kingdom with the kingdom of Poland, from the geographical portion of the latter, is in a somewhat exceptional position; all British produce consumed in Poland and the adjacent Russian governments is consigned through German ports, and therefore in British trade returns figures under exports to Germany. In the returns for 1871, published in the *Times*, the British exports to Russia are given at something under £7,000,000 sterling, an amount which would run up to above £11,000,000 were the exports consumed in Poland, &c., not put down to the account of Germany. For similar reasons imports into Poland in the Russian returns figure as German products. Exports from Poland, or which take Poland "in transit," are consigned through Dantzig, Kœnigsburg, Stettin, and Hamburg, and therefore in the Russian returns come under the head of exports to Germany. For these reasons it becomes evident that, as regard British commerce with Poland, little is to be gleaned from official sources, and it is only by comparing custom-house returns with information gathered from agents and houses most likely to be dealing with Great Britain, that any data can be obtained. The development of British commerce with Poland has been at first extremely gradual, while in the last three years, the advance has been in the same proportion which has characterised British trade all over the world. And extraordinary as has been this increase, there is no doubt that the movement is capable of yet further development. The imports into the kingdom of Poland are not only consumed by the 6,000,000 inhabitants of the "kingdom proper," but supply the neighbouring Polish provinces of Lithuania, Voltignia, and Podolia. The convention with Austria respecting the salt mines in Gallicia has terminated, and there will be a large opening for the Liverpool dealers in salt, which is well-worthy the attention of those firms; they should be early in the field, and acquire the business before it can get into German hands,

The population is undergoing a steady increase, no emigration takes place for America or elsewhere, and the Jews who run away to escape military service is more than counterbalanced by the gradual return of exiles from Russia, Siberia, and abroad, under the provisions of various Imperial amnesties. Of foreign countries, that upon which prosperity of Poland reacts to the greatest extent is unquestionably the United Kingdom, and the development of our commercial movement with the kingdom of Poland is worthy of the greatest attention on the part of British manufacturers.

WATCH-MAKING IN SWITZERLAND.

Horological industry has grown to extraordinary dimensions in Switzerland, and the *Journal de Genève* supplies the following statistics:—In the four cantons of Neuchâtel, Berne, Vaud, and Geneva more than 25,200 men and 12,700 women are employed in the various branches of the business, of whom 30,600 belong to Neuchâtel and Berne. The trade has grown of late most rapidly in Berne, where at present half a million of common watches are produced annually, their value being set down at an average of forty francs each, making a total of £800,000. In the canton of Geneva the number made annually does not exceed 150,000, but nearly all of them are in gold cases, and ornamental, so that the total value is about the same as the half million produced in Berne. Vaud makes about the same number as Geneva; the movements are generally well finished, but many of them are exported without cases; the value is considered to average about 55 francs, giving a total of £320,000. The same canton also produces about 80,000 musical boxes of the value of £80,000. One-half of the whole of the watches made in Switzerland are produced in Neuchâtel, and, in value, 35 per cent. of the whole, or £1,400,000 per annum. The total number and value of watches produced is given as follows:—Switzerland, 1,600,000, of the approximative value of £3,520,000; France, 300,000, value £660,000; England, 200,000, value £640,000; and the United States of America, 100,000, valued at £300,000. It will be observed from the above figures that while the average value of Swiss watches is about 4s. 6d. each, those of France reach an average of 44s., those of England 68s., and those of America 60s. The fine balance-spring of a watch is said to furnish the most remarkable example of the increase of the value of a raw material by the application of skill.

It would be curious to know the cost of the materials employed to produce the 2,200,000 watches of the four countries quoted, of the approximate value of £4,800,000. Still more curious would be the relative value of a first-rate chronometer, and the materials with which it is produced.

TRADE MAPS.

M. Lona, an engineer attached to the Statistical Department of the French Ministry of Agriculture and Public Works, has conceived the idea of gathering together in maps the results arrived at of the official inquiry into the state of trade in France from 1861 to 1865. These maps, to the number of thirty-three, which altogether constitute *The Atlas of Trade in France*, readily show the different results of the inquiry, and also the distribution and localities of each branch of industry.

In the case of all the chief trades, M. Lona has begun by dividing the total production by the number of departments, and having thus obtained an average, he classifies the different departments according as they produce more or less than this average, distinguishing them by a special tint. Thus blue indicates the departments reaching the average, carmine those in excess thereof, and white those which do not come up to the average. Other colours are employed in a similar way. A table added to every map gives the exact figure of the production for each department.

In map No. 1, which gives the statistics of the general trade in France, will be found the following figures:—The total amount of French manufactures in 1865 is valued at nearly ten thousand millions, while that of 1840 was only four thousand millions. The agricultural produce, which only reached five thousand millions in 1840, reached eight thousand millions in 1865, so that in twenty-five years the value of the total production of France has risen from nine thousand millions to eighteen thousand millions, that is to say has just doubled. There are in France seven departments the production of which has risen from 200 millions to 800 millions, eleven in which it has risen from 125 millions to 200 millions, twenty-three from 50 millions to 125 millions, thirty-one from 25 millions to 50 millions, and seventeen in which it has not reached 25 millions. The thirty-two remaining maps relate to the various industries, including the motive power and the various workshop appliances of France.

CORRESPONDENCE.

TRANS-HIMALAYAN ROUTE.

Sir,—In my communication published in last week's *Journal* on Trans-Himalayan routes there were two slight errors. Instead of "the two-humped camel of the elevated plateaus of the West and Bhootea, or native horses toward the East, are the safest, thriftiest, and most enduring carriers," read "the West and the Bhootea, or native horses of the East." The Bhootea horse is the native horse of Bhootan. Also, "the increasing and impulsive inferior races" should be "distrustful and impulsive."—I am, &c.,

R. Langford Locke, C.E.,
Honorary Corresponding Member.

133, Leinster-road, Dublin, October, 1874.

The revenue of Western Australia amounted last year to £140,686. The expenditure of the year was £119,651. The surplus was devoted to immigration, public works, telegraph extension, and harbour improvements.

OBITUARY.

T. Felkin.—The death of Mr. T. Felkin took place on Saturday, September 29, at Nottingham. Mr. Felkin was born in 1795, and he was consequently 79 years of age at the time of his death. At the early age of 13 he began to earn his living at the stocking-frame, In 1820 he became connected with Mr. John Heathcote, Tiverton, and the machine-wrought bobbin-net trade. On Mr. Heathcote's behalf he passed the greater part of the years 1824-5 in France and Italy, investigating the products and manufactures of those countries. The result of his inquiries was the discovery and patenting of the process of preparing silk, since well known under the name of "patent reeling." In 1825-6 Mr. Felkin superintended, at Tiverton, the only commercial silk filature ever set up in this country, and in that season he reeled for Mr. Heathcote 35,000 lbs. of cocoons into lace silk. In 1826 he came to reside in Nottingham as agent for the firm to which Mr. Heathcote belonged. In 1828-9 he presided over the committee sitting for the purpose of attempting to regulate the working hours of the bobbin-net trade. From this beginning may be said to have sprung the movement for the improvement of the state of women and children employed in factories. In 1830-33-36, Mr. Felkin drew up statistical accounts of the lace trade; in 1832 an account of the hosiery trade; and in 1844 a second and very elaborate statement of the latter trade. This paper, read at the second York meeting of the British Association, was the result of an inquiry instituted in 230 parishes of the three midland counties. In 1832 he published a descriptive and numerical statement of the production of silk throughout Europe, and a proposition for improving Bengal silk; in 1835, a condensed translation from the "Code Napoleon" of the laws by which "Conseils des Prud'hommes" are governed in France, with the view to the establishment in this country of authorised tribunals for the settlement of trade disputes; in 1837 a paper on wages, read at the Liverpool meeting of the British Association; in 1838, "State of the Labouring Classes at Hyde," together with an account of the "Strike at Derby," read before the British Association at Newcastle-upon-Tyne; in 1841, a speech in favour of the Property-tax, delivered in the Nottingham Town Council. Mr. Felkin gave evidence on the Children's Employment Commission, the Ten Hours' Bill, Export of Machinery, Silk Manufacturers' Inquiry, Hand-loom Weavers' Commission, Health of Towns' Bill, Educational Inquiries, Penny Postage, Midland Railways, Nottingham Inclosures, Repeal of the Corn Laws, and several other matters of public interest. In 1851 he officiated as chairman of Jury No. 20 in the Exhibition, and in 1855 as a Juror in the French Exhibition. In 1867 Mr. Felkin published his "History of the Machine-wrought Hosiery and Lace Manufactures." On May 30, 1856, he read a paper before the Society on "The History and Present State of the Machine-wrought Lace Trade."

England imports more than 5,000 tons of osiers, valued at about £40,000. About 300 varieties of osiers are known, the most important beds being situated near Nottingham; the home produce being insufficient to meet the demands, great attention is being paid to the cultivation beds in Australia, and a considerable quantity is yearly produced in that country.

The total silk production of Germany may now be valued at £7,500,000 sterling. The number of factories is 330, of which 130 are in the district of Arnfeld, and 102 in the district of Elberfeld.

Cotton seed is becoming one of the principal articles of export from Egypt. It has gradually risen from 1,090 cwt. in 1860 to 3,490,080 cwt. in 1873, of the value of £770,000. England takes nearly all this.

GENERAL NOTES.

Yorkshire College of Science.—All the arrangements for the Yorkshire College of Science are now completed, and the first session will commence on the 26th inst. The subjects of study, for which properly qualified professors are appointed, are mathematics, experimental physics, chemistry, geology, mining, and textile manufactures. The Company of Clothworkers of London have founded eight studentships, four of £30 each and four of £25 each.

Leveaux's Self-propelling Tramway Car.—Mr. Leveaux, the patentee of a new spring motive power, by the action of compound coiled steel springs, has been engaged on the application of his invention to tramway-cars upon a practical basis, and it is announced that public trials of such self-propelling cars will shortly be made on some of the metropolitan lines. The action is said to be smooth and noiseless, effective, and perfectly under control, both for forward and backward motion.

Wooden Buildings in Conflagrations.—In commenting on the value of wood as a building material the *Scientific American* says:—Four fires on the 11th and 14th of July, in Illinois, Wisconsin, and Iowa, destroyed wooden buildings, which cost originally 350,000 dols., and an aggregate of 5,080,000 dols. property. These buildings cost about 70,000 dols. less than brick ones would have done. The wooden buildings burnt at Chicago, July 14th, first cost 150,000 dols., but carried with them property to the amount of 4,000,000 dols. The wooden buildings burnt in the great fire of 1871, when the entire loss was 200,000,000 dols., were worth 2,000,000 dols., or 1 per cent of the whole. Wood is thus shown to be one of the costliest of building materials.

Tramways in New York.—The total length of the tramways in New York is 76 miles; they employ 11,086 horses, moving cars at the busiest times at the rate of one every 47 seconds. The rate of speed per hour is 5 miles, and the average cost of construction three-eighths of a million dollars per mile. The number of passengers carried last year was 192,000,000, being $2\frac{1}{2}$ millions per mile. On some parts the ratio was still greater. The tramway in the Sixth Avenue carried 4,000,000 per mile, and that in the Third Avenue below Central-park, 5,000,000. The average fare on the different lines and their branches is $5\frac{1}{8}$ cents, whilst the total expense for passage is $4\frac{15}{100}$ cents., leaving a net profit of $\frac{98}{100}$ cents. The business of these tramways has increased 225 per cent. during the last ten years.

Phormium Tenax.—This plant, says *Nature*, is being cultivated in St. Helena, and there seems no reason why the same thing should not be done in other countries. Hitherto no very great attention has been paid to the cultivation of this plant, but the natural supplies obtained in New Zealand are insufficient for the demands of commerce. It is a mistake to suppose that an illimitable supply can always be obtained because no cultivation has been necessary in the first crops of the wild produce. This is not to be regretted, for careful cultivation cannot fail to greatly improve the fibre, and the best kinds alone will be worth the trouble of proper rearing. Steps are, however, being taken to cultivate the plant in New Zealand, and in other countries which have been fortunate enough to acclimatise it. In the Azores, at St. Helena, in Algiers, and the south of France, it thrives well, and has been easily naturalised.

Painting on Zinc.—Herr Puscher, of Nuremberg, has recently invented a simple process, depending on the use of acetate of lead, which renders every kind of painting applicable to sheets of zinc. By mixing black lead, for instance, with the salt, a very agreeable reddish-brown tone is obtained. It is by these means that the cupola of the synagogue at Nuremberg has been painted; and, for more than a year, during which this work has stood, the atmosphere has had no influence on the zinc sheeting of the roof. By the addition of other colouring matters, the lightest or darkest shades of grey or yellow may be produced. It is this circumstance which gives to zinc mouldings quite the appearance of being sculptured in stone. For writing with dark ink on sheets of zinc, the inventor employs a solution of chlorate of copper. After a few minutes the zinc sheet is washed and then dried. This application might be found useful in making labels for the names of plants.

Shipbuilding in Italy.—The *Borsa* gives the following particulars respecting the sale and purchase of merchant vessels between Italy and other countries during the last ten years. During this period the number of foreign built vessels purchased by Italy was 432 sailing vessels, of a total tonnage of 70,725, and 64 steam vessels with a total tonnage of 37,305, in all 496 vessels, and 108,030 tons. On the other hand the sale of Italian built ships to foreigners was 538, of a total tonnage of 91,816, being 513 sailing vessels of 84,711 tons, and 25 steam vessels of 7,105 tons.

Indian Tea Exports.—The Bengal Chamber of Commerce remark, in their last report, that the growth of the tea industry of India has been almost unexampled in the history of its trade. The following figures represent the value of the annual exports during the ten years that ended on the 30th April, 1874; and there is every reasonable prospect of a continued progress, which will ultimately give Indian tea a foremost place among the productions of the country:—

	Value of Tea exported from Calcutta.
1863—64	£219,282
1864—65	273,475
1865—66	226,506
1866—67	362,703
1867—68	683,067
1868—69	860,441
1869—70	1,016,978
1870—71	1,083,502
1871—72	1,358,858
1872—73	1,523,527
1873—74	1,692,699

Angora Goats' Hair.—The cultivation of the Angora goat is attracting some attention in Australia, where this animal appears to thrive very well. The hair is said to make a very good "mohair" fabric, but its quality depends very much upon the nature of the locality in which the animals are reared. Undulating prairies with a good supply of pure water are best adapted to the habits of this goat. In sandy hilly districts it thrives admirably, but the hair is inferior and falls off very quickly. The flesh is excellent, and is preferred in some parts of Australia to the best mutton. The milk is of good quality and yields a good supply of butter and cheese. The hair is worth about four shillings a pound, and one ram will yield about four pounds at each shearing; the best plan is to shear them twice a year, as this prevents the hair from falling off and from splitting; at each shearing it is about six inches long. Compared with the merino sheep, the Angora goat seems to have the advantage in the fact that the former produces only three and a-half pounds of wool, worth two shillings and sixpence per pound, and that six merinos will eat as much as seven Angoras. These facts are important in view of the acclimatisation of the Angora goat in other parts of the world.

Production of Wine in Italy.—Italy should be, from her climate, soil, and geographical position, one of the most important wine-producing countries in the world. Some wines, such as the Barolo, Barbera, and Nebiola, of Piedmont; the Inferno, of the Valtellina; the Lambruschi, of Modena; the Chianti, of Tuscany; Lachryma Christi, of Naples; and choice wines of Falerno, Syracuse, and Marsala, are known to a certain extent out of Italy; but the general run of the wines produced in this country are little known beyond the district in which they are grown. The production of the various districts averages as follows:—

	Hectolitres.
Piedmont	8,000,000
Naples and Sicily	9,000,000
Emilia, the Marche, Umbria, and Romagna	8,000,000
Venetian Provinces	2,500,000
Modena and Parma	2,000,000
Tuscany	2,000,000
Lombardy	1,500,000
Total	33,000,000

The production of wine per hectare is far less in the vineyards of Italy than in those of France, Germany, Austria, or Hungary, and the two millions of hectares cultivated for wine in Italy produce on the average 33 millions of hectolitres, or at the rate of only 15 hectolitres of wine per hectare; and taking the average price per hectolitre of 25 francs, the total value of wine produced in Italy would be 825 millions of francs (£33,000,000).

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

EXHIBITIONS — LOCAL, METROPOLITAN, AND INTERNATIONAL.

The Society of Arts having originated numerous Exhibitions under these categories, especially the International Exhibitions in 1851 and in 1862, the Council have appointed a Committee to consider the subject of Exhibitions generally; and have resolved at some future opportunity to prosecute an inquiry into the desirability of holding future International Exhibitions, and the results of past great Exhibitions.

The proposed meeting on this subject, as previously announced for the end of October, is postponed for the present.

The Council consider that the question of Local Exhibitions stands on a different footing to International Exhibitions, and will be prepared to inquire what aid the Society can give to promote such Local Exhibitions.

INSTITUTIONS.

The following Institutions have been received into union since the last announcement :—

Kentish-town Literary Institute.
Sheffield Church of England Educational Institute.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The sixth lecture of the third course of Cantor Lectures for the past Session, "On Carbon and Certain Compounds of Carbon," was delivered by Professor Barff, on Monday, May 18th, 1874, as follows :—

Lecture VI.

Before entering on the special subject of this lecture, I wish to tell you how to determine the heating power of a liquid hydrocarbon. A weighed quantity of it should be mixed with black oxide of manganese or oxide of copper (cupric oxide). The mixture should be made to form a stiff paste; it can then be mixed with the oxidising agent, as the coke is mixed with it, and the experiment can be performed as we performed it with coal in a former lecture. I introduce this subject, because I have been asked to do so. I also wish to call your attention to these bottles, which were brought here a few evenings ago by a gentleman who has taken the trouble to test the animal charcoal, which I spoke to you about, which came from Leith. This is a standard solution of carmine; in this bottle there is some of the same solution, which has been filtered through 100 grains of ordinary animal charcoal. Here is some which has been filtered through 30 grains, and here is some which has been filtered through 50 grains of the Leith charcoal; you see it is perfectly colourless, the charcoal having absolutely discharged the colour. I think it is well worth calling your attention to it, and I am much obliged to the gentleman who took the trouble to make the experiment.

Coal gas is made, as I think I mentioned, by the destructive distillation of coal. The destructive distillation of any organic substance, fat, oil, vegetable refuse of all kinds, will give you gases very much resembling in their composition coal gas. By destructive distillation, one means the heating of substances which can be decomposed by heat, out of contact with atmospheric air, that is in such a way that they cannot be burnt. On the wall is a diagram of a gas manufactory, though it is not in any way perfect, many improvements having been introduced since it was first drawn; but it is sufficiently clear for me to be able to explain to you from it the general principles upon which gas is made and purified. I have not to speak to you so much of the manufacture of gas, as of the impurities contained in it, and the method of getting rid of them. In the manufacture of gas there is much the engineer has to do to improve the process, and the other evening a gentleman put a paper into my hands referring to an improvement made by a firm which he represented, Messrs. Coffel, Thomas, and Company. I had hoped to have been able to see the apparatus, which is stated to effect a considerable saving in the manufacture of coal gas, but I have not been able to do so yet. I hope to do so, however, during the present week, and if I see it does what it proposes to do I will explain it fully to you. I will only mention now that the object of it is to relieve the pressure in a certain part of the gas apparatus, thereby preventing the deposition of that substance which you see on the table, viz., carbon. First of all, there is a retort made of iron or fire-clay, the end of which can be taken off and put on. Into that end the coals are introduced, and the retort being charged, the end is screwed up. The gas passes out through what is termed the hydraulic main. In this a portion of the tar is deposited, and the ammoniacal liquid which I shall have to speak to you about presently. It is at this part of the apparatus that these gentlemen propose to put an appliance, the object of which is to relieve the pressure, for the gas here under ordinary circumstances is given off from the coal very rapidly, so that there is a considerable tension inside the retort and that portion of the apparatus which is in connection with it; the consequence is that the pressure exerted by the gas is such that the gases deposit carbon in the upper part of the retort, and this deposition of the carbon of course impoverishes the gas, that is to say, robs it of some of its carbon, and according to our theory must necessarily interfere with its illuminating properties. If you look at that lump of coke you will see it is evidently a deposit formed on the upper part of the gas retort, because it shows the shape of the half dome. After the gas has passed through here, and has deposited its tar, it is then passed through this series of tubes, which are kept cool by water trickling over them, and then it passes through a condenser, by means of which other liquid products that come off in the state of suspension or vapour with the gas are condensed and run down into this tank.

This is a scrubber; it is for the purpose of purifying the gas from certain impurities. Here, in the apparatus on the table, is a bottle which answers to the

scrubber; it contains the same sort of substance as is used in this scrubber, viz., dilute oil of vitriol, though we have reversed the order of these purifiers. Here again is what is called the lime purifier, through which the gas passes and loses certain other of its impurities, viz., sulphuretted hydrogen and a certain amount possibly of carbonic sulphide and other impurities of coal gas, which it is very difficult to get rid of entirely. Other substances besides lime are used for the perfect purification of common coal gas from sulphuretted hydrogen. This bottle represents this lime purifier. We will now proceed with the experiment. If you notice in this vessel coal is being heated; it is an iron retort, and the products of combustion are passing on here. By and bye a quantity of coal tar will be deposited in this little bottle, as you will recognise by the colour and the smell if you examine it after the lecture. Before the gas passes through these purifiers, I want to submit it to certain tests; that is done in this bottle, in which are placed two pieces of paper; one before the action commenced was white and the other was a pale yellow. The white one is getting black, and the yellow one is getting brown. The white one is to indicate the presence of sulphuretted hydrogen, which is coming off now, and the yellow one is to indicate the presence of the alkaline substance ammonia. After the completion of the experiment the two pieces of paper will be taken out and shown to you. The gas then passes on into some lime-water here, and you will notice already the lime-water, which was once perfectly transparent, has become milky, showing the presence of carbonic acid which has been arrested by the lime-water and formed with it lime carbonate. In this bottle we have some lime, and we have also a substance called hydrated oxide of iron. On the top there is a red stratum, and a white one below. When the sulphuretted hydrogen gas comes in contact with the lime (the sulphuretted hydrogen contains hydrogen and sulphur, and the lime contains calcium and oxygen) an interchange takes place, the calcium takes the sulphur and the hydrogen takes the oxygen, so that water and sulphate of lime are formed. In this way the sulphuretted hydrogen is decomposed. In small country towns lime only, I believe, is used to purify the gas, and lime does remarkably well, but there is this objection to it, in large cities like London, what is to be done with this sulphide of lime? because the smell of it is extremely offensive. In the country, people do not seem to care so much about it. This sulphide of lime is not a waste product, for after it has been exposed to the air for some time the sulphur becomes oxidised, and sulphate is formed, and if the operation be allowed to go on to its full extent, so that the whole of the sulphur is oxidised into sulphate, then it makes an excellent manure for the fields. Of course it would be very injurious to vegetation to put it on the ground before the oxidation had fully taken place. It used to be thought that if the lime was continually renewed in this lime-scrubber it would more perfectly purify the gas from the sulphur, but sulphur exists in two forms in coal gas, in the form of sulphuretted hydrogen, which causes it to blacken this lead paper, and also in another form, in that of bisulphide of carbon, some experiments with which I shall show you later on in order to explain to you what methods have been tried and adopted in order to free coal gas from this very objectionable impurity. This substance, bisulphide of carbon, is composed of carbon and sulphur in these proportions, CS_2, which means 12 parts by weight of carbon and 64 parts by weight of sulphur. Now I will write on the board the symbol for the molecule of a gas about which I have already spoken to you, and ask you to compare them, CO_2, carbonic acid. The carbonic acid in this vessel will unite with lime which contains 40 parts by weight of calcium, and will form CaO, CO_2, or calcic carbonate. Now, suppose I replace the oxygen by its equivalent quantity of sulphur, then I should have to put S in place of O, for two atoms of oxygen in this carbonic oxide are replaced by what I may call roughly their equivalents of sulphur. Now we have in the one case carbonate of the oxide of lime, and in the other the sulphide of lime, CaS, uniting with carbonic sulphide. Carbonic acid very readily unites with lime, but carbonic sulphide will not unite with it, but it does unite with sulphide of calcium. Now, if you have present in your scrubber some sulphide of calcium, that is, if you do not take away all that which has been already acted upon by the sulphuretted hydrogen, and only replace a portion of it, then your carbonic sulphide coming off with the coal gas will be taken up by the sulphide of calcium that is in your scrubber, whereas the carbonic sulphide coming off with the coal gas will not be taken up by the calcic oxide or lime. Therefore it is a matter of importance that you should have present some of this sulphide of calcium in order to take up this carbonic sulphide. One of the principal impurities in coal gas is ammonia; and perhaps I had better repeat what I said the other evening about the composition of coal gas. Pure coal gas contains hydrogen, marsh gas, olefiant gas, and carbonic oxide; impure gas, in addition, contains sulphuretted hydrogen, ammonia, and carbonic acid; water vapour is suspended in coal gas, pure or impure. How is the ammonia to be got rid of? By means of sulphuric acid or oil of vitriol, wich is used in a dilute state. There are two solutions prepared here in order to show you the action of oil of vitriol upon ammonia. In one of these bottles there is a solution of ammonia, and in the other oil of vitriol only. If we put some litmus into this one it is turned red, but in the other it is turned blue; and if these solutions are prepared in the proper proportions, the one should neutralise the other, and when we mix them we shall get no change in the colour of the litmus paper. Suppose you take some common smelling salts, or a solution of liquid ammonia, and drop into it gradually some oil of vitriol, you will utterly destroy the smell of the ammonia, showing that the ammonia has united with the oil of vitriol. The purification of coal gas from ammonia by this means can be made quite perfect. Suppose you are burning a jet of coal gas, and you pass into it a small quantity of ammonia gas, the flame will thereby immediately become less luminous. Mr. Lewis will show you this experiment in this way. There is a jet of coal gas burning, and by warming a solution of ammonia he will cause ammonia gas to pass into the coal gas, when you will see the effect it produces. The reason I call your attention to this is because these impurities injure the illuminating power of coal gas. They do it by taking away heat. In order that you may get the maximum of illumination there must be a certain amount of heat. Ammonia gas will not burn. It is stated that it burns at a high temperature, but I maintain that that is a mistake, for it is not the ammonia itself which burns, but the ammonia is decomposed, and the hydrogen of which it is partly composed, burns; therefore, a certain amount of heat is wasted in the decomposition of the ammonia gas before the hydrogen burns. This leads me to mention also something which was said after my lecture the other night, viz., that I did not speak about air gas. I thought I had spoken about it, but probably the gentleman who made the remark wished me to speak about this sort of air gas, gas formed by the passage of atmospheric air over red-hot carbon, and then passed through some petroleum oils in order that it might become saturated with them, and so become illuminating. There is a *prima facie* objection to this. In atmospheric air there are four volumes roughly of nitrogen, and one of oxygen, or more correctly, 21 of oxygen, and 79 of nitrogen. Then if you convert that oxygen into carbonic oxide you have four volumes of nitrogen holding it may be in suspension

some of these liquid hydrocarbons, but not contributing one single iota to their combustion. It is quite certain then that there must be a difficulty which is not at present got over. Now in water gas, which I spoke to you about the other night, where we passed steam over carbon and got carbonic oxide and hydrogen, we get carbonic oxide and hydrogen, which are both combustible gases, but in passing air over carbon we get a quantity of nitrogen, which is worse than useless, for it takes away heat.

Here is a striking experiment, showing the great affinity which sulphur has for iron. You heard a smart explosion showing the violence of this chemical action. In that tube there were sulphuretted hydrogen and oxygen, and when some hydrated oxide of iron was put into it the chemical action was so violent that that report took place. This hydrated oxide of iron absorbs sulphuretted hydrogen gas very readily, and therefore, is an excellent purifier of coal gas from this very great impurity. There need be no waste of iron, because the sulphide of iron, on exposure to atmospheric air in the presence of moisture, gets oxidised again, and the iron oxide can be recovered from it, so that it is not an expensivo process if care be used in its application. Here is a bottle which contains some brown bromine. I will put a little of it into a flask, through which some coal gas will be passed, and you will see that it decolorises it and forms a substance which I showed you the other night, chloride of ethylene or olefiant gas, united with an equal volume of chlorine. Here the action is being performed with bromine, which I have taken in order that you may see the change of colour that is produced by its absorbing the illuminating gas from coal gas. Coal gas also contains in suspension certain substances called hydrocarbons, and it is a very important matter to see of what kind these hydrocarbons are which the coal gas contains. It would seem clear that it depends on the amount of carbon which these hydrocarbons contain, as to whether they add to the luminosity of coal gas economically. Some experiments have been performed which I cannot detail to you to-night showing that this is not the case, or leading us to infer that it is not the case, but the experiments are of such a kind that they should lead those who are practically engaged in the manufacture of coal gas to see how they can supply proper hydrocarbons to the gas, by which I mean hydrocarbons of such a composition that for the quantity of vapour held in suspension by the coal gas might be got the highest amount of illumination. These are experiments the understanding of which will require a certain amount of scientific knowledge, but not very much. It is very easy to try the illuminating power of artificially made gas, and then from experiments in the manufacture of gas to apply the knowledge so gained to certain processes for either retaining in the gas certain hydrocarbons, or, by changes in the mode of working the apparatus, exchanging those hydrocarbons for others which add more perfectly to the illuminating power of the gas. I do not think that nearly sufficient attention has been paid to this subject. You notice the bromine here is entirely decolorised, and you see drops of an oily-looking substance sinking to the bottom of the liquid.

Here is an experiment which has been going on for some time. A jet of coal gas is burning slowly, and a water is formed, which is collecting in this bend. We will take this away, and pour the liquid into a test-tube, and test it for the presence of sulphuric acid. Most London coal gas is thoroughly purified from sulphuretted hydrogen, for at the City of London School, at my own house, and here also in this theatre on a former occasion, I have tested coal gas for sulphuretted hydrogen, and found in all cases it was free from it. Therefore the sulphate formed from the combustion of the coal gas is not resulting from the presence of sulphuretted hydrogen, but results from the presence of bisulphate of carbon, that substance the symbol for whose molecule is CS_2. There is a copious white precipitate in the test-tube, proving the presence of sulphate, and here is another sample which has been tested in the same way (by a young gentleman who is now present) at the City Middle-class School. He passed the products of combustion of coal gas for one hour through baryta water, and got this precipitate, showing a quantity of sulphate present. In neither case is the sulphate owing to the presence of sulphuretted hydrogen, but to carbonic sulphide in the gas; for when sulphur is burnt it always forms sulphurous acid, whether alone or in combination with other elements. Sulphuretted hydrogen, when burnt, forms water and sulphurous acid; carbonic sulphide forms carbonic acid and sulphurous acid; so you see it is important that this bisulphide of carbon should be got rid of from coal gas; for if during the time this has been burning here it has formed so much sulphuric acid in the presence of the water, for that is how it got formed, it is quite certain that all the gas burning here and elsewhere is giving off this sulphurous acid in large quantities, which in the presence of moisture —and you know moisture exists largely in all rooms —is converted into sulphuric acid; as the draught generally takes it to the walls, and the moisture gets condensed on the walls, the sulphuric acid gets deposited there, and if it comes in contact with substances which are easily destroyed by it, the destruction which it produces will be great. I do not know that the effects on the constitution are particularly bad—I dare say they may not be, because the quantity at any given time is very small—but when you come to consider that in a library, or in a room full of paintings, the gas burns every night for so many hours, then the sulphuric acid which gets formed and condensed on the walls must do a certain injury to them; and it has been found, without doubt, to have committed great ravages on the binding of books, and also on pictures which are affected by acids. I can quite understand that if a picture be not protected by glass or varnish, such colours as ultramarine, which are affected by acid, will be very considerably damaged by the continued action of sulphuric acid resulting from the burning of coal gas, because ultramarine, as I have shown you in a former course of lectures, is always destroyed by acids.

This bisulphide of carbon is a very inflammable substance, catching light at a temperature far below that required to produce a gas flame. A few drops have been put into this jar where they will volatilise, and you see that a heated rod being introduced is quite sufficient to set it on fire. We will now put these flowers into the jar, and you will see what happens to them; the colour is very quickly destroyed. How is this bisulphide of carbon to be got rid of? This has been a great difficulty to gas manufacturers for a long time past. We can get rid of it well enough in small quantities in laboratory experiments, but to get rid of it on a large scale in a manufactory is very difficult. Several processes have been adopted, and, as I have already told you, a certain portion can be got rid of by passing it through lime which has already absorbed the sulphur from the sulphuretted hydrogen. That would take away some but not the whole. Here is an experiment, not of my own devising by any means, for I read of it in the lectures of Mr. Vernon Harcourt at the Royal Institution, and I have also seen an account of it in a treatise by a German chemist. Bisulphide of carbon is put into a tube, a current of hydrogen gas will be passed through it, the hydrogen gas will take up the bisulphide of carbon in the state of vapour, and you will notice when a piece of lead paper is put to the end of it, that no blackening will take place, showing that no sulphuretted hydrogen is present. Hydrogen gas charged with the vapour of carbonic sulphide will be passed through this tube and will be heated, and as soon as the two are heated together the bisulphide of carbon will be decomposed, and sulphuretted hydrogen will be formed, as will be seen by its blackening the lead paper applied at the end of the tube. Suppose coal gas containing hydrogen and bi-

sulphide of carbon be heated in its passage through certain pipes, the hydrogen will decompose the bisulphide of carbon, and you will get sulphuretted hydrogen formed. Now, there is no difficulty whatever in absorbing sulphuretted hydrogen, as I have already explained. But then it will be said, if you pass olefiant gas through a red-hot tube, you told us the other evening that carbon is deposited, and if carbon is deposited, then the illuminating power of the gas is destroyed to a considerable extent. Now this is true, but Mr. Vernon Harcourt says—I have not tried it myself, but his authority is quite as respectable as mine, and on this subject worth a great deal more—if you pass the gases through tubes heated to a low temperature, and to such a temperature as does not cause the deposit of carbon, it will yet be sufficiently hot to cause the decomposition of bisulphide of carbon. Mr. Lewis has tested this paper. He will now test it after the tube has been heated; you see the lead paper is considerably blackened, showing the formation of sulphuretted hydrogen. This appears to be a very sensible scientific method of getting rid of bisulphide of carbon from coal gas, and if it has not been tried by anyone here interested in gas manufacture, I should advise him to have it tried on a practical scale.

Now, I am sorry to leave the subject of coal gas, because one could go on with it for two or three lectures; but, at all events, I have put you in the track of finding out certain improvements in its manufacture, and if I have done that I have done a great deal.

Now we pass on to the proper subject of this lecture, the means by which heat is communicated from body to body, and the way in which temperature and heating power are measured. How is heat transmitted from body to body, because that is what we have to do with in constructing stoves and economising heat in all illuminating and cooking apparatus, and in fact in all processes where heat is employed. I am sure that you will agree with me, and with all that I have said, that half the quantity of heat produced by the combustion of our coal is lost in this country by the way in which we burn our coal. This is really a very serious thing. Last year we suffered from it terribly, and though the price of coal is a little easier now, still I do not think that ought to make us at all careless in giving our attention to this important subject. We like to sit round a fire, and I do not see why we should not do so, and at the same time burn our coal economically. As a general rule, in our fire-places we allow half the heat at least to pass up the chimney without giving us the slightest benefit.

Heat passes from one body to another in three ways. First of all by what is called conduction, which I will explain to you more fully next time, when I shall have a better opportunity for illustrating it by experiment than I have to-night. Then we have convection, and, lastly, radiation. It is well for us to understand thoroughly these principles, and I think a few experiments will make us understand them in order that we may apply them to useful purposes. Here is a metal bar, one half of which is copper, and the other half iron. Two balls are stuck on to it at equal distances from the centre with wax. Heat will be applied to it at the junction of the metals, so that if heat travels as rapidly along one metal as along the other, one ball ought to fall off as soon as the other, whereas you will find that this ball which is attached to the copper will fall off first, showing us that heat passes along copper more rapidly than along iron. Copper, therefore, is said to be a better conductor of heat than iron. Metals are the best conductors of heat we have; then come stone, wood, woollen materials, and so forth, which are not such good conductors. Here is an air thermometer; the liquid stands at a certain distance from the top, and I will drop the bulb into boiling water, but the bulb of this air thermometer is covered with cotton wool, and you will see that there will be no rise for some time in the liquid, whereas if there had been no wool around the bulb it would have shot up in a moment. That shows that cotton wool is a very bad conductor of heat, and wool from a sheep is even a worse conductor still. Why are metals good conductors, and wool, worsted, and cotton wool bad conductors of heat? I can partly explain it in this way. If you take a bar of metal of considerable density, the particles of which are very close, and put it to your ear and strike at the end of it, and then take a metal, the particles of which are not in such close contact, you find that according to the density of the medium so is the sound more perfectly conducted to your ear—the more dense the material used the more perfect the sound. For instance, at the top of a mountain you cannot hear sounds at a distance, because the air is very light, whereas those who have been down in diving bells tell us that all noises sound like thunder because the air is so dense. So that a dense medium serves as a better conductor of sound than one which is not so dense. Now heat does not travel as sound does, but it travels through undulations —not of air, but of an imponderable ether—but we can imagine that those metals which are more dense, and whose particles are more close together, would be better conductors than those whose particles are less densely packed together, for this ether is supposed to permeate all matter. I am not sure that I am quite right in asserting this—I mean as to the density of all metals—it may be subject to corrections, but I know I am right in the general principle, for here you see you have a dense substance which conducts heat readily, but if you take air, for instance, which is not such a dense substance, you have not got a substance which conducts heat like a metal. Cotton wool and wool from a sheep are made up of a number of tubes, which I could show you by means of a microscope, and these tubes contain air. Here is a glass, tolerably well filled with cotton wool, but still, with a little care, I can go on pouring water into this glass until it will hold as much water, or nearly as much, as if it contained no cotton wool at all. What does that prove? Simply that the cotton wool has in its interstices spaces which are filled with atmospheric air, and it is, no doubt, to a great extent because those cavities contain air, that wool and such substances are extremely bad conductors of heat. In foreign countries more than in our own people use double windows in winter, allowing a space of three or four inches between the two, and these are found to keep a house perfectly warm. The reason of it is that you have the air confined between the two windows, and the air being a bad conductor of heat, does not allow the heat to escape from the apartment. Air, when it is still, is about the worst conductor of heat that we know of, but there is a difference between air fixed and air in motion. I shall have to speak to you about the effect of air in motion by and by. Liquids are bad conductors of heat, as you see by this experiment. Here is an air thermometer with a bulb upwards in a vessel of cold water; here is a flask with some hot water in it, which I will put on the top of the water in the other vessel, and if water were a good conductor of heat the cold water below would get hot and the air in the bulb would be expanded, and the liquid would be driven down. I think you will see that does not happen. Water then is a bad conductor of heat provided it is stationary. We will wait two or three minutes, and then we will apply heat to this little bulb here below the vessel of cold water; the liquid in the small bulb will get heated, the hot water will travel up into the cold water, it will raise the temperature of the liquid, and you will immediately notice the air thermometer will descend. This shows you that although water is a bad conductor of heat when stationary, yet if it can be made to travel it conducts heat readily. It is also the same in the case of air.

Metals, then, as a class, are the best conductors of heat, then stone, wood, and so forth, being intermediate, and then come cotton, wool, and such substances as these. I mention these three kinds, because when we come to

speak of the application of heat to cooking purposes we shall have to make much use of good non-conductors as well as of good conductors. The temperature of this room is uniform, but if I put my hand upon this marble I find it to be colder than if I put it on the wall. On the other hand, if I put it upon the blade of this iron knife I feel it to be colder than the marble. This is simply because metal is a good conductor of heat, and takes the heat away from my hand, although it is of the same temperature as the marble. Marble is a better conductor than the wall, and therefore my hand gets colder when placed on it than when it is placed on the wall.

So much about the conduction of heat. When air or any liquid is warmed, it rises, and when it is cold it descends, and so circulation is set up, and that is the principle on which water is used for the purpose of heating houses. The hot water goes to the extremity of the pipes, and the cold comes back to be warmed. Here is an apparatus showing you the warm particles which are going up and the cold which are coming down, a perpetual circulation being kept up.

How is it that heat, from any source, say a fire, warms the contents of the room? It is by radiation, a principle which I had hoped to illustrate to-night experimentally, but time will not allow me. Here is a pair of conjugate mirrors, if a hot iron ball be put in the focus of one mirror, the heat will be reflected from that mirror on to the other, and in the focus of the second mirror, something which is easily inflamed will be placed, and you will see that the heat radiated can also be reflected. I shall have to call your particular attention to this subject, because the principle of it is applicable to, and has been applied to fire-grates, and has also been applied to warming apartments of all kinds.

ANNUAL INTERNATIONAL EXHIBITIONS.

MACHINERY, ENGINEERING, AND CONSTRUCTION.

(*Continued from page* 931.)

IV.—Brick-making Machinery.

In the preceding divisions under which these articles, on the more important exhibits of machinery—mostly in motion—has been classified, namely those relating to the working of such materials as iron, stone, and wood, it must be noted that the subject-matter treated, the materials operated upon, manifest special structural characteristics—crystalline, granular, stratified, or fibrous, and are originally obtained or made in masses or blocks, regular or irregular in form and outline, before being submitted to the operations of the machine tools described; and, moreover, there could be no structural change, creating a difference between the crude material, and the same in its finished state. Nothing of all this, however, applies to the case of the subject-matter of the present division of the subject at which this article has now arrived, viz., the manufacture of bricks; for firstly the building material, brick, is not a natural product, and does not exist anywhere in the earth's crust, but is entirely the result of artificial treatment and manipulation; and secondly, its original and chief, almost only constituent, clay, is, in its natural state, as found, entirely amorphous, its one and sole characteristic being plasticity; and herein lies a farther distinction, as between the crude element or raw material and the finished product, that, whereas the latter is extremely refractory and little amenable to treatment, manually or mechanically, the former, from its very plastic nature, lends itself with the utmost readiness and facility to all kinds of manipulative treatment, whether by hand or machine. This great change, and, so to say, antagonism, is simply the result of excessive heat; it is therefore obvious that the exhibits in the machinery department comprise only machines for preparing and shaping the plastic clay into various special forms, to the entire exclusion of the kilns, furnaces, or other appliances by which those forms are hardened, fixed, or rendered unchangeable except by fracture or attrition. The building elements which are thus formed out of plastic clay burnt to hardness, viz., bricks, tiles, &c., occupy a prominent and important position in all construction; and this consideration suffices to attach a proportionate importance and interest to the mechanical appliances employed in their manufacture. The examples thereof are unfortunately not numerous, and relate almost solely to bricks, a complete set of brick-making machinery being shown, whereas of tiles and tile-making machinery the materials for a notice are extremely meagre.

No. 6,050. Messrs. T. Middleton and Co. exhibit in Room III. a number of machines, forming almost a complete brick-making plant, under the patents of Mr. C. H. Murray, whereof they are the sole licensees. These comprise Murray's Patent Brick-making Machine, Brick-moulding Machine, and Hand-press.

In Fig. 1 is represented Murray's Patent Continuous-Delivery Brick-making Machine, which may be regarded as being composed of three distinct parts, and performing two processes, namely—1. The efficient preparation of the clay and its conversion into a well-tempered, homogeneous, plastic mass, suitable for the manufacture of first-class bricks, of even and regular quality. 2. The cutting up and sub-division of such a mass of clay into rectangular blocks of suitable dimensions. The first two portions of the compound machine are devoted to the former process, and the third to the latter. Thus raw clay, as brought to the machine in crude lumps, is fed into the top of a pug-mill, which consists of a fixed hollow vertical cylinder, carried on a suitable cast-iron frame, within which is contained the gearing necessary to cause the mixing and cutting-knives to rotate duly within the cylinder. The shell of the pug-mill is constructed of wrought iron, combining lightness and strength to resist fracture. The rotating knives are fixed upon the central vertical axis of the mill, which is made square to hold the blades, and caused to rotate by the gearing beneath. The knife-blades are kept apart by collars, and disposed in a helical manner round the shaft, there being also such a set as will force the clay downwards while being masticated thereby. A nut screwed on the top of the shaft fixes the whole of the blades in proper position, and in case of fracture of any one of them, all can thus be readily released and re-fixed for repairs. The crude lumps of clay are thus cut up, commingled and compressed, and finally forced out of an opening or mouthpiece at the bottom of the cylinder. Here the issuing amorphous stream is received on a roller table, carried on a frame attached to the rolling-mill—the second part of the apparatus—and, being propelled by the succeeding clay, is carried forward until it is seized within the grip of a pair of smooth iron rollers, geared together, and driven by suitable mechanism. These rollers press and crush the clay in its passage between them. so as effectually to grind and free it from all air and blow-holes, and deliver it in a thoroughly tempered homogeneous mass. The clay issuing thus from the rollers is received in a stout iron casing or chamber, wherefrom there is but one outlet, namely, an oblong rectangular mouthpiece, which in itself is one of Mr. Murray's specialities, namely, the Patent Lubricating Solid Die. This die or orifice is exactly correspondent in shape and dimensions to the vertical longitudinal section of a brick, *i.e.*, a rectangle of about 9 inches by $4\frac{1}{2}$. Water is the lubricant, and is applied only at the ends or sides of the mouthpiece, so as to equalise, as nearly as practicable, the friction and resistance over the whole periphery of issue; thus the expressed clay comes forth continually

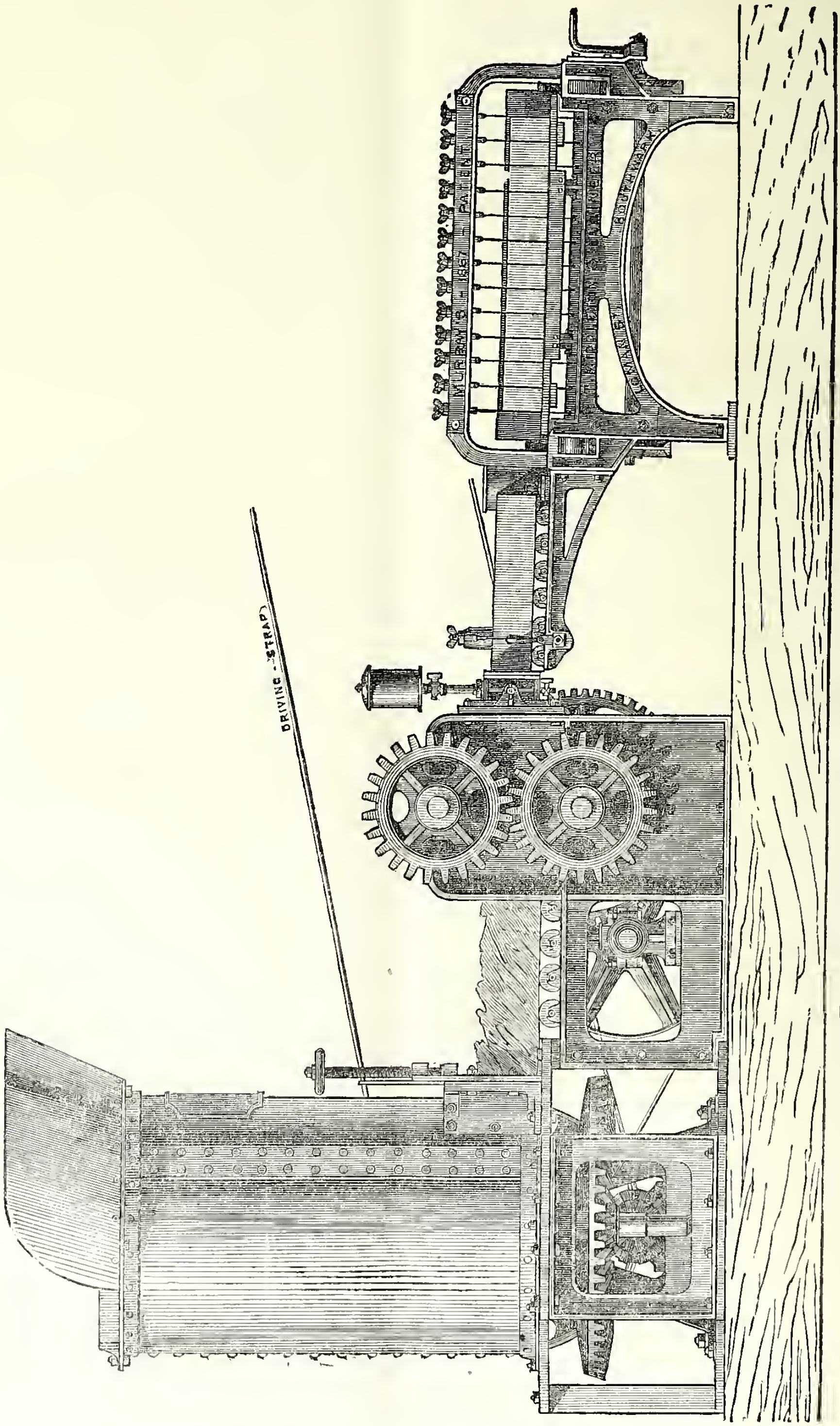


Fig. 1.—Murray's Continuous-delivery Brick-making Machine.

in an uniform and perfect rectatangular stream, with the arrises preserved quite sharp, and in plane laminæ, without curvature or bulging in the centre. The homogeneous stream, thus expressed, is received upon the third and most important part of the machine, namely, Murray's Improved Brick-cutting Table. A roller table, of adequate length, projecting on brackets, receives the rectangular clay-stream issuing from the die, and when a length of clay sufficient for any required number of bricks (which may be from 8 to 12, according to the gauge or interval at which the cutting wires are set in the frame), a single cutting wire, fixed in a sliding frame with a handle, is rapidly passed across by hand, whereby the desired length is severed, and it is then pushed forword manually, in advance of the still issuing clay, on to the flat iron plate which forms the cutting table itself, and alongside of the cutting apparatus. This consists of a suitable number of wires strained vertically across a fixed iron frame at regular intervals. For the manufacture of ordinary bricks these cutting wires are parallel at intervals of about three inches apart; but the intervals and positions of the wires may be varied and regulated, and they may be set askew, for cutting any size, or for angle or bevel bricks. The table is farther provided with a thrust plate, a vertical iron plate, which has a traversing motion on a slide, imparted to it by a rack motion, through a toothed segment wheel and lever-handle, whereby it can be brought up to and shifted away from the cutting wires. Then the severed block of clay having been laid by the side of the wires—without regard to its position, so long as its ends project beyond the outside wires—the thrust-plate is brought over by a turn of the handle, and in its progress, coming up against the block of clay, first lays it perfectly parallel to the wires, and then forces it through them, each wire making a perfectly clean cut, and delivering the cut clay bricks on a moveable board, ready for removal, with edges and arrises perfectly unbroken, sharp, and well defined, no fragments being torn off and detached. Meantime the clay-stream has been continually expressed on to the roller table; the thrust plate is traversed back again so as to leave the cutting table clear for the next block, which is cut off, and the whole process renewed *ad infinitum*, the cut brick-blocks being shifted on to barrows for removal to the drying floors, without being handled. The farther stages of their treatment pass beyond the scope of this article. In this manner, by the continuity maintained in the stream of clay, stoppage and waste are avoided, and a maximum of production attained, without accelerating the action of the rollers and the die to a prejudicial extent.

The machine and process thus described may be taken as relating to the ordinary, straightforward production of machine-made square or stock bricks for building purposes, such as are commonly burnt in kilns. But these bricks may be greatly improved, and made of a superior class by being pressed and perforated, and it is for this object that the machine shown in Fig. 2 has been devised, viz., Murray's Patent Single Brick Press. In this machine the unburnt bricks, or blocks of clay, as they are removed from the cutting-table of the brick-making machine last described, and after having been slightly air-dried, are pressed, with the primary object of compressing them, for the purpose of imparting to them an increased density, solidity, and hardness, combined with greater ultimate regularity of form and uniformity throughout when subsequently burnt. The machine is constructed with suitable framing, carried on wheels so as to be portable, and supporting two vertical standards formed with slides, and also carrying a fixed horizont

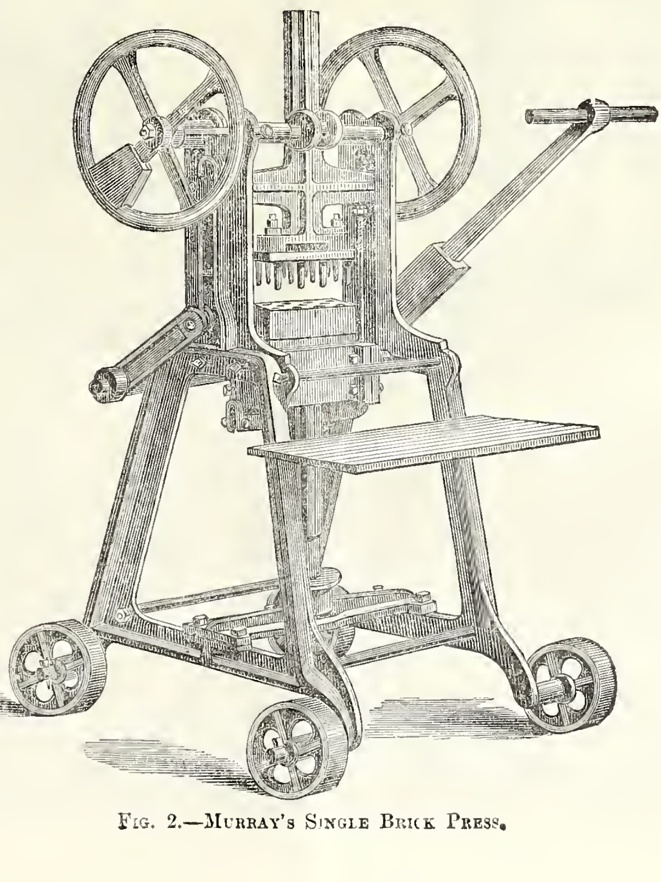
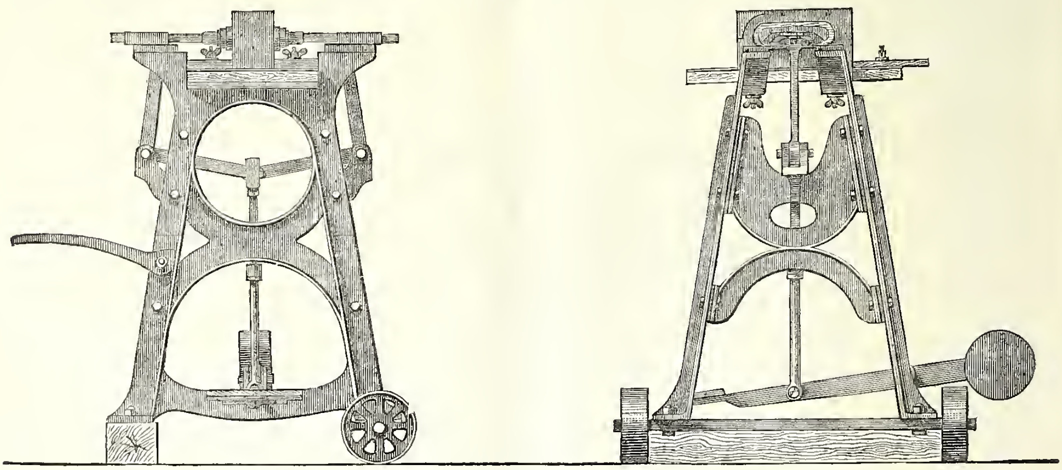


Fig. 2.—Murray's Single Brick Press.

mould-box, or matrix, made of the requisite dimensions, and having its upper sides at the mouth slightly bevelled outwards, so as to present a taper orifice for the entry of the clay-brick to be compressed. A strong cross-head is affixed to slides working in the side standards, and carries the upper or pressing die; and it is also connected by suitable rods with the ram or plunger, which forms the bottom of the mould-box or matrix, and rises and falls therein. The top of the cross-head carries a vertical arm, having a rack in which works a pinion keyed on to a horizontal transverse shaft, carrying at each of its extremities a counterweighted fly-wheel, which acts to give momentum to the descent of the cross-head and die. The vertical reciprocating motion of the cross-head, die, and plunger is effected by a link actuated by an arm and pivoted lever handle, giving a species of parallel motion. When the lever-handle is depressed, the plunger, which is in its normal position at the top of the mould, is depressed by the cross-head, simultaneously with the compressing die; but when the plunger has arrived at the bottom of the mould, its farther descent is arrested by a stop, while the upper die and cross-head continue to be depressed, and the die entering the mould effects the compression of the brick, which, having been placed by hand on the plunger, is thus forced into the mould and consolidated therein. Usually the upper or compressing die is simply a stamp, bearing the maker's name, and with the plunger is so formed as to impress a splayed oblong recess on the top and bottom of the brick; but for special purposes, a perforating die, as shown in the engraving, is employed in lieu thereof, whereby a number of circular or other orifices are made in the body of the brick, which make it lighter and promote even and regular drying, by freedom of access to the interior for the atmosphere. After the compression and, if necessary, perforation of the brick have thus been effected by the down-stroke, the up-stroke of the lever-handle first withdraws the perforating and compressing die, and then elevates the plunger, so raising the pressed brick and leaving it clear of the mould, ready for removal by hand; this being then removed, and replaced by another severed clay-brick, the operation is repeated. It may be noted that a single motion, *i.e.*, the depression of the lever and its return, effects the entire operation, which is perfectly simple, rapid, and easy. Shock is avoided by the interposition of an elastic ring in the collar of the cross-bar, in the lower part of the frame which arrests the plunger when at the bottom of the mould-box; and this latter is itself constructed in sections, so that any wear in action may be compensated for. By setting them up a little closer, the perforators, being lubricated, easily enter, and are withdrawn from the clay, the surplus of which is expressed in a thin lamina, which is readily trimmed off. By means of moulds and dies of any other suitable shape, different classes of articles, such as tiles, paving bricks, &c., may be manufactured by this machine.

By another of Mr. Murray's machines, Figs. 3 and 4, the Patent Brick-shaping and Moulding Machine, bricks of any curved and irregular shape may be manufactured



Figs. 3 and 4.—Murray's Brick-shaping and Moulding Machine.

out of the ordinary square clay-block, as turned out from the brick-making machine and cutting-table; such, for instance, as bull-nosed bricks, ogee bricks, angle bricks, and all other forms of moulded fancy bricks, for copings, string-courses, splays, reveals, &c. In this machine the clay-blocks to be moulded are firmly gripped between two metallic templates upon a plane table or plate, the templates being cut in pairs to the required pattern. The cutting or moulding is effected manually by means of a wire strained tightly across an iron frame or bow, and the wire, following the outlines, sinuosities, and angles of the template, removes the superfluous clay, leaving an even surface of corresponding shape; an operation which is effected with great ease and rapidity, and it is quite within the capacity of a boy or unskilled labourer. The templates which clip the bricks are actuated by a system of compound levers, under the influence of a weighted lever pivotted to the bottom of the framing. Thus in their normal position they are [pressed closely together, and a lever-handle is provided whereby they may be opened out for the purpose of receiving the clay-block to be operated upon. The templates are of any required form, suitable to the brick, tile, or other article which is to be moulded, and of course must be selected and affixed to the machine at need. In this manner, and by the aid of the various machines of the series described, the plastic material, clay, is prepared and turned out in the specific form required, ready for the subsequent processes of drying and burning, which are foreign to the scope of this article.

No. 6,045. Messrs. J. Whitehead and Co., are the only other firm of engineers and manufacturers of brick-making machinery who exhibit; and their show is limited to one machine only, viz., the Improved Brick-pressing Machine, with two chambers. (Fig. 5). This machine is of the dimensions $3\frac{1}{2}$ feet in length, by $2\frac{1}{2}$ feet in width, and 3 feet high, and is constructed in the form of a compact table and frame, mounted on

wheels for portability. In the centre of the top of the table two mould-boxes are fixed side by side, having one lid pivoted between them and common to both, so that by turning over from one side to the other it covers each mould alternately. Both sides of the lid are formed to act as a top die or stamp. The bottoms of the mould-boxes are formed by two rams, or plunger pistons, arranged with a vertical traverse, or rise and fall, but so that their action is alternate, the one rising while the other falls; thus these moveable pistons alternately

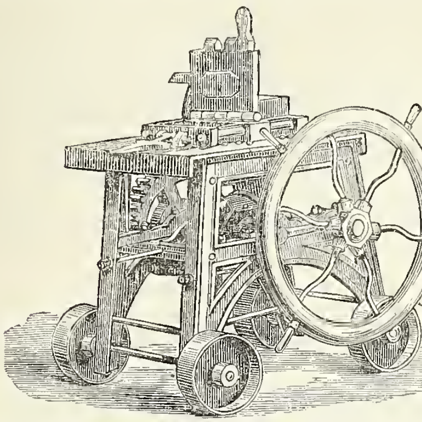


FIG. 5.—J. WHITEHEAD & CO.'S DOUBLE BRICK PRESS.

press a brick in each box. Motion is communicated to the pistons by a toothed sector, driven by a pinion which is worked by means of a large band or tiller-wheel, with a weighted periphery, so as to act as a fly-wheel and give momentum to the stroke and pressure to the pistons. A clay-block or brick having been placed in one of the mould-boxes, the cover is shut, and fastened by means of a stout clip, by hand. A half-turn of the wheel then raises that plunger, and compresses the clay into a solid brick, while, at the same time, the plunger in the twin mould is depressed, so as to allow of another clay-block or brick being placed therein. The lid is then lowered and raised for the delivery of the first brick, which is removed by the boy, while the cover is turned over on to the other mould, and by the reverse turn of the wheel the second brick is pressed, and the other plunger depressed ready to receive another brick. In this manner the twin moulds are kept in alternate action, whereby a man and a boy are enabled to press 4,000 bricks in an ordinary day of ten hours. The sizes of the mould-boxes are various, and any impression may be stamped on the bricks; but each machine may be fitted with loose mould-pieces, so as to adapt the boxes to different forms and sizes of bricks. It will be seen that this is simply a brick-press, and is not intended for the manufacture of perforated bricks.

No. 6,043. Messrs. Wade and Cherry exhibit in Room III. some specimens of their interlocking roofing tiles, for making a perfectly fitting and water-tight covering for buildings, as also a Single Hand Pressing Machine, for the manufacture of this their speciality, which in its general features and action resembles the brick presses previously described. In the centre of a portable table is placed a matrix or mould-box of the shape and size required for the patent tile; the bottom of the mould-box is formed by a moveable brass die or plunger of suitable shape, which has of course the requisite vertical traverse imparted to it, with pressure, mechanically, whereby, when the cover is down and locked, the mass of well prepared and tempered clay, placed in the box by hand, is first compressed, and then, on the lifting of the cover, protruded from the mould-box for removal. The cover is a strong metal die, formed to correspond to the form of the upper side of the tile (as the plunger corresponds to the lower side); and it is especially fitted with an ingenious device for giving a slight diagonal traverse to the brass die, which is affixed to its under side, with the object of an effectual disengagement from the pressed tile. This is effected by a short bent lever pivoted on the top of the cover. The whole process of the manufacture of the patent tiles by this machine is simple and expeditious. The tiles themselves have been designed with a view to dispense as far as possible with the necessity for pointing, and so as to obtain a perfect mutual fit throughout, by means of a joint, whereby the danger of displacement by storms, to which the ordinary slates and tiles now in use are so liable, may be entirely obviated. This is obtained by constructing the tiles with flanges on the edges, which are reversed in what may be called the upper and lower halves of the tiles; the lower or exposed part of the tile is made in the shape of the section of an acorn or the blade of a spade, *i.e.*, with a convex curvature; the upper portions are made with reverse curves precisely similar and corresponding, presenting a concave external edge. The dove-tailed flanges are formed on the face of the tile in the upper half, but on the reverse side of the tile in the lower half; thus there is very little overlap, except the flanges which clasp each other throughout the roof, so that these patent acorn-shaped interlocking tiles exclude both wind and rain, and can only be displaced by fracture. There is considerable gain in weight, owing to the diminished overlap, while they may be used much thinner than common tiles, on account of the superior density and soundness obtained by the pressure used in the manufacture; pointing is almost entirely unnecessary, or reduced to a minimum. Special forms of the tiles are made in special dies for finishing off and closing up the work at the ridge, eaves, and gable-ends; thus, for tiles under the ridge, the shape is simply that of the lower part of the acorn tile, cut square at the top; similarly for the eaves it is the upper half, cut square at the bottom; while for gable-ends, it is a half-tile longitudinally, with one side straight and one curvilinear. In one particular application, this class of tile may be used with advantage, viz., as a sheathing or protecting facing to thin outer walls, mansard roofs, &c., in lieu of slates.

(To be continued.)

ARCHITECTURE, BUILDING APPARATUS, AND CONSTRUCTION.

The articles exhibited under this head in Section B, of Class IX., are mainly the various building materials, &c., and as such appeal chiefly to a special class. The apparatus for dressing stone, the machines for moulding bricks, and the methods of concrete building shown in operation in the Western Annexe have already been described in the *Journal*. It only therefore remains to mention a few of the principal exhibits shown in Room XXII. Of the natural materials employed for architectural purposes, such as granites, marbles, and other stones, there are numerous exhibitors, who show rough and prepared specimens, and in some cases finished work. Among the varieties represented are Ancaster Oolite (Ancaster Stone Company, No. 5,652); Tisbury stone (J. P. Lilley, No. 5,723); Mansfield stone (R. Lindley, No. 5,724); Minera stone (Clarke and Parker, No. 5,669); Cornish and Jersey granite (J. Freeman and Sons, No. 5,692; Le Gros and Co., No. 5,721, &c.); roofing and other slates by various exhibitors. Bricks are not so largely represented, though one or two firms show blue Staffordshire and other bricks. In ornamented brickwork, there are also

several exhibitors. W. Looker shows a variety of examples in which architectural features of different descriptions are formed in brickwork of several colours. Another style of ornamentation is illustrated by the contributions of H. Pether (No. 5,736). In these the usual shape of the brick is preserved, but it is ornamented on the face with stamped or moulded patterns. By this means, when a row of these bricks is fitted together, a continuous pattern is produced.

Terra-cotta is a material that is coming more and more into use for building purposes, and though this employment of it is by no means novel, since it has been used to a small extent in architecture since time immemorial, it is only of late years that its use had become extended. The increased facilities for its manufacture provided by modern ingenuity enable the most ambitious architectural features to be constructed of it, while its lasting and impervious character are urged as important recommendations for its use in cities in the midst of an atmosphere impregnated with acid and other impurities which attack and destroy stone. Among the exhibitors who show examples of the use of terra-cotta as a building material are Doulton and Watts (No. 5,681) and Johnson and Co. (No. 5,712.) The former send a variety of articles, shafts for columns, capitals, &c., while the exhibits of the latter firm consist of ridgings and finials. Glazed tiles for mural decoration, &c., are also shown by Doulton and Co., Craven and Co., Maw and Co., and others. Craven, Dunnill and Co. also exhibit encaustic and geometrical tiles for pavements, hearths, and fireplaces, as well as for use in the construction of "Tilo-concrete" buildings.

The various imitations of marble, &c., have a good many representatives. The Magnus Enamelled Slate Company show some chimney-pieces and other specimens of their material, slate enamelled to resemble marble. The same material is also employed for a chimney-piece shown by Lewis, Ford, and Co. Bellman and Ivey also send some pedestals and other specimens in imitation marble.

A new decorative material, called "frescoa," (C. Hide, No. 5,699), is conspicuously illustrated by a number of different specimens on a large stand. On a coating of stucco applied to a wall any suitable decoration is applied in colour, so that it can be made to imitate brickwork, stones of various sorts, and other building materials. The inventor himself describes it as an improved process for finishing, decorating, and rendering impervious to damp the external and internal walls of buildings, and imitating finished brick and stonework in various colours and devices. He states that the material is waterproof and impervious to heat or cold, that it can be applied to any existing building, and that it is at once cheap and durable.

Among the exhibitors of various kinds of cement are the Selenitic Cement Company (No. 5,747), who show both specimens of the cement and articles made therefrom; and the Burgh Castle Portland Cement Company (No. 5,666), who show Portland cement and white Suffolk bricks.

There are several firms which show different sorts of paints and compositions for treating stone, &c. T. Griffiths (No. 5,695), "enamelling paint;" the Silicate Paint Company (No. 5,749), and the Indestructible Paint Company (No. 5,706). For treating wood only, J. S. Jackson sends some specially prepared "wood stains," and specimens of wood treated therewith.

Among various miscellaneous building appliances may be mentioned, Clarke and Dunham's (No. 5,670) applications of glass, such as for balustrade knobs, door handles, finger plates for doors, &c.; S. Chatwood's (No. 5,676) fire and burglar proof safes and locks; Hobbs, Hart and Co.'s (No. 5,700) locks; Haywards Brothers' (No. 5,698) pavement lights, &c., &c.

Of iron as a building material there are not many exhibitors. Homan and Rodgers show some fire-proof flooring, and some sections of iron girders. T. H. P. Dennis and Co. also sends a model of a patent wrought iron conservatory, erected in the ground to the west of the Exhibition building, near the works for methods of sewage purification. Cottam and Co. (No. 5,674) send specimens of iron-work, including a spiral staircase, brackets, castings, &c. Macnaught, Robertson, and Co. (No. 5,726) have some specimens of roller girders also.

There are a few models exhibited. The Commissioners for Japan (No. 5,710), send a model of a pagoda, and two drawings of the same; also a model of a prison-house, and some mural decoration and drawings. The director of convict prisons (No. 5672), Lieut.-Col. E. F. Du Cane, C.B., R.E., sends a series of models:—(*a*) model of Pentonville Prison; (*b*) church for officers at Portland Prison; (*c*) new bath-house, Portsmouth Prison; (*d*) new wing; (*e*) half section of wing, Pentonville Prison: (*f*) new infirmary, Portsmouth Prison; (*g*) warders' quarters, Portsmouth Prison; (*h*) lamp for cells used in Portsmouth Prison, full size.

The following is the return of admissions to the Exhibition for the week ending October 17:—Season tickets, 876; payment, 11,180; total, 12,056.

EXHIBITIONS.

Proposed Universal Exhibition at Algiers.—From a document which has been forwarded to the Liverpool Chamber of Commerce it appears that it has been decided by the authorities of Algiers to hold a grand Exhibition there, to commence in November, 1875, and continue until about the spring of the following year. The building will consist of one large central hall with lateral galleries attached, each covering a wide area of ground, and affording, it is expected, ample accommodation for the articles for exhibition which will be sent by various countries. The organising committee have issued a plan and a general specification of the proposed building, and they invite contractors to come forward.

CARBONIC ACID AS A MOTIVE POWER.

Much interest has recently been created by the publication, originally in a Dutch scientific journal, and afterwards in our own technical journals, of an article descriptive of Dr. Beins's "Carboleum Motor," which is spoken of as "the successor of steam." For many years, it would appear, Dr. H. Beins, of Groningen, assisted by his brother, Mr. J. F. Beins, manager of the Netherlands Soda Factory at Amsterdam, have been engaged in experiments, with a view of transforming heat into mechanical power more advantageously than is done in the steam and other engines at present in use. In one of these experiments they sought to find what degree of tension the carbonic acid given off by bicarbonate of soda would have, and found that this sodium salt (or the corresponding potassium salt) in a dry pulverised state, or in an aqueous solution, when heated in a closed place, gives off a portion of the carbonic acid, which is condensed at the cold end of the space, so that at a temperature of 300° to 400° C. liquid carbonic acid can be distilled out with a tension of 50 or 60 atmospheres. Dr. Beins has shown the experiment to several scientific men in Holland, who have taken great interest in the matter. The compressed state of the gas is a condition of importance for its application in technical chemistry, and Dr. Beins states that he has found the liquid acid, which he calls "carboleum," supplies an excellent motive power under certain circumstances.

The invention has been examined by an official commission in Holland, which, it seems, agreed with the inventor regarding the main points; but, for reasons

independent of the project itself, the Government has not yet resolved upon its immediate adoption. Dr. Beins asserts that freezing machines, working by evaporation of carboleum, produce ice at less cost than any existing freezing apparatus; and that, as regards this general usefelness of carbonic acid, an inexhaustible store is obtainable from common chalk.

INDIAN TEAS.

At the recent meeting of the British Association, Professor Hodges gave an account of the composition of tea and tea soils from Cachar. He said:—Notwithstanding the important place occupied by the tea plant in the dietary of so large a portion of the world, its chemical examination has attracted comparatively but little attention. We owe to Peligot and Mulder the most valuable investigations which have been made in connection with it; and more recently we have been supplied with some analyses of the ash of teas from the laboratory of Professor Horsford; while Wanklyn and Allen have lately contributed many facts of great value in reference to the examination of the tea of commerce and the detection of adulteration.

Some time ago, Professor Zöller read before the Physico-Medical Society at Erlangen a paper on the chemical investigation of a Himalaya tea ("Repertorium für Phurmacie," Band xx. Heft 8), which possessed peculiar value, from the circumstance that the specimen examined might be regarded as consisting of genuine tea without any foreign admixture, having been received from the growers by the late Baron von Liebig. Professor Zöller's investigations confirmed the correctness of observations which he had formerly made respecting the influence which the age of the leaves of plants exercised on the composition of the ash, that while young leaves are found to be rich in potash and phosphoric acid, and poor in lime and silica, the amount of lime and silica in the ash increases with the age of the plant. As the best qualities of tea are known to consist, as I shall presently show, merely of the very young shoots of the plant, the estimation of the amount of potash, phosphoric acid, lime, and silica, may be usefully, as he suggested, employed in enabling us to judge of the quality of a specimen of tea. This opinion he found confirmed by the examination of the specimens of Himalayan tea.

One hundred parts of the ash of this tea consisted of—

Potash	39·22
Soda	0·65
Magnesia	6·47
Lime	4·24
Oxide of iron	4·38
Protoxide of manganese	1·03
Phosphoric acid	14·55
Sulphuric acid	trace
Chlorine	0·81
Silica, acid, and sand	4·35
Carbonic acid	24·30
	100·00

The richness of the tea ash in potash and phosphoric acid, showing that the tea had been prepared from young leaves, suggested that the amount of matters in the leaves, soluble in water, and of nitrogen, and also probably of theine, would be large. These anticipations were confirmed by the investigations. The extract obtained by treating the leaves with boiling water weighed 36·38 per cent., and the nitrogen 5·38 per cent., while the theine amounted to 4·95 per cent. of the air-dried leaves.

Some time ago I had an opportunity of submitting to examination specimens of tea grown in Cachar, under the superintendence of Samuel Davidson, Esq., formerly of Belfast, and also a specimen of fine Cachar tea forwarded to me from the same district by Dr. Joseph Nelson. Mr. Davidson's specimens were taken from the fields in August, and were carefully enclosed in tinfoil, and may therefore be regarded as representing genuine, unmixed specimens of Indian tea. Mr. Davidson also kindly supplied the following history of the crop from which the specimens were taken:—"The leaves were taken from plants in their seventh season, and consisted of the young shoots from which tea is manufactured—viz., the bud, the first, second, and third leaves down the stem. In none of the samples were there old leaves or actual wood. A shoot with this number of leaves is usually the growth of about twelve days after the bud has got started to grow. The indigenous sample is from the variety of the plant which was originally found growing wild in the jungles of these districts. It is, I should think, the true *Thea viridis*. It is a very large-growing plant—almost a tree—and its leaves, when full grown, are very large and succulent. It yields by far the best quality of tea. The other sample was from a hybrid plant. This is supposed to be a true hybrid, between the indigenous and China varieties, and certainly partakes very much of the peculiarities of both varieties. The China plant is the variety which, I think, is the correct *Thea Bohea* originally imported direct from China. It is a miserable, small-growing, stunted plant compared to the indigenous, the full-grown leaves being only about two inches long, and the tea is inferior. The hybrid gives a good strong tea, and is a hardier plant than the indigenous, and so is very much liked; but the more closely it approaches to the indigenous, it is the more highly prized." The specimens received by me had been mainly dried in heated rooms. The produce of the crop was estimated at 400 lbs. of dried tea per English acre. It is so seldom that we are able to obtain any precise account of the history of the specimens of tea and other foreign productions which have been submitted to chemical examination, that Mr. Davidson's report possesses especial importance.

One hundred parts of each variety of the tea gave me the following results:—

	Indigenous.	Hybrid.
Moisture	16·06	16·20
Organic matters	78·81	78·98
Mineral matters	5·13	4·82
	100·00	100·00
Nitrogen in the dried tea	4·74	2·81

The ash of each respectively consisted of:—

	Indigenous.	Hybrid.
Potash	35·200	37·010
Soda	4·328	14·435
Chlorine	3·513	2·620
Sulphuric acid	5·040	6·322
Phosphoric acid	18·030	9·180
Oxide of iron	2·493	2·463
Protoxide of manganese	1·024	0·800
Lime	8·986	5·533
Magnesia	4·396	5·910
Sand and silica	0·500	1·300
Charcoal	2·900	1·830
Carbonic acid	13·590	12·600
	100·000	100·000

I was also enabled to submit to examination specimens of the soil and subsoil from the field on which the tea had been grown. Both soils were of a reddish colour, and in fine powder, the subsoil, which was taken 1 ft. 6 in. below the surface, being rather deeper in colour than the soil. A textural examination of the specimens was made according to the method which I have described in my work on "Chemistry for Farmers," and gave the following result:—

One hundred parts of each respectively were found to consist of—

	Soil.		Subsoil.
Sand in fine powder	71·5	..	82·5
Clay	28·5	..	17·5
Carbonate of lime, less than 5 per cent.			

Both soils may therefore be described as sandy loams.

Chemical Composition.

100 parts of each respectively consisted of—

	Soil.		Subsoil.
Organic matters	4·75	..	5·18
Chloride of sodium	0·11	..	0·35
Potash	0·03	..	0·03
Oxide of iron	6·00	..	7·20
Oxide of manganese	trace	..	trace
Alumina	2·02	..	3·86
Lime	trace	..	0·10
Magnesia	0·12	..	0·05
Sulphuric acid	0·07	..	0·35
Phosphoric acid	0·05	..	0·03
Insoluble siliceous matters	64·80	..	56·50
Moisture	22·20	..	24·44
Nitrogen per cent.	0·158	..	0·22

The amount of nitrogen and alkalies in the subsoil, it will be perceived, exceeds that which was found in the surface soil. This, I consider, may be owing to the circumstance that heavy rains (40 inches within four months) had fallen for some time before the specimens were taken.

Another sample of Cachar tea, kindly forwarded to me by Dr. Joseph Nelson, was also examined, chiefly for the purpose of ascertaining how far we could rely upon the determination of the amount of matters which are removed by heating tea with boiling water, as indicative of the presence in the tea of commerce of exhausted tea or of foreign leaves.

One hundred parts of the specimen were found to contain 4·963 parts of moisture, and the ash amounted to 5 parts. By treating the leaves with boiling water until exhausted of soluble matters, and evaporating the solution to dryness, an extract weighing 42·4 grains was obtained. Determinations of the amount of nitrogen in the leaves as received, and also in the insoluble residue were made, and while the nitrogen of the original sample amounted to 4·425 per cent., the insoluble residue was found to contain only 2·109 parts, the amount of mineral matters, by treatment with water, being reduced to 1·56 parts, so that 68 per cent. of the total mineral matter of the tea, and about 58 per cent. of the nitrogen, had been removed in the infusion.

By a typical error in the last number of the *Journal* T. Felkin was printed for W. Felkin. As there are a few copies of Mr. Felkin's work on Lace Manufacture yet unsold it has been determined to dispose of them at a reduction on the original price of a guinea. Anyone wishing to purchase the work can be supplied with a copy for 15s., on application to the secretary of the Society.

Germany during the first half of this year had 411 miles of new railroad opened for traffic within its borders, in nineteen different lines, the longest of which was 64 miles in length. During the same time in Austria and Hungary ten new lines were opened with an aggregate length of 205 miles.

Windmill power is being extensively utilised in New York. The *American Manufacturer* says that upwards of a hundred windmills of a new and improved form are now in use in private houses near that city for pumping water, sawing wood, grinding, &c., and in many instances are superseding steam and other agents of motive power.

Advices from Adelaide state that an important discovery of alluvial gold has been made in the Northern Territory.

PUBLIC MUSEUMS AND LIBRARIES.

The following returns of the numbers of visitors for September have been received up to the present date:—

	Number of Visitors.
British Museum	*
National Gallery (Trafalgar-square)	65,184
Kew Gardens and Museum	50,092
South Kensington Museum	80,917
Bethnal-green Museum	49,134
Geological Museum, Jermyn-street	2,200‡
Patent-office Museum	
Edinburgh National Gallery	12,071
Edinburgh Museum of Antiquities	12,079
Edinburgh Museum of Science and Art	30,932
Royal Dublin Society:—	
Natural History Museum	†
Botanic Gardens, Glasnevin	†
Dublin National Gallery	†
Zoological Society, Dublin	†
Museum of Irish Society, Dublin	†
Tower of London	18,287
Royal Naval College, including Greenwich Painted Hall	†

GENERAL NOTES.

Manufacture of Steel in France.—The Committee of the French Forges have collected the following figures, showing the production of steel in France from 1863 to 1870 included. It appears that Bessemer and Martin steel had grown from 1,856 tons to 90,000 tons; cast-steel, after falling from 10,000 tons in 1865 to half that quantity in the next year, rose to 7,610 tons; puddled steel fell from 35,823 tons in 1863 to 8,514 tons in 1869, rising again to 12,621 tons in the following year. The total quantity of steel produced was 47,000 tons in 1863, and 110,000 tons in 1870.

Production of Coal in the United States.—It appears from the statistics of the coal trade of the United States for the year 1873, the quantity of anthracite coal mined and sent to market was 19,585,178 tons, against 18,982,265 tons in the preceding year, showing an increase of 652.913 tons. The home consumption was estimated at 3,100,000 tons in 1872, and at 3,243,000 tons in 1873, so that the total production was 22,828,178 tons in 1873, against 22,032,265 tons in the preceding year, an increase of 795,913 tons. The whole supply of bituminous coal mined and moved towards the seaboard was 5,515,786 tons in 1873, and 5,231,998 tons in the preceding year, showing an increase of 283,786 tons, which, added to the increase of 652,913 tons of anthracite, makes a total increase of 936,699 tons.

NOTICES.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque, Post-office order, or Cheque Bank cheque, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Mon....Birkbeck Scientific Society, Southampton-buildings, 8. Mr. S. G. Young, "Brewing, and the Mechanism Employed."

* Return refused.
† Return for this month not yet received.
‡ Closed from 10th August to 10th September.

JOURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, OCTOBER 30, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

FOREIGN WINES.

A meeting of this Committee was held at the Royal Albert Hall, on October 16th. Present—Lord Methuen (in the chair); Dr. Birdwood, Lieut. H. H. Cole, R.E., Mr. J. Corlett, Mr. H. M. Cumming, Mr. R. Gray, Mr. C. L. de Luc, Mr. H. Matthiessen, Mr. H. Goodenough Smith, Captain the Hon. R. Talbot, and Mr. E. Venning, with Mr. Le Neve Foster (secretary). The Committee divided itself into three Sub-Committees, which will deal respectively with (A) Spanish wines, (B) Portuguese wines, (C) Australian and other wines. These Sub-Committees are now meeting from day to day, in order to carry on the necessary inquiries.

ECONOMICAL USE OF FUEL.

A meeting of this Committee was held on October 24th. Present—Major-Gen. F. Eardley-Wilmot, R.A., F.R.S. (in the chair); Mr. F. A. Abel, F.R.S., Mr. F. J. Bramwell, F.R.S., Captain Douglas Galton, R.E., F.R.S., Dr. Mann, Dr. David S. Price, and the Rev. A. Rigg, with Mr. Le Neve Foster (secretary). The Committee took into consideration their Report, and decided that it would be necessary to make a few further experiments before the Report could be finally adopted. Instructions were accordingly given for the prosecution of these experiments.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The seventh and last lecture of the third course of Cantor Lectures for the past Session, "On Carbon and Certain Compounds of Carbon," was delivered by Professor Barff, on Monday, May 25th, 1874, as follows:—

Lecture VII.

There is before me on the desk an apparatus which has been brought by Messrs. Caffall, Thomas and Co. I alluded to it last time, and told you I should go and see the invention at work, in order that I might be able to tell you about it. I have seen it at work in model form, and here are the models. It is certainly very well worth the attention of those who are interested in the manufacture of coal gas. You will remember that I showed you, during my early lectures, a large piece of graphite, taken out of a coal gas retort; but larger pieces than that have been shown to me by the gentlemen whose invention this is—very much larger. To any one at all conversant with the manufacture of coal gas, it must be perfectly clear that these accumulations of graphite are detrimental to the endurance of the retort, especially if made of fire-clay, as they now generally are, for it is impossible to clear off these incrustations from the inside of the retort without damaging it, especially if it is made of fire-clay. This carbon is not the coke which is left behind after the heating of the coal has gone on to completion, but it is carbon which is deposited from the gas in the retort; and you will remember I told you that when these gases, containing carbon and hydrocarbon vapours, are heated to a high temperature, they can be made to deposit all or part of their carbon, and the carbon deposited in the gas retort comes from this source. Now it is found by experience that pressure largely promotes the deposition of this carbon. When the gas retort, which is a long narrow vessel, is charged with coal and is heated to a high temperature, the gas is evolved more rapidly than it can escape easily through the hydraulic main, through the purifying chambers, and finally into the gasometer. The consequence is that there is a pressure in the retort, and this pressure, as has been proved experimentally, causes the deposition of carbon in this form in the retort. Now this is a matter of great importance. But if the pressure be decreased in the retort, certain consequences are likely to ensue if precautions are not adopted to prevent them. It appears to me, however, from studying these models, that all of those occurrences which might happen, and which would be detrimental to the workmen and injurious to the manufacture of coal gas, provided that an apparatus of this kind were used for the reduction of pressure, could be entirely prevented. Here is represented the mouth of the hydraulic main and the dip-pipe, and here the dip-pipe dips into water. Now the merit of the invention is this, that by pushing this weight down, or by relieving this balance, the weight closes and converts this dip-pipe into something else. Here is represented the mouth of the gas retort screwed up and charged. The workmen cannot open the retort without loosening this rod; when he loosens the rod, then this becomes a true dip-pipe, and consequently prevents the rush back of gas. When the rod is lifted up and screwed in this way, then the pipe ceases to be a dip-pipe. Here you see in this model it is a glass dip-pipe, and if I suck the air through this tube, you will notice bubbles will occur in the water. That is the apparatus as at present used. Now, if I lift up the weight and suck, you will see no bubbles occur. The cause of that is this—that the lower portion of this pipe leaves it, and the gas passes over the surface of the water and does not bubble up through it. Now, suppose there were to be a suck back of gas, that suck back would be prevented by the pressure of a column of water which will appear here in this tube, and that, drawing in here, prevents the rush back of gas, and this column of water prevents any injurious effect happening. This appears to me to be a most ingenious apparatus, and well worthy the consideration of those who have anything to do with the manufacture of coal gas. When the gas leaves the retort it is very hot, and when it passes into the hydraulic main, and into the water, it is so hot that the temperature of the water is considerably raised. Now, through the hydraulic main, the tar is passed into the water, and when you heat tar, and agitate it, it becomes thick, and in this way you may make it as solid as pitch. Then if this hot gas passes through the water and tar, it will

heat it, and stir it about, so that the tar gets thickened, and this ought be avoided. Now this is altogether obviated by the use of the apparatus, because where the tar passes into the water, the gas passes over the surface, and does not bubble through it.

I now pass on to complete what I have to say about heat, and ennunciate some of those principles which it is necessary to clearly understand before we can economise heat in its application to useful purposes. We saw the other day that metals were the hest conductors of heat, and that some conducted it better than others. Here is an apparatus which will illustrate this very well, and show the conductivity for heat of metals and other substances. Here is a vessel to be filled with hot water, and there are four rods—one iron, another copper, another glass, and another fire-clay. These rods pass into tubes, and these junctions are made air-tight. These tubes contain air. When these rods get heated they will cause the confined air to expand, so that it will press upon the column of liquid in this bent tube in front, with which it is in contact. When the air expands it will force the column of fluid up, so that any rise of temperature in the bar will be indicated by the rise of the fluid in the tube. Some boiling water will be put into this chamber, and you will notice which of these indicating columns of liquor will rise highest, and which will rise first. That in connection with the copper will rise first and highest, that with the iron will rise next, and the other two will not rise at all, for the temperature of the water will not be sufficient to cause any appreciable rise of temperature by means of conduction in these tubes. If you take an iron rod and hold it in a flame it soon gets so hot that you cannot continue to hold it. Here is a glass rod which I can hold in this flame, my fingers being only an inch from the flame on each side. I can hold it until the glass rod gets sufficiently heated to become quite soft. This shows you plainly that glass is a very bad conductor of heat. Fire-clay also is a very bad conductor, even worse than glass. These are points one has to consider very seriously in the construction of fire-places and furnaces, and of all kinds of apparatus that are to be used for heating and also for illuminating purposes. I shall show you this evening a gas-lamp which has been invented by Mr. Silber, where you can actually take hold of the bottom of tbe glass at any time, even after the gas has been lighted for an hour, and lift it off. It is so cold that you can touch it. This is making use of the nonconductive power of glass, and proves that glass is a bad conductor of heat, and that when it is put at a sufficient distance from the flame, the lower portion will remain cool.

Here is a well-known illustration of conductive power. I will put some common wire gauze over this flame, and you see no flame passes through it—gas passes through, but not flame; and to show that the gas passes through it, I will light the gas above it. The wire gauze conducts the heat away, so that there is not sufficient heat above to ignite the gas which passes through it. That is the principle on which the action of the Davy safety lamp depends.

Here again is a very interesting experiment. This is a coil of wire which will be put over the candle, and simply by its conducting power it will take away so much heat that the candle cannot go on burning; combustion will cease, that is to say, the candle gas cannot go on being formed, and, even if it were formed, it would not be at a sufficiently high temperature to unite with the oxygen of the air. Now, when this wire is made hot, it will be put over the candle flame again, and then the candle will go on burning, because, being hot, it cannot conduct the heat away from the burning candle.

Now we pass on to another method by which heat passes from one body to another, namely, by radiation. Here is a metal cube filled with boiling water. This cube is coated on one side with lamp black, and on the other the metal is polished. The heat will leave this cube more apidly from the side coated with lamp black than from the side which is polished metal, and this I shall be able to show you by a differential thermometer. You notice the columns of liquid in these two bulbs. They are not level at present, but that does not matter. If I hold this properly, the bulbs should be at equal distances from the two surfaces, and you will notice that the liquid in the tube nearest to the blackened surface will be depressed, and it will rise upon the other side. That will show that the heat from this vessel is leaving the water more rapidly on the blackened side than it is from the polished side. We therefore say that rough and blackened surfaces are better radiators of heat than bright, polished, metallic surfaces.

I will put this red-hot ball into the focus of this mirror, and in the focus of the opposite mirror will be placed a piece of phosphorus. Heat falls as light falls, in straight lines, from that hot ball upon this mirror to my left; it is then reflected to the other mirror in straight lines, and from that mirror the rays of heat pass to a focus, and in that focus a piece of phosphorus is placed. The phosphorus will get heated, and will be ignited by the radiated reflected heat from that red-hot ball. While that ball is glowing before us, let me call your attention to what I should say is pretty nearly the main point of all I have to speak to you about, and it is this. We have a ball there heated to a certain temperature. That ball is giving out its heat by radiation; after a while the heat from that ball will have left it, and it will have raised to a certain extent the temperature of everything in this room Here we have the most perfect idea of a heating apparatus. We have a substance that will retain its heat for a length of time, and which will give out its heat gradually, and none of its heat is lost. The heat from it is distributed throughout the whole of this chamber, and we shall all feel to a certain extent the rise of temperature produced by it. I am feeling it already. Every heating apparatus then for heating a room should do what this ball does. If you have a chimney up which a quantity of heat escapes impelled by the draught in the room, which is necessary to promote and keep up the combustion of the substances burning in the grate, you are losing a portion of your heat. I went the other day, and saw some grates at Mr. Murdoch's, in Cannon-street, called American stoves. They seem to be good. It was impossible for me to exhibit them here, but they give promise, and deserve a trial. The principle on which they are constructed is good, and a fair amount of heat is sent out into the room, and as little as possible up the chimney. But even they are far from perfect. What we want to see, and what inventors ought to turn their minds to produce is this—a stove, the products of combustion from which shall, before they leave the chamber, become cold or nearly so. Now that such a stove can be made, and can be made without interfering with our English liking for a bright cheerful fire, I am perfectly convinced. Mr. Davenport has tried an experiment on the fire-place in his room, partly at my suggestion. It did not answer, but yet I think he sees that if what I told him was my principle had been fully carried out, then, at all events, if not all the heat, a great portion of it would have been kept in the room. There is no difficulty whatever in conducting the products of combustion from a fire-place through an apparatus of winding tubes, provided you ensure that you shall have sufficient access of oxygen gas in the air to your fire to keep up tbe burning. That is all that is requisite. In our present fire-places you may have the stove standing with its front exposed where you can see all the coal, but on the top of it have a plate which can be put down and taken off at pleasure, then let the products of combustion come from the front near the bottom of the fire, for in that way what usually now escape as unburnt gases will be burnt in their progress through the fire; then lead the product through pipes, arranged in a pic-

turesque way if you like, covered by an iron grating, but have them so arranged that they will give out the heat resulting from the hot products of combustion to the air, which will pass through the tubes enclosing the flue tubes, through which these products of combustion pass, and I believe in that way, for the purpose of heating rooms, you will be able to get all the heat into the room that could possibly be got from the fire.*

Now we pass on to another subject intimately connected with radiation, viz., the absorption of heat. Here are two tin plates; one has a bright surface, while the surface of the other is blackened. Two balls are fixed by means of wax to these plates, and I will put one on each side of the gas burner. One of these balls will fall before the other, and that will show that the plate to which it is attached has got hotter than the other. The ball attached to the blackened plate will fall first. Black is a good absorber of heat, as well as a good radiator. If a black substance radiate heat, it is quite certain that you must not blacken those vessels which you desire should contain water, or any other substance, at a high temperature for a length of time. If you want to retain the heat as long as you can you must use polished surfaces. For example, a bright silver teapot will keep tea hot longer than a black one; on the other hand, suppose you want to keep water hot in a teapot and you put it on the hob, then a black teapot is better than a polished one, because the black teapot will absorb the heat from the fire, whereas the bright metal teapot will reflect back the heat and will not absorb it readily. Let me call your attention to the experiment with the mirrors. We now see the phosphorus in the focus of this mirror has caught fire. It would be perfectly possible, by a more complicated arrangement and larger mirrors, to cook a piece of meat in the focus of that mirror by radiated reflected heat.

You, no doubt, see the bearing which this radiation of heat has upon all apparatus which are used for cooking or heating. To blacken a fire-grate is to cause it to absorb heat, and if the thing blacked be metal, the heat is absorbed, and the metal conducts the heat away into the brickwork of the chimney. If you have a fire-clay back to your grate, and if, from a wish to make the fire-stove look neater and cleaner, you blacken that, you are actually, in fact, defeating in part the object for which you have the fire-clay back. If you have a fire-clay back, leave it the colour of the fire-clay, and if you have a metal back polish it. There are certain grates which were made some time ago, the backs of which were like that mirror, a hole being in the back to let the products of combustion pass up the chimney. If you stand in a large room, facing the fire, with such a grate, the heat is oppressive. Such a stove or fire-place is not handsome to begin with, and it is very unpleasant to sit directly in the focus of such a mirror, and to have the heat directly cast upon you. But at all events a very considerable portion of the heat which otherwise would be conducted away by the iron, is reflected by the polished metal. If you do have metal at the back of iron fire-places keep it polished, but it is much better to have fire-clay. If you now look at this apparatus with the tubes and rods, you will see why I say that we should have fire-clay and not metal backs to fire-places, for the fire-clay does not conduct the heat at all readily.

You see that the liquid in that tube containing the fire-clay rod has not risen, and that in those where the two metals are put it has slightly, thus showing you that fire-clay is a very bad conductor of heat. Therefore, wherever you want to prevent the escape of heat from anything, whether it be a fire-place fixed in a room or from a cooking apparatus, use fire-clay for the outside coating.

If the differential thermometer be put in the focus of the mirror you will see the column of liquid is depressed. Now there are substances which will not allow heat to pass freely through them, of which class of substances glass is a very fair representative. These substances are spoken of as being *adiathermanous*. Glass is one of those which is not diathermanous; that is, it will not allow heat rays to pass freely through it. Therefore, if you want to shut off heat from any part of a room, you cannot do better than put a plate of glass between the source of heat and the thing you want to keep cool, for the heat will not pass readily through it. There are certain substances, which I need not enumerate, which allow heat rays to pass through very readily, of which rock salt is a good example. It will allow about 90 per cent. of the heat to pass through, whereas glass will only allow a mere trifle. But you know that glass in time will get hot, if it is near the source of heat, and then it will radiate, so that it does not do, if you want to use glass to keep off heat from any object, to allow it to get hot. Glass is also transparent to rays of heat of a high intensity, but it is almost opaque to rays of heat of a low intensity. For instance, it is transparent to the rays of the sun. You know that the sun's rays pass through the glass of a greenhouse and make it hot, but when the heat has passed through the glass, that heat is reflected back by the ground and by the walls of the greenhouse, and then becomes heat of low intensity; and that heat is not able to pass through the glass, and this is how it is that the sun's rays heat a greenhouse. Heat, then, of high intensity can pass through glass readily, but not heat of low intensity.

I wanted to speak to you about what is termed specific heat, but there is not time. I will only mention it in passing, in order that I may induce you to look it up and read it in some manual, of which there are many, if you feel interested in it, because it is a matter of importance. I may just illustrate it in this way. Copper is a good conductor, and iron is a good conductor, but not so good as copper. Suppose I heat a ball of iron weighing an ounce, and a ball of copper weighing an ounce, to the same temperature, and I put these two balls into equal measures of water at the same temperature; then the two balls will not raise the temperature of the water to the same height. The iron ball will heat the water more than the copper. It appears therefore that the copper requires less heat to raise it to a certain temperature than iron does, taking weight for weight. This is a point that must necessarily bear on delicate experiments with heating apparatuses.

Now then we pass on to what is, perhaps, the most interesting portion of my subject—it is its practical applications, though we have already had many practical applications of these principles which I have been enunciating. I have already spoken to you about the general principles on which all fire-places for warming rooms should be constructed. Two things have to be remembered. You have a heating material which is only able, by its combustion, to give out a certain amount of heat. You must take care by some means to isolate that from any substance which will conduct away the heat, and then you get all the heat in your chamber. You will hardly expect me to attempt to explain to you the construction of stoves for rooms; I can only mention and illustrate principles, and call those gentlemen's attention to those principles who are themselves interested, either commercially or otherwise, in the construction of stoves for heating rooms. One thing we must have—we must have a cheerful-looking fire; and another thing we should aim at, and that is to lose no heat, but to get all the heat out of the substances we burn. We cannot, as I told you before, create heat. When we put chalk or other substances with coal, we perhaps produce a beneficial result, because the chalk or similar substances acts as a store house of heat, and like that iron ball retains it for a while and gives it out slowly. But it is simply impossible that chalk, by its decomposition and the evolu-

* Messrs. Shillito and Shorland, of Manchester, make a fire-place on true principles.

tion from it of carbonic acid, which carbonic acid in the fire is said to be converted into carbonic oxide by the carbon of the fire, can produce heat, it is simply impossible that more heat can be got out of the coal by this operation. For the amount of heat which is required to drive off the carbonic acid from that chalk is lost as heat, it is doing chemical work and therefore ceases to act as heat, and it only becomes heat again in exactly the same quantity when that carbonic oxide unites with the oxygen of the air to form carbonic acid. A certain weight of carbon will unite with a certain weight of oxygen (I have given you those figures already), and in so doing will give out 25,000 thermal units. Never mind what that means now, because you have had the data for determining what it means. I only want you to bear in mind the comparison I am making. The product of the decomposition is carbonic oxide. Now that carbonic oxide unites again with more oxygen and forms carbonic acid, and here we have 69 thermal units given out in this second union between the oxygen and the carbon, why that is I am not attempting to explain now, though there are many explanations of it which are extremely rational. I merely want you to understand the fact. If, then, carbonic acid is driven off from chalk—and those who have ever seen a lime-kiln burning know what a high temperature is required to perform the operation—the heat there absorbed is lost as heat. I am not speaking against using these things, but only against misapprehension. Use your chalk and use your fire-clay; it is an excellent thing to do, because it serves as a store-house for the heat, and moderates the rapidity with which it is given out, a most valuable property for any apparatus or furnace that is used for warming rooms.

Now we pass on to consider next, cooking apparatuses. I did wish to be able to show you a complete model of a cooking apparatus, but have not been able to do it. Many cooks think that they are doing their work better by boiling things rapidly and quickly. But it is not so. Water boils at 100° C., or 212° F., but you do not require that heat or anything approaching it to cook meat thoroughly and properly. A series of experiments have been performed in the laboratory at University College, the result of which I will now give you. Albumen, or white of egg, subjected to a temperature of 58° to 60° C., or about 140° F., was coagulated on the outside of the vessel. Here is some clear albumen the outside of which has become opaque, like boiled white of egg, but the inside is not so, it being liquid, like underdone white of egg. Mr. Lewis will put this into an air bath, and will tell us what the temperature is—it is 70° C. Now when the albumen or white of egg was exposed to a temperature of 65° C., the albumen was shortly coagulated all through its mass, that is to say, if you had been speaking of an egg you would say it was perfectly done, and the white was well set. This would take place at about 150° F., very much below the boiling point of water. Other experiments were performed on a slice of meat a quarter of an inch thick; a slice of meat was exposed in an air bath to a temperature of 65° C. or a little lower than that to which that white of egg is now exposed, for an hour, and it was not quite cooked through; but when it was exposed to a temperature of 88° C. it was thoroughly cooked, and not only thoroughly cooked, but the outside of it was thoroughly browned, and this took place at a temperature considerably below the temperature of boiling water. Now surely to those who have not been accustomed to consider these matters this must let a flood of light into their minds. What is the use of exposing our meat to the high temperature to which we do expose it, and of so wasting our fuel? By allowing your servants to do this you are the sufferers. Your meat continually gets charred outside, whilst it is raw in the centre, because the coagulated albumen on the outside acts as a non-conductor of heat to the underdone meat in the inside, and the heat cannot pass through to that which has to be cooked. The same happens when you put meat into boiling hot water, and keep it boiling as fast as you can, the albumen on the outside gets coagulated, and the heat is not able to penetrate into the centre, and it does not get properly done.

Here is a little apparatus to give you an idea of what can be done. Here is a simple gas-burner over which a flask of water is placed, and steam is being generated and is passing into a zinc vessel containing some water in which is placed a piece of meat, the whole being enclosed in a wood box. Here is a thermometor to show the temperature. It is now 80°C. It is not a large piece of meat, but I have not the least doubt it will be cooked before we leave the room this evening. The meat was first put into cold water, the steam was then introduced, and has heated the water up to 80°. This steam keeps going into the water, and supposing I had another box here, and another one here with sufficient tubes, the steam would pass into all these boxes, and warm the water in each box contained in the cooking vessel, and thus the meat and potatoes, and various things, might all be cooked from one vessel generating steam. How is it then that the heat would not be lost here? The temperature is 80°C. inside this box, but it is cold outside. This is a box simply containing a quantity of sawdust which is placed around the metal vessel in the centre, into which the steam passes. You have only then to have a series of boxes, and you can cook your dinner very economically. But some persons may say we cannot always be living on boiled and stewed meat, we must have it sometimes roasted. That is perfectly true. But all you have to do is to adopt the principle of Captain Warren's cooking apparatus which is a most excellent one. Have a dry vessel inside without any water in it, so arranged that the steam can play round between the two vessels. Then the steam will warm the inner vessel, and your meat will thus be cooked without water, but it will not be browned. However, here I have a rough diagram of the sort of apparatus I should recommend. In the centre is a Bunsen gas burner, burning about 9½ to 10 cubic feet of gas per hour; above it there are lumps of fire-clay, and around it is a vessel containing water, which is a bad conductor of heat. To insure that no heat is lost, it is jacketed and filled in round about with powdered charcoal, or some non-conductor. The water boils, the steam passes off into this vessel on the right hand side, and cooks something there, and also passes off into the vessel on the left hand side, and cooks something in it. Now suppose for a moment that we have no water in this one on the right hand side, but that we have a vessel jacketed so that the steam may pass round outside it, and your meat is put in that, then the meat will undergo the first process of roasting. The heat also heats these fire-clay lumps above, and if you want anything fried you can fry it above there, or you can put on a gridiron, and can grill it, or you can put on this cap. That is a little apparatus round which the heat will travel and come out at the top, and so at the other side. The heat has been doing all this work in cooking these various substances, and we must not mind at present, with our limited knowledge, if a little escapes at the top, but I think we might even utilise it. Hero we have a dry heat—a temperature sufficiently high to brown the meat, because it is much higher than the 90° C., which was shown to frizzle the meat and brown it outside, so that you may take out the meat from the jacketed vessel where it has been partially cooked, and then put it into this chamber where it can be browned, so that you can with such an apparatus easily cook, I believe, a dinner for ten or twelve people, because here on the top you can fry your cutlets or anything else before the browning takes place. I need not enter into these details. Such an apparatus could be worked at a very small cost, and I do very much wish that gentlemen who turn their attention to this subject would take a few hints from what I have said, if they are of any value, and I think they are, and would try and arrange a gas cooking apparatus on this principle.

Now, let me call your attention to the lights arranged on the table. There are two sorts. On the left are some exhibited by Mr. Lotz, of Messrs. Dietz and Co.; they are flat wicked-lamps. The air is allowed to pass in through slits in the side, and is so arranged, I am informed, that it produces the greatest amount of light possible for the size of the wick, and the quantity of oil burnt. You can judge for yourselves of the luminosity of those flames. I have a statement that a wick three-eighths of an inch gives the light of six candles, with a consumption of half an ounce an hour,

$\frac{5}{8}$ inch wick	....	12 candles	....	$1\frac{1}{8}$ oz.
$\frac{3}{4}$,,	....	14 ,,	....	$1\frac{1}{3}$,,
1 ,,	....	20 ,,	....	$1\frac{3}{4}$,,
$1\frac{1}{2}$,,	....	25 ,,	....	2 ,,

Those are the details furnished me by Messrs. Dietz and Co., which I have the pleasure of laying before you. It is not my business to say that Messrs. Dietz's lamp is better than anybody else's; all I can do is to call your attention to them, and say that, as far as I can see scientifically, there is nothing wrong whatsoever in their construction.*

Now we turn to the right hand, to Messrs. Silber's lamp; and here there is a different arrangement. Mr. Silber, in this paraffin lamp which you see here, admits air in two ways to the wick. His wicks are circular, and I will show how the air is admitted by a diagram. There was no occasion to use a diagram in the other case, because it is perfectly simple, and it seems most efficient. I have here drawn the wick, and the air comes up through here, and through here. The wicks are very porous; a certain quantity of oil comes up here, and a small quantity of it is vaporised. Now you see what happens here; provided that there be the proper adjustment of the draught to the consumption of the oil, there will be here a current of air, and here will be the vaporised oil, and it will burn if the thing be properly managed at a certain distance above the wick. That is what Mr. Silber tells me is managed in his lamps when they are properly arranged, so that you do not, provided the lamp be properly burnt, get any charring of the wick. And I should tell you that Mr. Lotz has shown me one of Dietz's wicks in which you get no charring at all, where it was cautiously used. There is a lamp which is causing some distress to a gentleman near it, it is giving so brilliant a light. Mr. Silber's assistant will take out through the centre of the lamp a tube, and then you will see the change that is produced in the centre of the flame. The tube is now taken out, and you notice the light is not so brilliant, and there is a considerable amount of smoke; whereas when the tube is replaced the smoke disappears, and the light increases in brilliancy. You see, then, that the central tube manifestly promotes combustion of the carbon, and that you get a white light from it. That is a point that I think I mentioned to you a lecture or two back, that what we had to attend to in the illuminating material was, that we had the proportion of our air to our combustible material so regulated, that we get the highest amount of illumination possible out of it. There is a ship's lamp, in which colza oil is being burnt without a glass, and I have made here a rough sketch of it on the board, to show the principle on which it acts. Inside that lamp is a dome, which comes down upon the oil-chamber, which can be drawn easily out of the lamp. At the back of the oil-chamber there is a slit, through which the air passes to the wick, so that the whole of the air that is used for the combustion of the oil passes in from the top round the back and underneath into the wick; no air whatsoever getting into the lamp by any other access. The consequence is that you get a light which is perfectly steady, and which can be waved or moved about, as in the case of a vessel lying at anchor, without any danger whatever. Mr. Lotz also showed me some lamps at his house the other day which you might take and swing about in the same manner, he also having some arrangement by which that can be performed. In this case I have explained to you the principle. There is another point in connection with Mr. Silber's invention which is of great scientific interest to me, namely, the way in which he prevents the draught or anything interfering with the flame in such lamps as this. No gale of wind will cause the flame to flicker, because no air whatever has access to it except through the proper channel. There must be in a lamp like this such an adjustment of air as that you get the most perfect combustion consistent with luminosity, but we have a lamp also that no gust of wind can affect. At the top there is a cone, and the heat products from the lamp pass, as the arrows points on this diagram show, round the sides, and the air can play against it, but cannot enter against those heated currents, and in that way all flickering of the light is prevented.

Now I pass on to another burner, which interests me infinitely more than any of these other lamps, and that is an adaptation of the same principle to gas. The gas from this burner is now burning the same as in a Bunsen burner. I show you this that you may see what perfect control of the draught we have here. Now it is burning as an ordinary gas burner. I have tested this myself with Mr. Silber, at his works, and it burns at the rate of five cubic feet per hour. An ordinary Argand burner, such as you see here, was also tested by the meter, and it burned $9\frac{1}{2}$ cubic feet of gas per hour. We tested it with a photometer, and we found that it gave a light of nineteen candles, and it gave a reddish-yellow light. I think you will all see that this Silber burner gives a very bright and white light. There the admission of air is regulated in a somewhat similar manner to that which I have explained to you in the ship's lantern; it comes through the centre and goes up the side, and it is so contrived as to meet the gas at a certain angle. Whether that is by design or not I cannot say, but I should think it is, for everything seems to be by design in these lamps. You get in them the most perfect combustion, and are able to do almost anything with them, which with a gas flame is a very great desideratum. You have a less combustion of gas, and you have a greater illuminating power. I believe these gas burners are not yet brought into the market, because I think Mr. Silber told me he has something yet to do to perfect them. I will now remove this glass, and I will show you a beautiful illustration of how the current of air works in the centre of the gas flame. It is going round, forming a most beautiful rotary movement in the centre of the flame, and I can increase it by moderating the draught. Here I think we have a very beautiful thing, illustrating very well those principles which I have endeavoured to impress upon you, namely, the necessity of perfect combustion, or combustion as nearly perfect as possible. You see that by touching this I can change it into a Bunsen burner; that is where the air and gas are mixed before combustion, and I can change the current by a wave of my hand, and you have an Argand gas burner; that is where gas burns by the help of air, but the two are not mixed together. Here is another burner, which Mr. Silber told me he made with his own hands when he first commenced the experiments. It is most ingeniously made, and well adapted to show the particular phenomena I have explained to you. Here is another burner much more perfect, and more in the condition, I believe, in which they are eventually to be sent into the market. This one gives a light of 22 candles, and one advantage of it is that the glass chimney never gets hot at the bottom. If the light were burning for some hours it would not get hot; I can hold it and take it off at any time

* I have since these lectures tested one of Messrs. Dietz's lamps for a month, and find that it completely bears out all the statements that have been made in its favour. The inch-and-a-half wick gives sufficient light to illuminate well a room 21 ft. by 15 ft., and $11\frac{1}{2}$ ft. high, no trouble attends its use, and the consumption of oil is very moderate. Care should be taken not to cut the wick, but the charred portion should be raked off from time to time with a piece of rag or paper.

that is owing, I believe, to the non-conducting power of the glass, the glass being some distance below the flame, and also, as Mr. Silber suggested, because the currents of air passing through this passage tends to keep it cool. It is a matter of considerable practical convenience.*

I have now only to thank you for your kindness in attending to me in delivering this very imperfect course of lectures. It is always a source of considerable grief to find that one has not been able to attain the object which one set before one at starting on such a subject as I have undertaken to lecture upon. However, I know from my experience of your kindness, for I have lectured to you twice before, that you will forgive all shortcomings, that you will take the will for the deed, and that you will be sure that what I have done has been with the desire to promote scientific study and its application to useful and industrial purposes. Many of you are engaged in daily occupations far removed from anything scientific; many of you doubtless are engaged in commerce, and you require to have recreation in your evenings, something to entertain your minds, and change the channel of your thoughts, for we all want this. And you cannot, I think, adopt anything more interesting than the study of science with a view to adapt it to useful purposes. I do not ask you to study pure science for its own sake alone—that would be asking too much —it would take up too much time, and would involve too much mental effort, but study it with a view to its application to useful purposes, and you will then find how from time to time your scientific knowledge will assist you in overcoming the difficulties that you could not think how to overcome before. Try your hand at inventions. You see something that is wanted; try and supply that want, and if you have the necessary knowledge, although you may not be successful the first and second time, you may at last be successful in producing the effect which you desire. "Oft expectation fails, and most oft there where most it promises." I am sure I can agree with those words of Shakespeare. Many and many a time when one has expected that one was arriving at the summit of one's wishes, and the attainment of one's ideas, by some strange unfortunate circumstance the fabric which one has been building up is knocked down and shattered, and falls to the ground; but let us not lose heart by this, but go on, steadily pursuing our way, and if we do this, in scientific subjects especially, we shall come to a satisfactory and pleasant result. I would ask you, then, to let science share your engagements, and take part in your other pleasures, not to their exclusion, and I am perfectly certain you will be rewarded, for in that you will have not only pleasure at the time, but you will have this much greater pleasure, in knowing you are doing your small mite for the benefit of others besides your own personal enjoyment. Scientific men, I can assure you from experience—and those of you who have knowledge of it will agree with me—scientific men "linger in pleasures that never are gone, for, like waves of the summer, as one dies away another as bright and as smiling comes on." So it is with us always, one idea gives birth to another. We work out one thing, and before we arrive at its completion we are led into reflections which open up to us other views, other channels in which we may gratify ourselves and be useful to our fellow creatures. Allow me to thank you for the kindness with which you have listened to me.

Mr. Le Neve Foster having proposed a cordial vote of thanks to Professor Barff for his interesting lectures, and the valuable advice which he had given at the close, and the same having been carried unanimously,

Professor Barff said:—The hearty applause by which the proposition from our kind Chairman has been received only tells me that I still hold a place in your favour. On other occasions you have responded as cordially to a vote of thanks after my lectures, and it is a satisfaction to me to know that one does not by continually appearing before you lose that place in your esteem which I hope always in my intercourse with you and the Society of Arts to endeavour to maintain.

* I can now bear testimony from experience to the perfection of Mr. Silber's gas burners. I have two fitted up in my own house, and I constantly use them; one is sufficient to light perfectly for all useful purposes a room 21 ft., by 15ft., and 11½ft. high; two illuminate it most brilliantly; the light they give is perfectly steady and very white. The quantity of gas consumed is a little more than that consumed by an ordinary Argand burner.

ANNUAL INTERNATIONAL EXHIBITIONS.

MACHINERY, ENGINEERING, AND CONSTRUCTION.

(*Continued from page* 969.)

V.—Miscellaneous Appliances.

In the preceding four sections a full description has been given of all the machines in motion, &c., which are concerned in the manufacture, treatment, and manipulation of iron, stone, wood, and brick, mainly for purposes of construction and building. There are, however, a variety of machines, somewhat akin, and closely allied thereto, though not strictly coming within the same class, whereof a brief notice is due; and there are also a few exhibits of a more general character, meriting a short casual reference. The conclusion of this series of articles will therefore be devoted to a review of the most noteworthy of a necessarily large and miscellaneous group.

The Heaton's Patent Climax Grinder, Fig. 1, exhibited

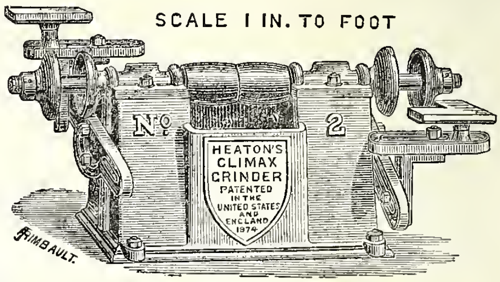


Fig. 1.—Heaton's Climax Grinder.

by Ransome's Patent Stone Company, fitted with the Bessemer Emery Wheel (F. Ransome's Patents) and Heaton's Patent Adjustable Centres, is a novel type of machine, in extension and application of an old principle. The examples exhibited of plates, bars, &c., of iron and other metals, cut, shaped, and recessed, by means of this machine, show its power and adaptability. A good emery-wheel is in fact a rotary file that never gets dull, and is always effective to the last. The Bessemer emery-wheels are made of the purest and best emery, combined and cemented with a material which is in itself possessed of very high cutting qualities, and consolidated on the principles of Ransome's patent artificial stone. The advantages claimed for them are:—durability and rapidity of cut, smoothness of finish, and freedom from choking and glazing. A half-inch iron-plate may be cut into by a wheel 12 by 2 inches, at the rate of 1 inch per minute; and such a 12-inch wheel has been in nearly constant use on steel, the wear and tear being half an inch reduction in diameter monthly. The wheels are run at a very high speed, viz., about a circumferential velocity of 4,500 to 5,000

feet per minute, at which they are said not to give out any smell, and not to heat with severe and prolonged work; they may be worked dry, or with oil or water. They are fitted with soft washers and broad cast-iron cheeks, or side-plates, screwed up tight, and mounted on patent adjustable centres, which devices are to secure proper hanging and centreing, and smooth and easy running, without jumping, jarring, or vibration. The framework of the machine is designed with a view to solidity and convenience, great steadiness, and plenty of room for the operator. It can be taken to pieces or put together again by shifting two bolts. It is fitted with a convenient system of rests, with simple adjustments; and also an efficient device for protecting the bearings from emery and dust. The emery-wheels are made of seven qualities, from A extra coarse, suitable for edging wrought and cast-iron, and cutting with ease the hardest chilled metal, to G, fine surface, a fast cutting wheel, suitable for moderately light surfacing work, and especially adapted for tool-sharpening.

Messrs. T. Middleton and Co., in addition to their brick-making machinery previously described, exhibit a Steam Warehouse Crane with winding drum driven by duplicate vertical engines, for which the steam is generated by one of their Jackson's patent generator of steam by gas. This consists simply of a vertical multitubular boiler, heated at the bottom by gas-jets, and fitted with all suitable and necessary appliances. This power-generator is compact, and if used in combination with a gas machine, such as Fogarty's patent gas machine (exhibited in the same galleries, and already noticed in the *Journal*), wherein gas is continuously generated from gasoline, would render steam users entirely independent of coal and gas companies—an important advantage in these days. Among many large industrial establishments where this steam-generator by gas is employed for cranes, hoists, and other purposes, may be named the Crystal Palace School of Practical Engineering, where Mr. J. W. Wilson, C.E., the principal, reports that steam can be raised from cold water in half an hour, with the consumption of 150 cubic feet of ordinary coal gas, of which also 100 cubic feet correspond to an effective horse-power.

Messrs. W. Eassie and Co. are the exhibitors of Improved Pile-driving Machinery. This pile driver is constructed of the best pitch pine for the framing, mounted on flanged wheels so as to act as castors and afford faci-

FIG. 2. FIG. 3.

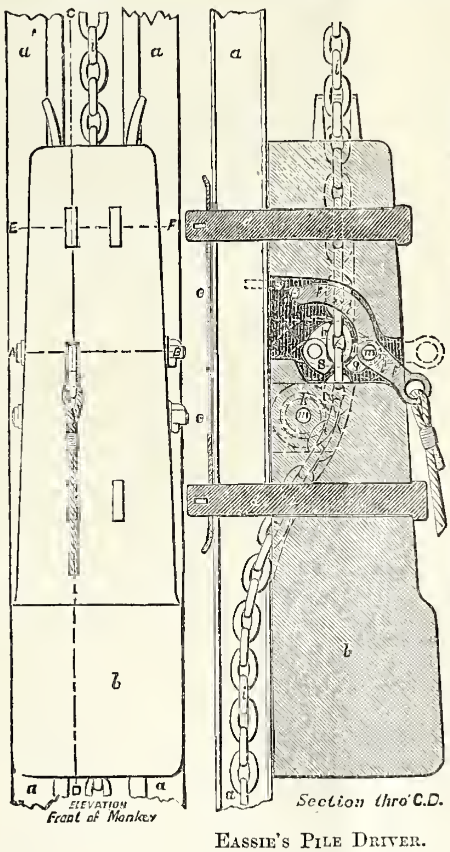


FIG. 5.

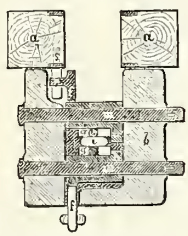
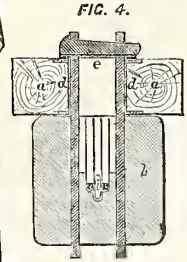


FIG. 4.



Eassie's Pile Driver.

lities for change of place, and is fitted with a regulating screw at the back of the ladder, so as to drive piles perpendicularly or aslant up to a batter of about 1 in 5. The motive power is derived from a compact vertical engine and boiler, detachable and self-contained; this works a drum and endless chain passing round a sheave or pulley at the top of the machine, and it is herein that the chief speciality consists. The patented improvements relate to a simple method of readily attaching the monkey, ram or driver to the chain, which is not a heavy pitch chain, but merely an ordinary close-linked crane-chain, made endless, and worked continuously upwards in front of the leaders; also in lifting the ram through its centre of gravity so as to reduce to a minimum the friction between the leaders or guides; consequently applying the full power of the engine directly to the raising of the weight, and promoting economy of fuel in proportion to the work done. Fig. 2 is an elevation of the monkey or ram; Fig. 3, a longitudinal section; and Figs. 4 and 5, transverse sections of the same; *a*, *a*, are the usual

guides or leaders for the monkey, or ram *b b*, the latter being held in position by the collared bolts *d d*, and the backboard, or plate *e e*; the chain *i i*, by which the monkey is lifted, passes from the back of the pile by a curved groove cut in the monkey to its centre of gravity, and is held there by the roller *k* running freely on the pin, *n*, and is kept continuously moving in an upward direction from the base of the machine to the top of the same. A little above the centre of the monkey are two levers, *f f*, working on the pins *m m*, geared together also by the studs, *h h*. One of these levers has on one side a handle, to which a rope is attached, for the purpose of placing the lifting apparatus in gear; and on the other a handle, with stud *s* temporarily fixed at various heights in the leader, releases it from the chain. Each lever has a cable stopper, *g g*, one on each side of the link in the chain, which, on the lever handle being moved in either direction, clutches or releases the chain. These pile-drivers vary in height from 30 to 45 feet, and are fitted with rams 15 cwt. or 1 ton in weight.

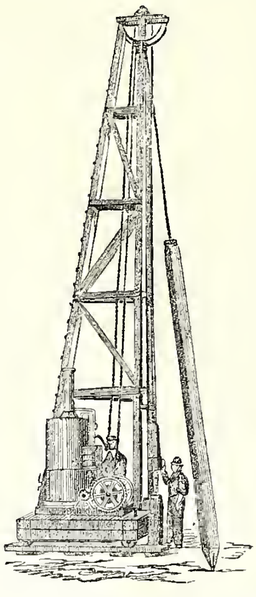


Fig. 6.—Eassie's Pile Driver.

☞ No. 7,015. Messrs. J. H. Wilson and Co. exhibit a Patent Steam Pump and Condenser. The former is the Selden Direct-action Steam Pump, in which a boss, on the common piston rod of the steam and water cylinders, actuates the reciprocating motion of the slide valve by alternately striking tappets connected therewith at each end of the stroke. The latter is Craig and Brevoort's Patent Condenser for steam donkey pumps, winches, cranes, engines, &c. This appliance is interposed between the source of water supply and the suction orifice of the pump, and it is so arranged as to bring the exhaust steam into direct contact with the water entering the condenser on its way to the pump-barrel, thereby condensing the steam, and at the same time heating the feed water in the case of a boiler; there is also a float with upright pipe attached, serving as a guide, and automatically acting as a valve to enlarge or contract the orifice by which the water enters, so as to prevent flooding the condenser. It may be noted, also, that the condenser is entirely jacketed with the cold water from the source of supply, which can only pass to the pump by the orifice at the top, where it comes in contact with and condenses the steam. Thus any steam donkey pump or engine may be converted advantageously into a condensing engine; and the vacuum created thereby in the steam cylinder is an additional pressure or gain in power, which may be utilised in various ways, either directly or by a shorter cut-off, giving a higher expansion-grade, or by reduction of boiler and steam pressure.

A very recent introduction into Room I. of the Machinery Galleries is a practical exemplification of the application of steam power to the working of Punkahs for Hospitals and Barracks in India, by Mr. P. Orr. A suitable driving-wheel has a crank-pin and connecting-rod affixed to the centre of a vertical lever, pivoted at its foot, and attached at its upper extremity to a cord or wire rope encircling the room, wards, or buildings, with running pullies; the punkahs and sets of actuating lever-arms, connected by bridles and drawing-ropes, are suspended from the ceilings. The reciprocation of the primary lever (or, in certain cases, the engine cross-head) sets the whole system in oscillation, swinging at a suitable speed of thirty or forty to the minute, and with corresponding sweep. There is no slack, and all the punkahs are braced into a single swinging frame, with regular uniform motion, and entirely without undue strains.

In the South Corridor, Mr. Rogers Field has a simple and effective patent Self-acting Flushing Tank (No. 5968) adapted for the more effectual flushing of house drains, by the ordinary slops, and applicable also to the utilisation of such slops by upward irrigation through underground drains, suitably laid, for gardens, &c. By collecting and concentrating the flow of occasional quantities of water, the accumulated supply is discharged suddenly and effectively, with a flushing power, by means of an automatic syphon. The tank has a suitable double trapped inlet, and the syphon ends in a discharge or delivery trough, fitted with a stop or weir, in which a notch is cut; the action of the apparatus is in fact a self-acting intermittent syphon, set in action by a specified small quantity of water. This apparatus is suitable for use in suburban and country places, especially in conjunction with earth-closets, &c., where excrementitious matter is not conveyed away by water in the drain, but otherwise disposed of, leaving slops alone to be dealt with. Mr. Field is also associated as an exhibitor in another part of the building with Mr. Bailey Denton, C.E., as joint inventors of the Self-acting Sewage Regulator or Automatic Sewage Meter, for regulating the flow and quantity of sewage applied to land, either for the purpose of irrigation or intermittent downward filtration; suitable for country mansions, public institutions, villages, and small towns.

No. 6,005. The Universal Charcoal and Sewage Company have exhibits connected with and illustrating their system as carried out at Salford, comprising refuse collecting wall-boxes, charcoal and manures made by them, and drawings of retorts and machinery. They take the ordinary street-sweepings of a town and carbonise them in heated retorts, caused to rotate by suitable machinery and gearing. The resulting carbonised material is an effective disinfectant and deodoriser, and is so applied to the fœcal matter and excreta, collected in pans from the privies, &c., on a system similar to what is known as the Rochdale system. The product is an inert and inoffensive and inodorous compound, possessing manurial qualities of value.

No. 5,965. Messrs. T. H. P. Dennis and Co. have various exhibits, viz., a New Patent High-pressure Valve for Steam, Water, and Gas, a Water-waste Preventer, and Patent Independent Hot-water Boilers, and Horizontal Tubular Boilers. The stop or high-pressure valve is a double-face valve, giving full and free way, suitable for high or low pressure. Two discs working against the faces of the valves, and having toothed peripheries gearing into racks in opposite sides of the valve-case, have screwed axes fitting into the centre barrel or headstock; thus as the barrel is raised and lowered by means of the ordinary screwed spindle and hand-wheel, the valve discs

rotate in opposite directions, expanding and contracting so as to approach or leave the valve-faces. When the barrel is at its lowest point the valves are screwed out tight against the valve-faces. The arrangement is simple, and will be readily understood from the annexed engraving, Fig. 7.

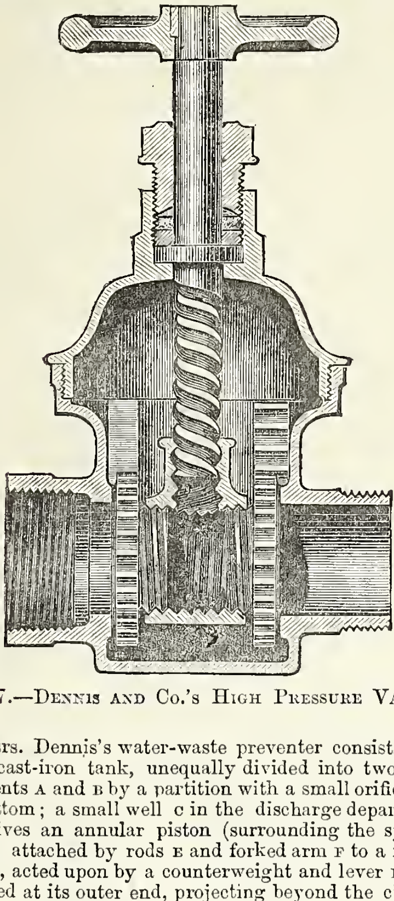


Fig. 7.—Dennis and Co.'s High Pressure Valve.

Messrs. Dennis's water-waste preventer consists of a small cast-iron tank, unequally divided into two compartments A and B by a partition with a small orifice I at the bottom; a small well C in the discharge department B receives an annular piston (surrounding the syphon pipe K) attached by rods E and forked arm F to a rotary shaft G, acted upon by a counterweight and lever H, and provided at its outer end, projecting beyond the cistern, with a lever and chain whereby the action is set in operation. M is a stop to the balance weight, carried on standards N; and L is the discharge pipe. The storage compartment A is provided with the usual service pipe and ball-cock, and when the cistern is full the pull on the handle depresses the annular piston, fills up the head of the syphon, and sets the syphon in action, whereby the discharge compartment is emptied, and the syphon run dry. But as the filling again by the orifice I is only a slow process, several minutes will elapse before any pull on the handle will produce a fresh discharge.

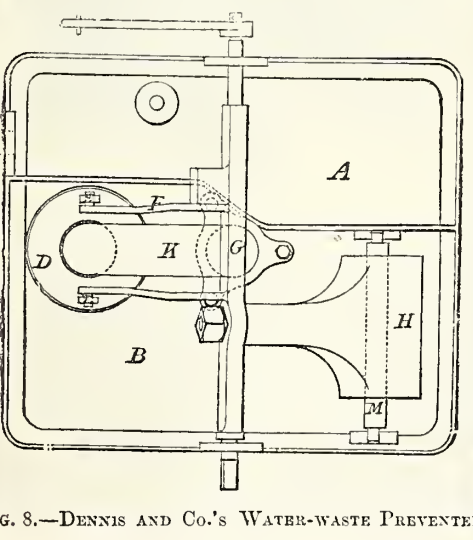


Fig. 8.—Dennis and Co.'s Water-waste Preventer.

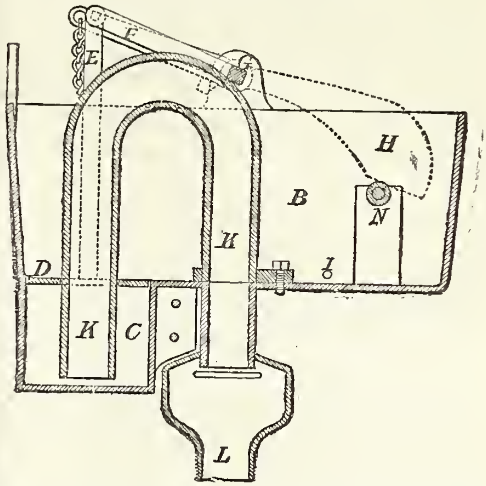


Fig. 9.—Dennis and Co.'s Water-waste Preventer.

Messrs. Dennis's horizontal tubular boiler is devised to give great heating surface and capacity, and rapid circulation, so as to be capable of sustaining the same through a maximum length of pipe; it is fitted with patent air-casing and furnace fittings, so as to dispense

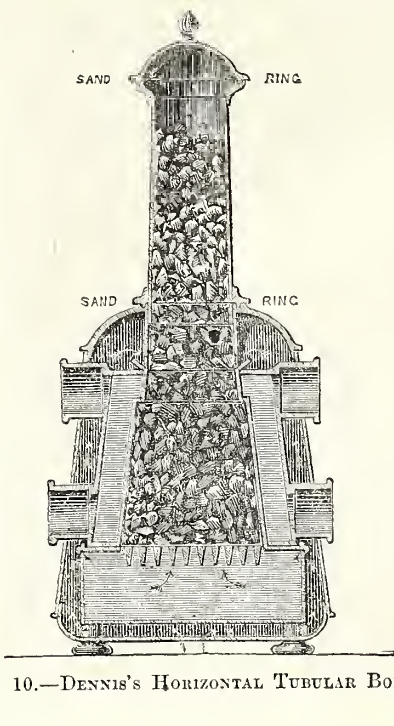


Fig. 10.—Dennis's Horizontal Tubular Boiler.

with brickwork setting. The patent independent boiler without brickwork is also fitted with casing, consisting of an arrangement of chambers, creating and introducing a continuous current of hot air, both under and above the burning fuel, tending to perfect combustion and economy of fuel, the absence of smoke, and the utilisation of the heat, and avoidance of waste heat in the smoke flue. The arrangement is shown in the accompanying sectional drawing, Fig. 10.

In concluding this series, it may be remarked, as regards the four building materials mainly treated of, iron, stone, wood, and brick, that their combinations in various ways in composite structures, such as concrete and tilo-concrete structures, on various principles, are also fully illustrated in practice in the grounds adjoining the Machinery Annexe. An account of the method of concrete building has already been given in the *Journal*, as have also some brief notices of the principal building materials exhibited. More than this space would not allow.

CIVIL AND MECHANICAL ENGINEERING.

Two of the most conspicuous objects shown in this class are Messrs. Siebe and Gorman's diving apparatus and the revolving light of Messrs. Chance.

The diving apparatus of Messrs. Siebe and Gorman is shown complete and in action. For this purpose a tank was constructed, fitted with large glass windows, through which the actions of the diver could be watched. The position of the tank is not the most favourable that might have been selected, as it is in a place where all the light is thrown from outside on the windows. To show the interior to the greatest advantage, it should have been lighted from above, so that the light might have been transmitted from within towards the outside, as is the case with the well-known aquariums at Brighton and the Crystal Palace. Still, the arrangements have been quite sufficient to illustrate completely the method of diving now generally adopted. It is hardly needful to remark that the diving-dress has for the most part supplanted the diving-bell. With it there is far greater freedom of motion, as the diver can move about within a considerable distance, whereas to move a bell is a matter of time and trouble. Then the depths to which the diver can descend are practically greater than those which can be reached by the bell, as the pressure outside forces up the water inside the bell so as to incommode those within it, and render work difficult long before the greatest amount of pressure is attained which can be borne by the human frame. There is also the great advantage that a diver can make his way into many places inaccessible to the bell. When to these considerations are added the greater compactness of the dress, and the readiness with which it can be moved from place to place, the advantages of the latter are obvious. The use of the diving-dress is extending itself to all parts of the world, and the employment of divers for recovering lost property is becoming more and more common. This and works of subaqueous engineering are the principal uses of divers, though there are other purposes for which they are employed. Such, for instance, is sponge-fishing, in which the native Greek divers are being rapidly surpassed by English and French divers with suitable dresses. It is said that the natives get finer sponges, from being able to descend to greater depths than can be reached in the diving-dress; but, on the other hand, the use of the latter enables a much greater quantity of sponges to be gathered in the same time. There are, of course, various other purposes for which divers are employed, and perhaps one other, that of cleaning the hulls of ships without docking them, is as important as the two first mentioned, but these four illustrations may serve to show the variety of uses that can be fulfilled by them.

In its present state of perfection, the diving-dress is of necessity a somewhat complicated apparatus. It may be considered as consisting of two parts, the dress itself, and the apparatus above water for keeping up the supply of air and communicating with the diver.

Messrs. Siebe and Gorman's Air-pump is of special construction. It consists of two cylinders, which can be used to drive air down a common delivery pipe, or can be employed as two separate pumps. The alteration is effected by a simple arrangement, so that the change can be made without checking the action of the pump. One object of this is that a second diver may be at once sent down should the first, as sometimes happens, require help to be extricated from wreck, or for any

other reason. In other respects the pump is merely an air-pump of highly finished construction.

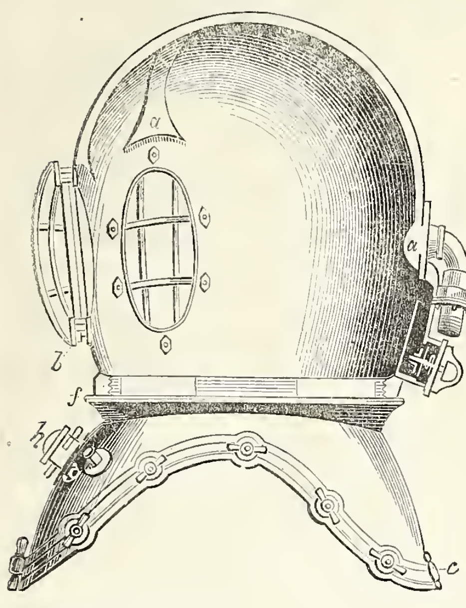
The communication with the diver is kept up by the air-pipe and a life-line, attached to the diver, so that he can be hauled up by it if needful, and can also signal those above by pulling it. There is also in some cases a speaking-tube, but this has only proved available in moderate depths, where the compression is not extreme.

It is of course in the diving-dress itself that the principal efforts of inventive ingenuity are manifest. The entire dress, as it appears when on the diver, is shown in the annexed illustration. It is all in one piece, and is made of solid sheet indiarubber, covered on both sides with tanned twill. It has a double collar, the

inner part of which fits close round the neck, while the outer portion passes over the breast-plate and provides a water-tight joint. The cuffs fit tightly round the wrist, and are held by indiarubber rings so as to make a water-tight joint while leaving the hands free. The latter are generally protected by gloves. Additional rings may also be fitted over the cuffs to make all secure. A sort of crinoline is worn round the waist in deep water to relieve the body from pressure. To preserve the dress from injury a canvass overall is worn outside it.

The helmet and breast-plate are shown together in the second figure. The breast-plate is made of tinned copper. It has a valve (*h*) in front by which the diver can regulate the pressure of air inside his dress and helmet. The outer edge of the breast-plate is of brass, and has a set of screws along it, which pass through corresponding holes in the outer collar of the dress, and have secured on them the four pieces of the breast-plate band (*c*) by means of thumb-screws. The neck is fitted with a segmental screw bayonet joint (*d*), fitting in a corresponding joint on the helmet, so that the latter can be removed by one-eighth of a turn. There are two studs (*g*) in front, to which the front and back weights are attached. The form of the breast-plate is such that the diver can raise his arm to any position.

The helmet is fitted with three strong glass plates or windows, each protected by a metal framework. One is



round, and is in front; the other two are on the sides, and are oval in shape. The front plate (*b*) can be unscrewed, to enable the diver to converse when above water without removing any other part of the dress. This is always screwed in the last thing of all, just before the diver descends. The elbow tube (*d*) at the back has connected to it the air-pipe from the pump. It is fitted with a valve to prevent the air escaping in case of a break in the pipe. The air, after passing through this valve, is conducted by pipes (*a*) to the diver's face, and this prevents the breath condensing on the glass. The outlet valve (*e*) is also at the back. This, of course, allows the foul air to escape without permitting water to enter. By stopping this valve with his finger, the diver can prevent the discharge of air, and can thus cause his dress to become inflated, and consequently buoyant. This arrangement is useful in helping the diver to reach parts of a wreck, &c., otherwise difficult of access, and it will also enable him to rise to the surface without assistance from above. On each side of the helmet is a hook for the lines of the back weight. There are also studs to which the life-line and air-pipe are secured in the manner shown in the first woodcut. The weights are both of lead, and of the shape figured. To complete the outfit, the boots should be mentioned. These are of leather, and heavily loaded, so that they weigh about 20lbs. each.

Such is the entire diving-dress, as shown in the exhibition, and in regular use for all diving operations. An important adjunct to the diver is the submarine electric lamp, especially constructed for use below water. No other light is at all available under these peculiar circumstances, but even in muddy and disturbed water the light of the electric lamp is visible for a considerable distance round.

Close by this diving apparatus is an object equally conspicuous, the Dioptric Holophotal Revolving Light of the First Order, for the South Stack Lighthouse, Holyhead, shown by Messrs. Chance, of Birmingham.

The clearest idea of this structure is given by saying that it resembles a gigantic bee-hive in glass, the sides and the surmounting cone being all built up of lenses and prisms fitted in a gun-metal frame-work, the object being, it is hardly needful to observe, to seize every ray of light and direct it onwards to that zone of the surface of the sea whence the light is to be observed, instead of allowing any to be lost in the sky. In a well-constructed dioptric light this object is practically attained, and it may be said that the whole light evolved from the central lamp is fully utilised. Seeing how complete is the apparatus, and how successful its working, it is not a little remarkable that the science of lighthouse illumination is of very recent date. Till the end of the last century the Eddystone was lighted with an arrangement of twenty-four large candles, and it was not till 1816 that the enormous coal fire, which had for two centuries blazed on the Bell Rock lighthouse in the Firth of Forth, gave way to a set of oil lamps and reflectors. There is no need to enter here on the history of the subject, that has been treated with sufficient fullness in an article contributed by Mr. J. Kenward to Mr. Timmins' work, "Birmingham and the Midland Hardware District," but the two facts mentioned may serve to show how immense is the progress which has been made by means of the application of the principles of optical science to the practical necessities of lighthouse illumination.

Although the example in the exhibition may well serve to mark the exact points the science has reached, it does not pretend to illustrate in itself any novel principle. There are in existence two others like it, also the work of Messrs. Chance. One is now at Start Point, Devon, where it has replaced an older dioptric light—the first, in fact, of that system adopted on the English coast. A second is about to be erected at Cape Bon, in Africa, this latter being a gift from the British Government to the Bey of Tunis, in the interest of commerce and navigation. The third is the one now in the Exhibition, but soon to be placed in position.

It has been said above that the whole structure resembles a huge bee-hive. Each of the six sides consists of a circular dioptric lens, about 3 ft. 6 in. in total diameter, with annular segments of concentric prisms above and below it, so as to fill up the oblong-shaped side, and the corresponding portion of the surmounting cone.

The principal characteristic of this light is the exceptional magnitude of its "panels" or sides. The central refracting lens is formed in the usual manner, being "built up" of annular segments. The whole height of the optical apparatus, about 9 feet, and the focal distance, 920 millimètres (about 3 feet), do not differ from those of the usual lights of the first order; but the angular breadth of the panels being 60°, or one-third greater than that of former apparatus, their illuminating power is proportionably increased. The lamp is of the sort known as the "pressure" lamp, and is of

special construction to enable it to supply a sufficient amount of oil to the six concentric wicks with which it is fitted. This six-wick burner is the invention of Mr. J. N. Douglass, the chief engineer of the Trinity-house. Before its invention the greatest number of wicks used was four, from one up to four being used according to the amount of light required. Either colza or petroleum can be used in these lamps, and it appears to be found that in most instances the oil lamp is more convenient than either the oxy-hydrogen or the electric light, considering the situations in which it is generally necessary that lighthouses should be placed. In a paper read before the Institution of Civil Engineers, in 1867, Mr. J. T. Chance, by whom the existing system has been brought to perfection, gave it as his opinion that the magneto-electric spark would in all probability be the source of light to be ultimately adopted at most of the important lighthouse stations which are ready of access and otherwise suitable. For remote and isolated positions it seems probable that an oil of one sort or another must continue to be employed. With regard to the six-wick burner it may be mentioned that its power is estimated as equal to 730 standard candles, Mr. Douglass' four-wick burner being about the equivalent of 330.

Disposal of the Exhibition Buildings.—Her Majesty's Commissioners have entered into arrangements for a lease to the Secretary of State for India, of the main eastern galleries of the Exhibition, and part of the objects belonging to the Indian Museum will shortly be removed to South Kensington. The Commissioners have also agreed to grant to the Trustees of the School of Art Needlework a lease of the building formerly used as the Belgian Annexe, and they are negotiating with various departments of the Government in reference to the disposal of the remaining portions of the exhibition buildings.

Leather in the Exhibition.—With regard to the account of the leather exhibits in this year's International Exhibition, M. Greck, one of the Russian Commissioners, writes to say that the statement contained in the article in reference to tanning materials was not quite accurate. Allusion was made therein to the absence of specimens of tanning materials, and M. Greck draws attention to a collection of tanning materials shown in the Russian department.

The following is the return of admissions to the Exhibition for the week ending October 24:—Season tickets, 1,031; payment (1d. admission), 35,365; total, 36,396.

In the report of Professor Barff's sixth Cantor Lecture, in the last number of the *Journal*, the name Coffel, on page 961, was given incorrectly for Caffall.

Iron says there is some idea of lighting the *Agincourt*, as an experiment, with a patent magno-electric light. The inventor has been requested to visit the ship, and give his opinion on the feasibility of introducing this system.

A School of Mines has been established by the Territorial Government at Golden, Colorado, one of the best places in the country, says *Nature*, for practical instruction.

From official correspondence laid before the House of Commons, and ordered to be printed May 21st, 1874, relating to the subject of break of gauge in India, it appears that the number of miles of railroad of the 5ft. 6in. gauge, constructed in India up to June, 1873, was 5,340; and of narrow or metre gauge, 3ft. 3⅜in., 472 milss.

The quantity of pig iron produced in France in the first half of 1874, was 707,755 tons, against 660,668 tons in the corresponding period of 1873. The total quantity of manufactured iron made in France in the first half of this year was 415,856 tons, against 464,410 tons in the first half of 1873.

GENERAL NOTES.

Technical Education in Russia.—There already exists in Russia a civil engineering school. Such is the success of this institution that it is intended to found another at Nijni Novgorod, but the academical council of the present institution is of opinion that the number of students should be limited, and not exceed 600.

Concerts in the Albert Hall.—Messrs. Novello, Ewer, and Company have issued a prospectus of a series of concerts which they have undertaken to give in the Royal Albert Hall, beginning on Saturday, the 7th November, and continuing every evening. Their scheme of operations is divided into six branches:—1. Classical, orchestral, and vocal music, under the direction of Mr. Barnby. 2. English music, under the conductership of Mr. John Francis Barnett. 3. Modern orchestral music, under the direction of Mr. Edward Dannreuther. 4. Oratorio, under the direction of Mr. Barnby. 5. Songs, ballads, and madrigals. 6. Ballet and other popular music, under the direction of Mr. Barnby. This scheme may be varied by the occasional introduction of Church music and operatic selections. The weekly programme of arrangements will be as follows:—Monday, ballad night; Tuesday, English night; Wednesday, classical night; Thursday, oratorio night; Friday, Wagner night; Saturday, popular night. Analytical and historical programmes will be produced on suitable occasions, the notes being supplied by Mr. Joseph Bennett. The orchestra will consist of 70 performers, and the chorus will be provided by the Royal Albert Hall Choral Society.

NOTICES.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque, Post-office order, or Cheque Bank cheque, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Mon. ...Farmers' Club, Salisbury-square, E.C., 5½ p.m. Mr. James Howard, M.P. (Bedford), "Our Villages: their Sanitary Reform."
British Architects, 9, Conduit-street, W., 8 p.m.

Tues. ...Zoological, 11, Hanover-square, W., 8½ p.m. 1. The Secretary, "Report on the recent additions to the Society's Menagerie." 2. Mr. A. B. Wallace, F.Z.S., "Exhibition of some Rhinoceros Horns obtained by Mr. Everett in Borneo." 3. Mr. L. Taczanowski, "Liste des Oiseaux recueillis par M. Constantine Jelski dans la partie centrale du Perou occidental." 4. Mr. A. H. Garrod, F.Z.S., "On points in the anatomy of the Parrots which bear on the classification of the sub-order."

Wed. ...Geological, Burlington House, W., 8 p.m. 1. Mr. J. Clifton Ward, "Notes on the Comparative Microscopic Rock-structure of some ancient and modern Volcanic Rocks." 2. Mr. J. Clifton Ward, "The Glaciation of the Southern part of the Lake-district, and the Glacial Origin of the Lake-basins of Cumberland and Westmoreland." (Second Paper.)
Microscopical, King's College, W.C., 8 p.m. Dr. Fleming and Mr. C. Cooke, "On some Himalayan Leaf-fungi."

Thur. ...Linnean, Burlington House, W., 8 p.m. 1. Mr. J. G. Baker, "Revision of *Asparagaceæ*." 2. Dr. Masters, "Monographic sketch of the *Durtoneæ*."
Chemical, Burlington House, W., 8 p.m. 1. Dr. C. Schorlemmer, "On Methyl Hexyl Carbinol." 2. Dr. C. R. A. Wright, "On the Action of Organic Acids and their Anhydrides on the Natural Alkaloids." 3. Dr. J. L. W. Thudichum, "Further researches on Bilirubin and its compounds." 4. Dr. Stenhouse, "Action of Bromine in the presence of water on Bromopyrogallol and on Bromopyrocatechin."

Fri. ......Philological, University College, W.C., 8 p.m. Professor Aufrecht, "On Etruscan."

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,146. Vol. XXII.

FRIDAY, NOVEMBER 6, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

NOTICE TO MEMBERS.

The 121st session of the Society will commence on Wednesday, November 18, when the opening address will be delivered by Major-General F. EARDLEY-WILMOT, R.A., F.R.S., Chairman of the Council.

Candidates proposed for election as members are privileged to attend on this occasion.

Evening Meetings of the Society will be held on the following dates, subject to any alterations which may be found necessary :—

	CANTOR LECTURES.				AFRICAN MEETINGS.				ORDINARY MEETINGS.				INDIAN MEETINGS.				CHEMICAL MEETINGS.			
	Mondays.				Tuesdays.				Wednesdays.				Fridays.							
1874. NOVEMBER..	—	—	—	—	—	—	—	—	—	—	18	25	—	—	—	—	—	—	—	—
„ DECEMBER ..	7	14	21	—	—	—	—	—	2	9	16	—	—	—	—	—	—	—	—	—
1875. JANUARY ..	—	18	25	—	—	—	—	26	—	—	20	27	—	—	22	—	—	—	—	29
„ FEBRUARY ..	1	8	15	22	9	—	—	30	3	10	17	24	—	12	—	—	—	—	19	—
„ MARCH	1	8	15	—	9	—	23	—	3	10	17	31	5	—	—	—	—	12	—	—
„ APRIL......	5	12	19	26	—	13	—	—	7	14	21	28	2	—	—	30	—	—	16	—
„ MAY	—	—	—	—	—	—	—	—	5	12	19	26	—	14	—	—	7	—	21	—

THE CHAIR WILL BE TAKEN AT EIGHT O'CLOCK AT EACH OF THE ABOVE MEETINGS.

The following arrangements have already been made :—

CANTOR LECTURES.

Courses of Cantor Lectures will be given on Monday evenings at eight o'clock, as follows :—

1ST COURSE.—"Alcohol: Its Action and its Use." by Dr. B. W. RICHARDSON, F.R.S.

2ND COURSE.—"On the Material, Construction, Form, and Principles of Tools used in Handicraft," by the Rev. ARTHUR RIGG, M.A.

3RD COURSE.—"On some of the Forms of the Modern Steam Engine," by F. J. BRAMWELL, Esq., F.R.S., President of the Institution of Mechanical Engineers.

ORDINARY MEETINGS.

The following arrangements for the Wednesday evenings before Christmas have been made :—

NOVEMBER 18.—Opening Address, by Major-General F. EARDLEY-WILMOT, R.A., F.R.S., Chairman of the Council.

NOVEMBER 25.—"On School Buildings and School Fittings," by T. ROGER SMITH, Esq. On this evening Sir CHARLES REED, Chairman of the School Board for London, will preside.

DECEMBER 2.—"On the Expediency of Protection for Inventions," by F. J. BRAMWELL, Esq., F.R.S.

DECEMBER 9.—"On the Protection of Buildings from Lightning," by Dr. R. J. MANN.

DECEMBER 16.—"On the Sandblast and its Application to Industrial Purposes," by W. E. NEWTON, Esq.

AFRICAN SECTION.

Meetings of this Section will be held on Tuesday evenings at eight o'clock. Papers to be read will be announced in the *Journal.*

CHEMICAL SECTION.

Meetings of this Section will be held on Friday evenings at eight o'clock. Papers to be read will be announced in the *Journal.*

INDIAN SECTION.

Meetings of this Section will be held on Friday evenings at eight o'clock. Papers to be read will be announced in the *Journal.*

JUVENILE LECTURES.

During the Christmas vacation, Lectures will be delivered, specially suited to a juvenile audience. Particulars will be duly announced.

Members are privileged to introduce *two* friends to each of the Ordinary and Sectional Meetings of the Society, and *one* friend to each Cantor Lecture.

A book of tickets for the admission of friends to the Ordinary Meetings is sent to each member with this *Journal.* Tickets for the Sectional Meetings and Cantor Lectures will be delivered with the *Journal* in due course.

Members are admitted on signing their names.

TECHNOLOGICAL EXAMINATIONS.

In addition to the list already published, the following Certificates have been awarded :—

71,568 Davenport, Frank, 21, Manchester Mechanics' Institution, 1st Elementary in Steel Manufacture.

71,575 Lees, Kay, 20, Oldham Lyceum, 2nd Elementary in Steel Manufacture.

INSTITUTION.

The following Institution have been received into union since the last announcement:—

Bradford Church Institute.

ANNUAL INTERNATIONAL EXHIBITIONS.

SANITARY EXHIBITS AT THE INTERNATIONAL EXHIBITION.*

By W. C. Homersham, C.E.

In Class IX., Section C, under the head of "Sanitary Apparatus and Construction," a great number of exhibits are made, of which perhaps the more important are to be found on the ground known as the Western Annexe.

Of the most useful and extensively used of sanitary appliances, "filters," there are but two exhibitors. Mr. George Cheavin (No. 5,962), and the London and General Water Purifying Company (No. 5,986). Both of these exhibitors profess to use nothing but the purest prepared animal charcoal as the filtering medium. In the filters made by Mr. Cheavin, the water passes downwards, and in those made by the London firm it passes upwards, through a layer of animal charcoal. In the first-named filters, a small perforated cylinder is fixed in the centre of the filtering medium to facilitate cleansing it as occasion may require. Whenever the charcoal, which is packed around the cylinder and between two perforated plates, becomes foul, a piston fitting the cylinder quite air-tight may be worked to and fro in it, thereby forcing a current of air through the charcoal, and effectually clearing away all the impurities. Tho arrangement is so simple, that the filtering medium can be easily and satisfactorily cleaned by anyone.

The London and General Water Purifying Company exhibits besides filters some cases of "Danchell's Testing Apparatus" for discovering the presence of impurities in water. By means of this little apparatus anyone, even though unacquainted with the science of chemistry, can ascertain whether water contains any of the impurities more common thereto, or, if the water be hard, whether the hardness arises from the presence in solution of carbonate of lime or of sulphate of lime. This latter information is of every importance when seeking for a supply of water for domestic purposes, Water which is rendered hard by the presence of sulphate of lime in solution is permanently so, whereas water, the hardness of which is due only to the presence of carbonate of lime, is rendered perfectly soft by being boiled from ten minutes to one quarter of an hour. Thus the hardness of the water supplied by the London water companies being due chiefly to the presence of carbonate of lime, the hardness is reduced from 15 degrees to 4 degrees by boiling the water for about ten or fifteen minutes. Were the hardness due, as is the case with the water of Paris, to the presence of sulphate of lime, no amount of boiling would reduce it.

One is led by other exhibits to infer that water is not the only necessary of life that can be converted from an impure to a pure state by tho action of charcoal, for we find in exhibits 5,959 and 5,984 apparatus for purifying the compound of atmospheric air and noxious gases (emanating from the fermentation of excreta and the decay of animal and vegetable matter) that issues from the sewers, by passing it through a layer of wood-charcoal about nine inches in thickness. These exhibits are similar in principle, and vary but little in detail, with the exception that 5,959 is manufactured (by Messrs. E. Brooke and Son) chiefly of earthenware of a quality similar to that of ordinary glazed drained pipes, whereas 5,984 (designed by Mr. Baldwin Latham, C.E.), is composed principally of cast-iron. In considering the effectiveness of these inventions, termed by their inventors "Patent Sewer Ventilators," it is pertinent to remember that one volume of quite fresh wood-charcoal will absorb but 65 volumes of sulphurous acid gas, 55 volumes of sulphuretted hydrogen, or 35 volumes of carbonic acid gas. Those who have faith in the healthiness of gases emanating from sewers after they have passed through a thin layer of charcoal, should make themselves acquainted with the exhibits of Mr. W. Head, of 138, High-street, Notting-hill. This exhibit (5,977) contains several models on the same principle as those last described, but they are more adapted to the ventilation of dip-traps, house-drains, &c.

The exhibit No. 5,956, by Mr. Robert Birch, has for its object not the purifying of foul air formed in sewers, but the prevention of its formation. This invention is termed a "Self-acting Penstock for Flushing Drains, Sewers, Water Courses, &c." By the action of this penstock, drains or sewers not having a sufficient fall or rate of inclination to cause the stream of sewage to run with a velocity sufficient to carry along the matter suspended in it, are made self-scouring by penning up the sewage at intervals, and then letting the whole quantity so penned up suddenly flush down the length of the sewer below it. The action of this penstock is rendered automatic by suspending the flap or valve on centres, in such a manner that when the water has risen to a certain given height in the length of sewer behind it, the weight of the water causes the flap to turn over and suddenly release all the water that has accumulated at the back thereof. When the flush has passed away the penstock readjusts itself for collecting water for another flush.

Two other exhibitors, Mr. Rogers Field, and Mr. Andrew Richmond, exhibit contrivances for a somewhat similar purpose. They are termed by each, "Self-acting Flush Tanks." The result of the proper action of these tanks is to flush and keep free from deposit the drain-pipes which form the connection between the house and the main sewer.

The exhibit by Mr. Field (No. 5,968) consists of a water-tight cast-iron tank, having a manhole on the top fitted with a cover in the form of a basin, with a trapped inlet for water to the cistern at the bottom of the basin. The outlet is formed by a syphon, so arranged that no discharge can take place till the tank is completely filled with liquid. When the tank is full, any further quantity of water that may find its way somewhat slowly into the basin in the cover, will cause room to be made for it within the cistern by forcing an equivalent quantity of water from the cistern over the lower part of the bend in the syphon. This action will continue until a flush of water of sufficient volume to set the syphon in active operation finds its way into the cistern. Once the syphon has begun to act as such, the tank will commence to empty, and continue so to do all the time the supply through the trapped inlet does not equal or exceed the power of the syphon to empty the cistern. The rate of discharge by this apparatus is much more rapid when the syphon commences to act than it is when the cistern is nearly empty. In connection with the apparatus, the exhibitor has a model illustrating how, in place of flushing the drains, the liquid passing through it may be utilised for fertilising ground situated on a lower level than the apparatus by means of sub-irrigation. Reference was made to this exhibit in a previous article in this *Journal*, but to complete the account of the sanitary department it has seemed advisable to add the above particulars.

The tank of the apparatus exhibited by Mr. Richmond, numbered 5,996, is constructed of slabs of slate. The tank has a disc-valve outlet fitted in the bottom, and an ordinary grating on the top. From the top of the disc-

* This article was detained until after the closing of the Exhibition by press of other matter.

valve, an iron spindle of small diameter rises. At the bottom of this spindle a globe of copper, similar to that of a ball-cock, is fixed. The top of the rod is jointed to one end of a lever. This lever has a small bucket fixed to it at the other end, and is so arranged and fitted with an intermediate fulcrum, that on the bucket, which hangs in an independent chamber, being filled with water, on the main cistern becoming full, the united forces of the floatative power of the copper ball and the weight of the bucket and water lift the outlet-valve, and permit the free exit of all the collected water. When the cistern is empty, the unsupported weight of the ball and valve is sufficient to raise the bucket, which by this time has discharged the water with which it was filled, through the agency of a small hole in the bottom. The valve being closed, the cistern commences to re-fill and become ready to perform another flushing operation. This apparatus is perfectly automatic in its action, and the working parts are so simple that there is little fear of trouble through their getting out of order.

Flush and ventilate our drains and sewers as we may, it is at least advisable to protect our houses by the most efficacious means known from the possibility of the entrance of any atmosphere that has even passed through sewers, not to say been generated therein. A large number of the sanitary exhibits contain "traps," designed with a view to prevent sewer air entering houses through the house drains, though but few contain anything novel or particularly advantageous in their form or mode of construction. One of the best, if not the best, and most novel of these exhibits, is termed the Redcliffe Sanitary and Ventilating Trap. It is exhibited by Mr. Alexander Greig, of 107, Adrian-terrace, Redcliffe-estate, Kensington. This trap has the advantage of being made entirely of stoneware, a material not liable to be acted upon by sewage, as iron is, or to wear away as does lead. It contains a comparatively large body of water, into which the inlets enter a considerable distance, thus forming a good "seal" against the entrance into the house of the atmosphere from the sewers. In the top, a hole has been left to facilitate examining and cleaning the interior, as may be required. The hole is fitted with a cover of stoneware, so formed as to be easily secured in its position by cement. There are two inlets, each supplied with a socket joint; the larger one, to take the pipe from the closets, discharges close to and in the direction of the outlet-pipe, and in front of the smaller one, through which the water from the sinks, baths, &c., enters. The position of the smaller inlet is so arranged as to cause the flow of the water entering through it to scour the bottom of the trap. There are also two ventilating holes in the top, provided with socket joints to receive ventilating pipes, the outlet of which may be carried to any convenient situation, whence there is no chance of the foul gases passing from them entering the house. In cases where ventilating pipes are not to be used, the holes may be conveniently and securely stopped by the use of small pieces of tile or slate, and a small quantity of cement.

There are no less than ten exhibits in which earth or dry-closets are to be found in greater or less variety. Of these exhibitors six are of London, two from Manchester, one from Woodstock, Oxon, and one from Vienna.

Three of the exhibitors not only show earth-closets of various designs, but also samples of charcoal in very small lumps (not dust) wherewith to charge the closets, and made from different materials. Thus the Carbon Fertiliser Company exhibit dry-closets and commodes suitable to the means of the rich and of the poor, and also samples of charcoal made from seaweed, and of charcoal made from a compound of charcoal and fœcal matter as it comes from the dry-closet. This latter charcoal they term "cycle charcoal." It is stated that cycle charcoal is a better disinfector and deodorant than even charcoal from seaweed, and that acts very powerfully.

The Peat Engineering and Sewage Company, and the Universal Charcoal and Sewage Company, exhibit also, as well as dry-closets, samples of charcoal suitable to be used in dry-closets. The former company, as their name implies, make the charcoal, of which they exhibit samples, from peat, whereas the charcoal manufactured by the Manchester company, of which specimens are shown, is made from the sweepings of the streets of the town of Salford. This company's operations and exhibits will be spoken of hereafter. An earth-closet is exhibited for which an advantage is claimed, for keeping separate the liquid and solid matters. This exhibit (5,972), is by Mr. J. F. Gibson. Sanitary considerations give place to those for horticulture with this exhibitor. He informs the public that "the soil obtained from these closets being dry, is found to be preferable to that hitherto obtained for horticultural purposes;" and that the urine may be conducted to a distinct receptacle, or conveyed straight away to the house drain.

The principles and details of the patent earth system of the Rev. Henry Moule are made very clear to the visitor by the exhibit (5,989) of "Moule's Patent Earth-closet Company." This company exhibit no less than nine different forms of apparatuses for earth-closets, besides several very neat-looking commodes. By perhaps the best form of these apparatuses, the user of the closet previous to its use sees nothing beneath the seat but an earthenware rim and a layer of clean dry earth, which last, resting on a valve beneath the rim, effectually conceals the contents of the receptacle. On the handle in the seat being raised after the use of the closet, the soil on the valve is upset into the receptacle, while, on the handle being returned to its normal position, a fresh charge of earth is spread over the valve in readiness for the next user of the closet, the valve at the same time preventing almost entirely all upward draught. This closet may be provided with a seat wider from front to back than can with success be provided when any other form of apparatus is employed. A method of working dry-closets upstairs is also exemplified by a large model, showing how the earth-closet may be worked entirely from the outside of the house, even when situated on the highest floor. Several forms of "self-acting" apparatus are included in this exhibit, as well as in that of the Carbon Fertiliser Company. The remaining exhibits of dry-closets require no particular remark.

Before leaving the subject of earth-closets it may be mentioned that it is found that six persons require about one hundred weight of earth per week, and that the same earth may, by being air-dried after each time of being used, be utilised as many as twelve times without being in any degree offensive. It is only necessary to air-dry it after being used, as the earth should not be so dry as to make dust when it falls. Dry earth of a loamy or clayey nature, finely sifted, has proved to be, of all the natural earths, both the best deodorant and the best disinfectant. Where, however, it is difficult to obtain sufficient suitable earth, sifted ashes may be used with the earth in the proportion of one of ashes to two of earth.

Immediately after passing through the labyrinth of dry-closets, commodes, &c., in Room XXIII., one is reminded by the exhibit (5,971) of the General Sewage and Manure Company of the vast difficulty that has been created by the water-closet system fouling our streams. To put a stop to this evil is the object of the General Sewage and Manure Company. This they propose to accomplish, and render the water of our streams once again clear and fit for general purposes, both for mankind and for fish, by precipitating the fœcal and other putrescent and noxious matters contained in sewage prior to the water entering our streams and rivers. The process which this company has adopted is one secured by letters patent by Dr. Anderson. Crude sulphate of alumina and lime are the precipitating agents made use of under the specification of Dr. Anderson. This exhibit consists of a coloured drawing and plan of the company's works at Coventry, a model of a sewage extractor, and some small bottles containing

—(1) crude sulphate of alumina, (2) sulphate of alumina from shale, (3) alum from shale, and (4) sewage manure. No information is to be gained from this exhibit, except as to the *locale* of the company's offices. This company has erected works for treating sewage by the process of Dr. Anderson at both Coventry and Nuneaton. As the works for treating the sewage at Nuneaton were in an advanced state in June, 1872, every information as to the practical working of the process as carried out by this company can be obtained by paying a visit to the sewage works either of the town of Coventry or of the town of Nuneaton, or, better still, by taking notes of the results of the operations at both sets of works. It by no means follows that the system which acts well on the sewage of one town will be necessarily equally successful when applied to that of another town.

The Secretary to the Commissioners of the Annual International Exhibitions (Major-General Scott, C.B.) by an exhibit in the Western Annexe, calls the attention of the public to his system of clarifying sewage by precipitation. The precipitant here employed is understood to be lime, without the admixture of any other article. The efficacy of lime when mixed with sewage to cause the deposit of more or less of the flocculent and nitrogenous matter contained therein, has been well known for many years. It appears the process is now being worked on the sewage of Birmingham, and that from twenty to thirty tons of cement for building purposes are being made weekly from the sludge precipitated by the action of the lime. The sewage works at Birmingham as carried on under the process are open to the inspection of all parties interested in solving the great sanitary question.

The Phosphate Sewage Company has perhaps the neatest and best appointed exhibit in the whole Exhibition. It consists of a timber building, situated in the Western Annexe, fitted with the mixing and subsiding tanks necessary for explaining the working of the process, and also with a carbon filter. Shallow tanks are provided, with bottoms and sides covered with white tiles, for the double purpose of receiving the effluent water and acting as ponds for gold and silver fish, &c. These tanks or ponds are surrounded by different kinds of grasses, ferns, &c., and the whole form a very pretty *coup-d'œil*. The process by which this company hope to solve the difficulty of defecating sewage sufficiently to permit of the water running into streams without any damaging effect on the water of the stream is also one to which the term "precipitating" applies. Dr. David Forbes, F.R.S. and Dr. Astley Paston Price, F.R.S., are the inventors and patentees of the process adopted by this company. Imported mineral phosphate of alumina is the precipitating agent employed by this company. This process has not yet been applied to the sewage of any town, but at Barking, in Essex, the company have some tanks in which they occasionally experiment upon some of the North London sewage in rather large quantities. The working on a very small scale is exhibited daily in the exhibit. The effluent water flows into the prettily arranged tanks containing the gold and silver fish, &c., though not until (as can be seen perhaps only by the attentive observer) it has been passed upwards slowly through a carbon filter.

Whether the great sewage difficulty has been or is about to be solved by the operations of either or any of those exhibitors who work on the precipitating principle, it is impossible to say. The two important points to ascertain in relation to their modes of operations are—First, can ordinary sewage of a "water-closet" town be defecated and deodorised by all or either of these processes to such an extent as to permit of the effluent water passing into streams and rivers without danger to the lives of the most delicate fish? Secondly, is the sludge deposited by all or either of these processes so innoxious in its character as to allow of its conversion into manure or cement without creating an offensive effluvium that might prove a nuisance and injurious to the health of the workmen and of persons living in the neighbourhood of the works? If both of these questions can be answered satisfactorily by the results of the absolute working of either of these or any other system, then the vexed question is settled, as, after all, the question of cost is but a secondary consideration. The prevention of the continued pollution of our rivers and streams is no longer a matter in which cost should be taken into consideration, except relatively. The fetid condition of most of our streams and rivers has resolved the purifying of them into a matter of health, nay of life and death.

Should it once be proved that sewage can be thoroughly purified, or at least so purified that delicate fish can live in the effluent water, and that the sludge can be converted into manure without danger to health, or creating a nuisance, the system that can accomplish these feats must be adopted by the authorities of innumerable towns. The cost of applying such a process is but a secondary consideration. Every practical engineer must feel assured that, however great the annual cost may be in the first instance, a few years of experience at the works of the numerous towns that necessarily must adopt the principle will soon lead to a very material reduction in the annual cost of working. While the cost of production is being reduced, it is but natural for believers in "Liebig" to anticipate that the value of the manure will increase in the eyes of the farmer, and that but a very few years would find the selling value of the resulting manure equal almost, if not exceed, the total cost of purifying the sewage, including interest on plant.

Shortly after the opening of the Exhibition, Mr. John Bailey Denton, the well-known engineer, in association with Mr. Rogers Field, had a small apparatus built in the Western Annexe, and close by the exhibit last described, to illustrate to the uninitiated the now thoroughly recognised powers of earth to defecate and deodorise sewage if applied intermittently.

The apparatus consists in part of a tank built in brickwork, having an internal top surface of about two square yards, and a depth of five feet. At the bottom of this tank drains are laid with a proper outlet, and covered to a depth of five feet with earth and mould, so as to represent the state of the soil of a field thoroughly drained and trenched to a depth of five feet.

London sewage has been delivered daily since the last week of June to the regulator forming a portion of this exhibit. From this regulator the sewage has been and still is discharged daily on to the surface of the soil in the tank, at the rate of eight gallons of sewage to a cubic yard of the drained soil and earth. This is stated to be equal to the disposal of sewage at the rate of 3,000 (more correctly 3,226) persons supplied per diem with 20 gallons of water per head, to an acre of land drained five feet deep.

Dr. Benjamin Paul, in reports, of which copies are presented to visitors making inquiries on the subject, gives analyses, first of the effluent water that ran off from the drains of this exhibit some few days after the London sewage was first distributed on the surface, by which it appears the effluent then contained—

·009 in 100,000 parts of water of free ammonia,
and ·049 in 100,000 parts of water of organic nitrogen.

and, secondly, of the effluent after the sewage had been supplied daily for two months, when it contained—

·006 in 100,000 parts of water of free ammonia.
·038 in 100,000 parts of water of organic nitrogen.
And 1·300 in 100,000 parts of water of organic carbon.

According to this analysis the effluent water contained less ammonia and organic nitrogen when taken two months after the filter commenced working, than it did when taken only a few days after the sewage had been first applied. Such is exactly what would have been expected by any person who had given the subject consideration. The earth having become more consolidated,

and consequently the rate of filtering less rapid, the earth had more time to take up the free ammonia, and the organic nitrogen having smaller pores or interstices in the earth to pass through, was the more thoroughly retained in the soil.

That the fœcal matter, in addition to 20 gallons of water per diem per head, from 3,226 persons, can be discharged and utilised on an acre of land by means of "intermittent downward filtration," or in fact through any agency, is questionable. The following rather startling figures may show more clearly what is meant by discharging sewage on to land drained five feet deep at the rate of eight gallons to a cubic yard of drained soil.

It means—

13⅓ gallons per yard superficial per diem,
64,533 gallons per acre per diem,
or 23,554,667 gallons per acre per year;

Or to express the same thing in other terms, it is equal to a depth over the whole surface of—

2·844 inches per diem,
or 1038·000 inches, or 86 feet 6 inches per annum.

86 feet 6 inches per annum is about thirty times the average amount of annual rainfall over all England, or about forty times that in the south-east of England.

Most readers will not require to be reminded that the dry weather flow of town sewage on the water-closet system is upwards of 30 gallons per head, in place of 20, as assumed by the exhibitors. Consequently the depth of sewage that would be delivered in dry weather is in reality no less than 4·266 inches per diem, or 129 feet 9 inches per annum.

Calculation also shows that if sewage supplied at the rate of 8 gallons per diem per cubic yard of drained earth left behind it on soil drained five feet deep only 70 grains of matter per gallon, the total amount annually deposited on the surface and in the pores of the earth in an acre would be no less than one hundred and five tons.

Taking Liebig as authority, the excrements of a man for a year contain 16½ lbs. of nitrogen, but reducing that one-third to allow for small children (to 11lbs.) we find that an acre of land, taking the sewage of 3,226 persons will be supplied, in a year, with upwards of fifteen tons of nitrogen. Liebig in his "Chemistry of Agriculture" says, "If we admit that the liquid and solid excrements of a man amount to one pound and a half daily, and that both, taken together, contain three per cent. of nitrogen, then in one year they will amount to 547 pounds, which contain 16½ pounds nearly—a quantity sufficient to yield the nitrogen of 800 pounds (12·7 bushels) of wheat, rye, oats, or 900 pounds of barley."

The average crop of wheat on highly cultivated land in England may be taken at thirty bushels per acre.

No remarks need here be made on the above calculations. To those having the slightest knowledge of agriculture and sanitary engineering, the figures speak plainly for themselves, though perhaps more so when read by the light of the above extract from "Liebig's Chemistry of Agriculture."

The regulator before referred to as forming a portion of this exhibit is in principle the same as "Field's Patent Self-acting Flush Tank" (exhibit 5,968), the construction and action of which has been already described. The only apparent difference is, first, that in the former the inner leg of the syphon is enclosed in a strainer, whereas in the latter the necessity for such strainer is avoided by fixing strainers so as to intercept and detain in a separate tank the coarser matter contained in the sewage; and secondly, the bend of the syphon is placed at such a level in Denton and Field's apparatus as to cause the syphon to come into active play before the tank becomes quite filled. The active play does not commence without the arrival of a flush of water of considerable volume, as was described as being requisite for bringing the syphon of the Field apparatus into full play. The actions of the two are identical both before and after the syphon is brought into full operation, and the sewage flows continuously through the apparatus, until the supply has not been for some considerable period of time equal to the capacity of the syphon to discharge. By the action of this apparatus not only is the coarser matter of the sewage kept back from flowing on to the land, but a not inconsiderable portion of the finer particles have time to subside in the tank. The inner leg of the syphon not reaching the bottom of the tank, a receptacle is formed for the deposit from such subsidence, and a pipe and sluice-valve are shown in the drawing of Denton and Field's apparatus to facilitate the clearing out of such deposit. The all-important fact must not be lost sight of, that by the use of this apparatus the sewage may be said to be "decanted," and the most offensive of the putrescent matter contained in the sewage is left on hand, and has to be deodorised and defecated. As this deposit is in a more concentrated form than the sewage itself, it becomes more practicable to deodorise and defecate the sediment and the produce of the intercepting chamber; but the exhibitors do not explain in any of their circulars how they propose so to do. The differences in the action of the two apparatus consist in the fact that the "Regulator" delivers the sewage on to the surface of the ground, and the "Flush-tank" underground for sub-irrigation.

The specimens of charcoal, &c., exhibited by the Universal Charcoal and Sewage Company (exhibit 6,005 before referred to) are very numerous, the object of the company being to draw the attention of the public in general, and of sanitary officers in particular, to them as convincing proofs of the practicability of the thorough utilisation of town refuse of the most worthless kinds, by converting it into charcoal and thereby securing the means of perfectly deodorising the most noxious matters with which officers of Boards of Health have to deal. This desirable end is, the company contend, secured by their patented process, by which the street sweepings of cities, towns, &c., may be converted into charcoal, suitable both for deodorisation and for the filtration of impure water. The contents of the case exhibited are, in the first place, a sample of raw street sweepings, as collected by the authorities of the borough of Salford. From sweepings such as these by the company's process are obtained the following articles, of which samples are shown:—First, rough charcoal, as it is delivered from the retorts; 26s. per ton. Second, fine charcoal, being a sample of the rough charcoal after being subjected to the process of grinding. The analysis of this charcoal, it is stated in the pamphlet issued by this company, possesses, on the average, about twice the quantity of pure carbon which is found in the best animal charcoal, the fetor-absorbing properties of which have been so long known to the scientific and general public; 36s. per ton. Third, moulder's charcoal, similar to the last, but so finely ground that it has passed through wire meshes giving 15,600 openings in the square inch. It is stated that this moulder's charcoal does not run before the hottest metal, and that founders who have used it give a preference to it over ordinary founders' blacking; 120s. per ton.

A sample is shown of what is termed filtering charcoal, made from a mixture of the raw street sweepings with a clay free from sand, the mass being thoroughly incorporated, dried, and then carbonised. It is stated that charcoal manufactured in this manner has so many valuable qualities as a purifier of water, that the Universal Charcoal and Sewage Company are contemplating applying it to filters for potable water. A sample of charcoal manure, which consists of rough charcoal, as made by the company's process, mixed with the night-soil collected by the authorities of Salford on "the pail system," is also exhibited. This sample of manure is said to contain from 40 to 50 per cent. of night-soil, yet not a trace of any putrescent effluvium is perceptible.

Specimens of other kinds of charcoal and manure are also exhibited by the company, but as their constitu-

tion and mode of manufacture are in no way connected with the sanitary question, there is no need to enter into any particulars relating to them. Suffice it to mention that, quite recently, there have been shown at this exhibition samples of charcoal made from the deposit of the sewage works at Birmingham (Scott's process), Coventry (General Sewage Company's process), and Leeds (Native Guano Company's process). Charcoal has long been known to be not only a powerful detergent, but a good fertiliser of the more ordinary descriptions of soil. It also possesses, in the highest degree, the power of absorbing the offensive gases arising from decaying substances, both animal and vegetable. The obstacles which have hitherto prevented the more general use of charcoal as a manure precipitator and deodoriser have been not only its high price, but the difficulty of obtaining it perfectly dry and in fine powder. Both these difficulties would be overcome by the authorities of a town converting the street sweepings into charcoal on the site of the sewage deodorising or precipitating works. It is stated that the prime cost of carbonising the street-sweepings of the Borough of Salford is considerably below ten shillings per ton of charcoal as delivered from the retorts.

CLOSING OF THE INTERNATIONAL EXHIBITION.

The following is taken from the *Observer* of Sunday last:—Yesterday afternoon, at five o'clock, the London International Exhibition closed its doors, not only for the present year, but, so far as the intention of Her Majesty's Commissioners are at present known, for an indefinite period. A large and increasing class in this country will hear of this decision with regret; but few persons who are in a position to judge of their motives will question the soundness of their conclusion. It is mortifying to have to make the confession; but the fact remains that in spite of the outcry for technical education, the public do not yet appear to be able to appreciate the boon which has been tendered to them, and a scheme in every way creditable to those who devised it may be said, with some reservation, to have for the present proved a failure from a financial point of view. It is, however, by no means improbable that the series of exhibitions now brought to a close will have had the effect of stimulating a public want which in a few years will acquire sufficient strength to demand their continuation, either on the present basis, or with such minor modifications as may be found advisable. There is little doubt that sufficient pecuniary success would have been achieved, and that this suspension need not have taken place if the Commissioners had been enabled to carry out a plan which would have attracted the public in greatly-increased numbers—namely, throwing open the noble gardens of the Horticultural Society, as well as the Albert Hall, to all visitors to the Exhibition without any additional payment. They were prevented, however, from doing this by the exclusive spirit of the Horticultural Society, whose views with regard to benefiting the public are opposed to those of Her Majesty's Commissioners.

As compared with 1873, the number of visitors does not show any startling diminution, though the reduction in the price of admission this year, which commenced on the 28th of August, has, of course, told materially on the receipts. In 1873 the total number of admissions were as follows:—By season tickets 42,368, and by payment 457,474, or a total of 499,842. We have not the corrected returns for last week, but the following figures may be taken as approximating very closely to the truth. By season tickets 40,900, and by payment 431,800 or a total of 472,700. A great deal has been said about the Commissioners charging so low a price for admission as a penny every day but Wednesday, since the 19th of October, and it has been suggested that it would have been much better to have made it free at once; but this they had no power to do; and as they were earnesly desirous that the public should have all the benefit possible from the opportunities for technical instruction which Division 2 of the Exhibition affords, they did the next best thing to gratuitous admission by charging a merely nominal entrance fee.

In estimating the value of the work which has been done, due credit must be given to the Commissioners for having successfully started the School of Cookery, now on its own resources and going on most successfully, and the National Art School of Needlework, which is now also self-supporting, and, indeed, paying well. The National Training School for Music, which is also going on prosperously, undoubtedly owes its success to the assistance which the Commissioners afforded it in the sums advanced by the general purposes committee from the funds of the Exhibition of 1851. In taking into consideration the pecuniary results of tho work, the permanent value of the buildings, shafting, and fittings must be taken into account, and then it will probably turn out that if there is not a balance on the right side, the Commissioners have at least not lost very much; but as such exhibitions are clearly a little in advance of the times, the Commissioners have, no doubt, decided wisely in closing them, with the intention, however, of giving the public the full benefit of their valuable plant in another form. It is intended that the south galleries shall be handed over to be utilised as the National Portrait Gallery. The west galleries will, in like manner, enable the authorities of the Patent Museum to exhibit in something like a satisfactory form the numerous and interesting series they have of models of patent inventions, and of real working machines, some of which, like the first practical railway locomotive, are of national, and even world-wide interest. Then, again, it is proposed to move the Indian Museum, which, with its rapidly growing and valuable collection, is now located in a secluded position under the roof of the New India Office, to the east galleries as soon as the present exhibits are removed. What is now the French Annexe is destined for the reception of a collection which must be of ever-increasing interest as years go on, namely, a Colonial Museum, in which intending emigrants will be able to form, through their own eyes, a much better idea of the new country they are about to adopt as their home than would be possible from the most earnest study of the most reliable books. Assuming that each colony of this country desirous of attaching settlers will carry out the idea which the young, vigorous, and enterprising colony of Queensland has already perfected, the new Colonial Museum will in itself ensure no inconsiderable flow of visitors to South Kensington under the new *régime*. Not only does the visitor see for himself specimens of the corn, wine, oil, sugar, cotton, and wool so easily raised from the fertile soil of this sunny land, but masses of copper, iron, and tin, specimens of gold, complete collections of the *feræ naturæ*, birds, beasts, and fishes; also specimens of all the timber grown, all the ore extracted, and well painted pictures and photographs innumerable, which convey a very fair impression of what will meet his view on arriving at the antipodes. One thing is quite clear, that if all tho other colonies rival Queensland in the extent and completeness of their collection, the area at present intended for the new Colonial Museum will prove far too small for the purpose, and some redistribution of space will have to be effected.

The School of Art for Needlework is to find a home in the new Belgian Annexe as soon as it can be cleared and prepared for the reception of the establishment which is at present doing good work at 31, Sloane-street. Perhaps the greatest interest, however, centres in the National Training School of Cookery, which, under the new arrangement, will extend its operations, taking in additional space adjoining its present location. It will be remembered that this institution took its rise on account of the great interest in and popularity of the

lectures delivered by Mr. Buckmaster during the Exhibition of 1873. The constant flow of auditors who listened to his clever expositions, with the avowed desire for something more practical than merely passing a pleasant half-hour, pointed to the existence of a great national want, and it was seen that to meet that want something permanent would have to be done, not merely to add to the comfort of the middle classes, but if possible, to spread a really sound knowledge of cookery through the humbler classes of the community. A training school was therefore opened last Easter, with a class of pupils who, for a fee of two guineas, are practically taught cookery, beginning at the best mode of keeping clean and in order, stoves, ovens, pots, and pans, and every article, in fact, forming part of the *batterie de cuisine*, and going on to practical cookery and complete *vivâ voce* instruction in the best known modes of preparing fish, meat, soups, puddings, pastry, and sick-room delicacies. So far, this system has been very successful, both as regards the number of pupils and the proficiency attained, which is tested by examination once a month. One interesting feature in the work is the fact that mistresses, as well as servants, come for instruction, and work successfully and harmoniously; and, meeting as they do on a sort of neutral ground, learn to appreciate each others' good qualities much more rapidly and successfully than they could possibly do in their normal sphere of relationship. All this is very good in its way, but the National Training School of Cookery is steadily keeping in view a much more important object. The executive committee desire to get classes of ten or twelve persons of good education, who will undertake to study with the view of becoming future certificated teachers of cookery, available to come forward at the call of School Boards, local bodies, or in schools of cookery on their own account. It is not too much to predict that if this excellent idea is properly carried out, and is supported as it deserves to be, a very few years ought to remove from us the national reproach, which, so far as the humbler classes are concerned, is undoubtedly true, of being the very worst cooks in the world. The attempt will be made as soon as the school committee are in possession of their new premises, and if its teaching is successful, the result will of itself be a sufficient monument to the value of the series of exhibitions which have come to a close. The Commissioners are now in negociation with various departments of the Government, in reference to the disposal of the remaining portions of the exhibition buildings, none of which will be long unoccupied.

RETURN OF ADMISSIONS FOR 1874.

	Season Tickets.	Payment.	Total.
Private View, April 4	1,532	Nil.	1,532
1st Week ending April 11*	1,719	25,279	26,998
2nd " " " 18	1,185	11,471	12,656
3rd " " " 25	1,061	10,599	11,660
4th " " May 2	1,289	11,206	12,495
5th " " " 9	1,368	10,235	11,603
6th " " " 16	1,469	10,901	12,370
7th " " " 23	1,378	10,693	12,071
8th " " " 30†	2,584	22,179	24,763
9th " " June 6	2,246	11,601	13,847
10th " " " 13	1,215	10,707	11,922
11th " " " 20	2,526	13,572	16,098
12th " " " 27	1,177	13,099	14,276
13th " " July 4	1,280	10,231	11,511
14th " " " 11	2,153	10,497	12,650
15th " " " 18	1,110	7,691	8,801
16th " " " 25	1,074	8,763	9,837
17th " " August 1	1,068	7,842	8,910
18th " " " 8‡	1,900	15,131	17,031
19th " " " 15	985	8,138	9,123
20th " " " 22	1,061	9,329	10,390
21st " " " 29	975	7,251	8,226
22nd " " Sept. 5	1,010	8,536	9,546
23rd Week ending Sept. 12*	981	16,003	16,984
24th " " " 19*	1,039	16,367	17,406
25th " " " 26*	956	16,236	17,192
26th " " Oct. 3*	836	12,343	13,179
27th " " " 10*	809	10,867	11,676
28th " " " 17*	876	11,180	12,056
29th " " " 24†	1,031	35,365	36,396
30th " " " 31†	1,049	52,491	53,540
Total	40,942	425,803	466,745

* Easter week. † Whitsun week. ‡ Bank Holiday.

Total number of Admissions in 1873.

By Season Ticket, 42,368. By Payment, 457,474. Total, 499,842.

MUSEUM OF NEW INVENTIONS.

Commenting on the close of the International Exhibition, *Iron* says:—A portion of the building is understood to be destined to receive the Patent Museum, and in connection with this, we appeal earnestly to the Government to keep in view the object of technical education, which, it is admitted on all hands, is one of the most important questions of the age, especially to the people of these kingdoms.

The attraction of the Patent Museum is proved by the number of visitors, and a collection of new machines, apparatus, processes, and manufactures could not fail of being still more so. The difficulty, on the one hand, of making known new inventions and discoveries is great in the case of inventors of small means; while on the other, the great mass of the working and other classes have often much difficulty in studying novelties on account of the time that is lost in seeking them.

The proposal we make is that a portion of the building in connection with the Patent Museum, be devoted to the exhibition of inventions and novelties of any kind which a competent jury shall declare to possess unquestionable merit and to be of public interest.

Paris has an institution of the kind in the Conservatoire des Arts et Metiers, as far as regards machinery and apparatus, and a considerable number of novelties are always on view in what was formerly the chapel of the monastery to which the structure originally belonged, and twice in the week the machinery is shown in motion. Connected with new inventions another admirable arrangement exists at the Conservatoire. Any inventor who has confidence in the value of a machine he has constructed may have it tested by the best known scientific methods, and receive a written report of the result, without charge.

The Conservatoire des Arts et Metiers has grown from small beginnings to a magnificent museum of machinery, scientific apparatus, and implements, of models of construction of all kinds, of productions in glass, china, pottery, and other materials, and of remarkable novelties or extraordinary specimens of chemical products. Moreover, there is attached to the establishment a body of the most eminent professors in mechanical science, chemistry as applied to the arts, dyeing, agriculture, physics, &c., who lecture daily in turn to large and most attentive audiences, composed principally of workmen and apprentices, and who have their laboratories in the establishment.

It appears to us monstrous that London should be without its Conservatory of Arts and Manufactures; and here the opportunity is afforded of commencing it in the immediate vicinity of the school of art and science at South Kensington.

A great variety of articles, such as mats, grain-bags, waggon covers, ropes, sails, &c., are made in Russia from the inner bark of the bass wood or linden tree. It is estimated that upwards of a million trees are cut down annually for this purpose. The value of this manufacture amounts to about 2,400,000 dollars.

* 3l. admission. † 1d. admission.

INDIAN, COLONIAL, AND IMPERIAL INTERESTS IN QUICK AND CHEAP TRANSIT.

At the recent meeting of the Association for the Promotion of Social Science, held at Glasgow, the following question was proposed for discussion: "What are the best means for drawing together the interests of the United Kingdom of India, and of the Colonies?" Mr. Edwin Chadwick, C.B., read the following paper on the subject—

On this important question propounded for discussion in this Department of Economy and Trade, I have to submit some principles of political economy as applicable to the question, which I have had occasion to aid in developing in connection with recent inquiries made under the auspices of the Council of the Society of Arts, of which I have the honour to be a vice-president.

I have heard from a former Chief Secretary of the Colonial Office, and from others in high position, avowals that the policy on which they were disposed to act was a policy of "weaning" our colonies from the mother country. I have heard such avowals with regret, but, as a political economist, without surprise, and I advert to the avowals as illustrative of the great question propounded by the noble Earl, our president, of the necessity of technical education for statemanship, especially, of course, of education in the elementary principles of political economy, which until recently has been entirely omitted in superior education. For to one conversant with the economy of the subject this policy of weaning the colonies would be found to mean weaning us from the greatest of our means of progress in arts, manufactures, and commerce—weaning us from powerful conditions of demand for production, for labour in it, and for the increase of wages—weaning us from the best means of relief from congested labour markets—weaning us from means of augmenting revenue—weaning also the colonies from the most extended markets of the empire, from the cheapest means of their national defence, and from the accepted centre of their economical and social, as well as of their political progress. Overlooking these, having no conception of any substantive economies having element of dominion other than military force, and that being evidently ineligible, having no conception of the economic force of mutual interests as binders of dominion, the feeling of the right hon. gentlemen, as regards the colonies, has been to "let them go." Now I beg to submit for consideration one element to be taken into account of constant and unceasing beneficent action, the element of what I call "intercolonial goodwills." I may illustrate this goodwill principle and its primary economical value thus:—I may call myself in political phrase "a dependency" of my baker, my butcher, or other of my tradesmen. To anyone of these my habit of dealing with him, in preference to others—though I am perfectly free to deal elsewhere—is to him, with the same habit of his other customers, a habit of saleable value at several years' purchase of his future annual profits, as "a goodwill"—which includes his cost of forming and maintaining his business connection. You may see such "goodwills," large and small, constantly advertised for sale as properties. On a large scale, manufactories and businesses are frequently sold for the formation of joint-stock companies, at such sums as twenty and fifty thousand pounds, and in one instance of which I have heard, of upwards of two hundred thousand. Now, all our commerce with India, or with our colonies, will be through commercial houses. Each of those houses will have formed connections and established commercial habits of dealing with customers in India or the colonies—habits of dealing, constituting "goodwills" or saleable properties. All the houses in India or the colonies are perfectly free, if they be so minded, to deal with any foreign house, but the habit of dealing with the British houses, *cæteris paribus*, is to that British house a habit of money value for which some years' purchase would be asked and given. The whole colonial and Indian commerce collectively through such houses constitutes what I call our "intercolonial goodwill," or as regards India, it might be called "intra-imperial goodwill." If the commerce of the Mauritius, of which we have retained dominion, be compared with the commerce of Bourbon, of which our Government gave up the dominion, and therewith much of the habit and the trading connection, I expect that the difference in the money value of the commerce to us and of the "goodwills" will be found to be considerable, as it would probably be on a comparison of our commercial relation with Java and Ceylon. If the Cape had remained with Holland, its commercial progress would no doubt have been chiefly Dutch, instead of being as it now is largely and increasingly British. This view admits of extended illustration by comparisons of our commerce with the colonies of other nationalities and our own. No one on looking at the facts will doubt that in the annexing of the Fiji Islands ourselves, instead of leaving them to any other nationality, we annex a greater future amount of commerce from them.

The goodwill principle, it need scarcely be stated, is mutual, though from older establishments, its development is the strongest in the mother country, and from recent commercial formations and conditions of constraint, they are the weakest and most in need of nurture in the colonies.

All that I have stated is known in commerce, though it has been hitherto unknown from defective education in politics. It will appear that the statesmen who were not economists knew not what they were doing either for several islands or for their own country, when they gave them away as a profitless trouble—as they probably were to them—men saturated with wealth, scarcely knowing how to administer their own, and above the consideration of how to get it for the many. If a valuation of the purchase of the goodwills of the commercial Indian and Colonial houses were made, with a view to a transference to the houses of some other nationality, it may be confidently anticipated that the total amount of the value claimed and justified for compensation would be a large surprise to Downing-street. It would, I expect, be found that the commerce of regular imports and exports must for the greater proportion be made up of goodwills—that is to say, the greater proportion of the commerce in goods, borne by three thousand steamships and twenty-three thousand sailing vessels—carrying imports and exports to the custom-house, declared value of six hundred and fifty millions per annum, for which (with all large deductions) the price of the total good at three years' purchase might possibly exceed the amount of the National Debt.

The instance of our commerce with the United States might appear to militate against the doctrine of international goodwills; but when fairly examined, I believe it will be found to confirm it. The habits of race, and of home connections constantly sustained and increased by a powerful and an increasing emigration from the mother country, have to a great extent maintained social ties and have overborne the economical consequences of a political severance; but, large as that commerce now is, it may be confidently stated that, but for the political severance, it would have been yet larger, safer, and in greatly increasing proportions. The political severance will indeed be found to have been economically the most detrimental to our kinsmen in the States, for it has subjected them to restricted settlements and intercourse with the wide colonial markets under the British dominion. The Canadians, as fellow-citizens of the Empire have freer access to the home markets, and are more free to establish branch houses to form connections with all the colonies of the great Empire of the mother country; and, it may be added, a free participation of a consular and diplomatic service, and naval protection all over the world. With the like privilege the goodwills of the United States, I anticipate, would now have been of higher value than they are. If economical considerations be regarded, separation from the mother country would be found by the Dominion to be separation from a large future of commercial profit and interest, apart from the severance from sympathies and moral and political interests, which have a distinct value. On the main question, propounded by our lamented colleague, the late secretary of the Colonial Institute, "By what means may the interests of the colonies of India, and of the mother country, be best drawn together," the answer I have to submit is—By our strengthening these goodwills, by cheapening and by speeding the transit of goods, of persons, and of information. Let it be considered how this may be done. In the time of Adam Smith steam may be said to have been unapplied. There were no railways, no steamships, no postal telegraphs, nor had our earlier political economists before them the great facts displaying the vast importance in the production and distribution of cheap and quick means of transit, of produce, and of persons, and for the creation of international interests. About forty years ago, the time of the transit of goods round the Cape to India was four or five

months, and the cost for the first-class passenger about £120, the second about £60, and the third about £30. A letter was considered to have been duly answered if it were answered within a year. I perfectly well remember that an administrative appeal to the Court of Directors was held to have been dealt with in due course if it were despatched in fifteen months. By steam through the Suez Canal, the time of the transit of passengers and much of the goods is reduced to less than one month, and the cost by the Peninsular and Oriental, for the first-class passenger, to £65; for the second, to £35; and for the third, to £18. The reduction of the cost of transit of goods has been proportionate. The cost of time in the transit of persons is displayed in the transit for military and civil service, by the reduction from eight months' pay to a month's pay in the passage, besides the reduced cost of the passage money. The time saved in transit constitutes a large proportion of the time given in furloughs for recruiting health and strength, and also for the transit of force. It is an example of the deplorable conditions of the want of economical principle from defects of education in economical science in high political circles, when but recently the cutting of the Suez Canal was proposed and supported by one Government and from year to year thwarted and obstructed by another Government—that of this commercial nation—as being an injury to England. "It would," said the imperial politicians of the Tuileries, "give the lead in the commerce of the East to France; it would pierce the shield of England." "Deplorably too true," responded Downing-street. "How can the sad work be prevented?" Look at the extent of verification of the uselessly forewarned economical results. Of the traffic through that canal 75 per cent. has been British, and the proportion is increasing. Only 11 per cent. has been French, and the proportion is diminishing. Of 1,100 vessels which passed through the canal last year, 800 were British. The political ignorance, from the defect of superior technical education, occasioned the delay for years of all the fourfold "turnover," as compared with the Cape, of the capital now passing through the canal, at the rate of seventy millions annually in ships and cargoes. The combined result of speeding the transit of goods and persons has been to bring India in time as near to England as Constantinople was at the beginning of the present century, or as Rome was at the beginning of the last century; but the rule of engineering and mechanical science will, it is promised, further reduce that time by one-half. And so to a greater or less extent of from one-third to one-half with all our colonies. Mr. Reed's principle of construction promises, for the Bessemer steam passenger ships, an augmentation of speed by one-third, or to twenty miles an hour. We may say, too, that by improved asphalte tramways, at a third the cost of iron tramways, branches to railways may be made to be feeders instead of suckers, and that for all common vehicles the cost of horse-power may be reduced more than one-half. We say further, that by the application of economical science and unity of administration, and by the use of cheap public capital in the place of dear private capital, the cost of internal transit may yet be reduced by one-third.

I now beg to submit to consideration some economic elements involved in speeding and cheapening the transit of information. At the beginning of the century the transit of intelligence from Australia by return letter was one year. It is now, by electric telegraph, accomplished in a day. By the ocean telegraph, the Australian merchant and the London merchant are brought almost as near to each other as if the one were at the Royal Exchange, London, and the other were at Westminster. It is now a matter of practice that merchandise is bought in Calcutta and sold in London on the same day, as readily as if Calcutta were where the London Docks now are, and the sale were made in the Royal Exchange in the City. Even transmission by electricity may yet be further speeded—at least as to the number of messages that may be transmitted over the same wire within the same day. But the question of the highest economical and commercial importance for saving stocks and saving the interest on capital by speeding operations, is as to the extent to which electric telegraph communication admit of being extended and cheapened. Electrical science may be said to have provided for the commerce, and affairs, and interests of the world a new system of nerves of sensation and volition. Economical science would confer the benefits of this time-saving and interest-creating gift to the many, but ignorant, uneconomical administration has encumbered it, augmented its charges, and restricted its action, and confined its benefits to the few at least in this country. Here the internal postal telegraph charge, though reduced, confines the use of the telegraph to professional men, and to a few of the higher middle class. It is very little used at all by the great agricultural class. But in Switzerland and Belgium, half-franc messages extend the benefits to all of the middle class, and to the artisan class for speeding their daily operations, and it does so with a good surplus revenue—which, however, we deem a very secondary consideration. In respect, however, to our immediate subject of inter-colonial interests and goodwills, the high charges, owing to errors in political economy, restrict the regular use of telegraphic communication to a few great houses, and confine even those few great houses to wholesale transactions, and for those transactions—to painfully restricted messages, which are often puzzling and dangerous enigmas. The necessities of commerce are compelling correspondence more and more by telegraph and less and less by letter, and are making the existing conditions more and more burthensome and grievous to the few who regularly use it, inducing the special employment of skilled clerks and decipherers. The charges are prohibitory of the use of the time-saving gift for the great mass of small houses and for their smaller transactions. They are, above all, prohibitory of social messages from emigrants, travellers, and colonists. They deprive the emigrant and the belated traveller of remittances of small sums from home, needful to speed his progress. The social messsages from India do not amount to much more than one per cent., and the proportion is not much greater from Canada, being confined indeed to extraordinary events and messages for the few who can afford to pay for them.

Nevertheless let us consider what we find to be the economical working of the service, even so far as it has yet been carried. The first operation is in saving capital, in saving stocks by enabling dealers to telegraph for goods as they are wanted. To meet sudden demands, the provincial retail grocer telegraphs to the wholesale dealer in the metropolis; the wholesale dealer telegraphs for supplies to the importer at Liverpool or Glasgow; and the importer again telegraphs to the producer—the planter in the West Indies. The supply is the more closely adjusted to the demand, and gluts of produce are avoided. By these means business is conducted in various lines with one-third the capital formerly necessary. But the further effect is to speed the "turnover" by two or three fold within the same time. The effect of speeding the transit of goods by the working of the Suez Canal and of the telegraph in speeding transactions, as I have stated, has been a fourfold turnover as compared with the transit round the Cape. The interest on the cost of the canal appears to be less than 2 per cent. on the estimated turnover of the British capital passing through it, so that probably it would have been worth while for this country to have cut the canal at its own charge, and have bestowed the freedom of it on France to do the best with it she could. This fourfold "turnover," and all the "turnovers," be it noted, include the "turnovers" of large proportions of duty-paying produce. Wonderment is expressed by statesmen at the "rebounds" of revenue, often ascribed by those hon. gentlemen to measures which can have had little or nothing to do with the real actuating cause. As a rule, every inland business telegram saves a day of time, or speeds a transaction by a day, and every business ocean telegram speeds a considerable transaction, or set of transactions, by weeks and by months, and saves weeks and months of interest on large capital—saves weeks and months of establishment charges, and often saves weeks and months of deterioration of agricultural and of perishable produce. How little is known of the practical operation of economical principles is shown by the fact of the recent absence of surplus, or the assumed deficit of revenue from the inland postal telegraph being bewailed as a severe and absolute loss, as if a surplus of revenue were the sole test of gain in the operations any more than such instances (which I might multiply) of new means of transit, which yield nothing directly in rates or tolls, but which otherwise yield great returns, as in the instance of the Suez Canal. I believe, however, it will appear on examination, if one member of the Council of the Society of Arts (Mr. Reed, the member for Pembroke) obtains the committee of which he has given notice, that the apparent deficit on the inland telegraphs, which is temporary, has been in great part occasioned by an economical blunder in the extension of an unnecessary monopoly, and occasioning immense claims for several millions of compensation by

the railway companies, and also by a financial error by the Treasury improperly charging the revenue extension works, which commerce would have charged to capital. That which the nation has real cause to bewail, as it has had to pay some eight millions and more for it, and shillings, instead of sixpenny messages, which we should have had years ago, is the ignorance of political economy which allowed the charges for multiplied establishments on dear capital to grow up, despite of indoor representations, despite the outdoor representations from our Society of Arts, until upwards of ten millions had to be paid for what might have been at first got for two. Each of half a dozen of changing political chiefs must, by his want of the economical knowledge befitting his position, have occasioned to the public a loss of more than half a million of money during his period of service. It is estimated that two-thirds of the inland telegrams are on business messages, and that the saving of the interest of capital, or of the value of the business time, is judged to be upwards of ten shillings per telegram. At the time the inland service was taken over from the private trading companies, the rate of service was about six millions of telegrams per annum, and was increasing very little. It is now upwards of twenty millions, and is increasing very much. So that in the lowest estimate of gain obtained on inquiry as to the two-thirds of business messages, and despite the inflated charges, to which economical ignorance has subjected the public, there has been a real public gain of several millions, above any deficit of revenue, even had the telegraph service been rendered gratis. A wonderful proportion of the rebound of the revenue may be demonstrated to be created by the increasing turnover of duty, paying commodities from their being telegraphed for as they are wanted. In the present condition of the inland postal telegraphs, whilst the central department at St. Martin's-le-Grand is from defects in arrangements (of which there was time for preparation) declared to be working up to their full power, we may show that the local offices are, for the greater number, working greatly below their power, and in need of further occupation. Proceeding upon a long practised plan we adopt the system of France and of the North of Germany of telegraphic zones. In France, there are half-franc messages for zones of departments, and franc messages for all beyond them. Why should not sixpenny telegrams be adopted for Glasgow, which once had them—and, indeed, for all Scotland, as for all Switzerland or Belgium? It must be observed, however, in answer to those who object to any change in the existing system, that "the Government does everything badly," that here we have an example of where we say that it has done and is doing this work badly, as compared with the government of Belgium and Switzerland, yet that this public postal telegraph administration at its worst is demonstrated by the statistical returns to be already more than three-fold better than that of the private trading directorates at their best, when they declared that it could not be surpassed. Why, however, should the mercantile service of Glasgow and other commercial centres be kept back, and the restoration of a surplus be delayed for years, on account of the gorged condition of St. Martin's-le-Grand? We dispute, upon the precedent recited of France and Germany, and, indeed, of home experience, the principle of a uniform sixpenny rate for all the United Kingdom of Great Britain and Ireland.

The best forecasts of wide commercial knowledge are of two years to come of dull trade under the existing conditions, including two years slackened rebound of the revenue. It therefore follows that every stimulus should be immediately and earnestly applied to restore and animate our commerce, and experience shows that cheap telegraphy is a most powerful stimulus, especially cheap ocean telegraphy, to bring in retail business and extend branches required to bring in new islands. At present, the practice of merchants is, on account of the expense, to direct their captains not to telegraph home until they reach the port of final destination. With cheap ocean telegraphy, captains would telegraph information from every port at which they touch, and send retail orders, and receive instructions; and merchants sitting in their offices at home here at Glasgow or elsewhere, may exercise their own discretion in conducting their ventures round the world—an immense advantage for the guidance and maintenance of our mercantile marine—the greatest in the world. Now, we say that it is a rigid economical condition that the service of private telegraph companies must be dear and comparatively restrictive, whilst ocean postal telegraphy on a public footing may be cheap and widely expansive. The private companies for this riskful service can only work with dear capital, usually 10 per cent. On a public footing the service may be conducted on the cheap capital and on public security, raised for the public service at 3¼ per cent. Private companies cannot form branches except on dear capital, and on a prospect of working them at a profit upon that dear capital—usually 10 per cent.—as also upon separate offices and establishments, charged usually upon inferior traffic. On a public footing branches may be formed with cheap capital, and may be worked with the existing postal establishments at the cost of the service, and at some points may be worked with public profit at even less than the cost of the service, just as the penny post is at some points. This question of the extension of branch ocean lines is of the highest importance for the service of remote rising settlements, and also for the economy and the prompt efficient direction of war force for their protection. The Cape Coast is about a thousand miles—that is, two weeks of time for information and action. If there had been a branch line to Sierra Leone, or the Cape Coast, we know that the Ashantee war might have been nipped in the bud. The known power of promptly bringing up a reserve force is in itself a great means of prevention and of economy of protection. It really appears to me that the economy of our dominion to India—to the Indians—has yet to be considered. If India was left to the Indians, as has been talked of, it would not be left to the bulk of the Indians but to numerous savage and other expensive dominations of independent forces. By a quarter of a million of force, or by about seventy thousand of British force, we certainly save the Indians from the burthen of some three millions of native forces and their ravaging wars. It is an economical feat and a great glory that with less than 10,000 of British force we give security to the producers of 63 millions of population of Bengal—a population equal to that of the Empire of all the Russias. Great Britain holds all India in peace with a force no greater than that with which France has held Algeria. But to the end in view, with the increasing dearness of our home labour market, and the increasing difficulties of enlistment, every means of economising and quickly concentrating force and supplies by improved means for its transit, by improved roads and speeded information, becomes of increasing public necessity. Of what value in the movement of force, would information in a day or an hour, instead of a three weeks overland journey, have been on the occurrence of the Indian mutiny? By a completed system of ocean telegraphs, branch and mains, a power is gained of concentrating all war ships, with crews, now made by discipline floating regiments for land service, on such occasions. Added to such occasions are the necessities of speeding relief on the occasions of calamity of famine, as has been exhibited during the recent famine in Bengal. Great as were the benefits derived from the improved means of transit of information and of produce, we know they would have been yet greater had there been branch lines of ocean telegraph to the Mauritius and to other markets of food supplies. In the provisions needed are the means of relief to our large mercantile marine on the occurrence of shipwreck, and also on the occurrence of cyclones, against which the ocean telegraphs may often give most important forewarnings. The navy department, as well as the war department and the mercantile marine, might be expected to be anxious and urgent on this question. Of the new cheap public lines of communication immediately required, are lines from Halifax to Bermuda, *via* Windward Islands to Demerara; Demerara to Sierra Leone; thence, *via* Cape Coast Castle, Ascension, and St. Helena, to the Cape of Good Hope; thence, *via* Natal, to Mauritius; Mauritius to Galle, or an alternative line direct to Australia. I now come more directly to the economics, or of the income derivable for public acquisition and extension of the system of ocean telegraphs.

Unfortunately it is the common condition of Governments or of statesmen in office, especially of those who, as in the instance cited, have not had the light of science or of master economic principle for their guidance, has hitherto been, that they are mainly dependant for any advance in administrative improvement on the advice of "insiders," or permanent officers, whose own knowledge is very much bounded by the four walls of their offices and their own daily routine within them. If it be on a question of finance, it may be, or at least would have been hitherto, at the disposal of the insider, whose reputed speciality has been to say "No" to anything new,

and to economise the means of economy on the largest scale; or if it be on the germane question of administration it may be dependent on the overworried, overwearied "insider," who is in need of relief from the muddle made of his present work, and who in regard to any new work, if anything must be done, thinks "how not to do it" for years to come, during which time waste must go on as it has gone on. The cramped education of most insiders will generally have excluded them from the knowledge of sound economical principles, and amongst those principles, the one immediately applicable, the law of increasing rates of consumption, with diminishing scales of prices in different orders of the community, which the student in statesmanship may find expounded in the fourth chapter of Say's "Political Economy." This ignorance was exemplified in this very department on the occasion of Sir Rowland Hill's proposal of the penny letter post. The inside positive declaration of the department was that if letters were even carried gratis their numbers would not be doubled. Their numbers have been increased ninefold. Much of this increase has been ascribed to the working of the railways; but in the Metropolitan postal district, with which railway postal transit has had nothing to do, the increase from twopence only from a penny has been more than sevenfold. Now our Society of Arts has been at the pains to obtain the requisite outside information from existing users of the telegraph in commerce, and they declare that where they now use one postal telegram at a shilling they would use three or four or more at sixpence; and then there is the great mass to be brought in who do not now use them, but who would use them if they were cheaper. From merchants and ship owners (of the very few who now use the ocean telegraph) we have received declarations that at one-fourth the existing rates they would spend a great deal more than they now do. Added to these few are the many who are now prohibited from using them. There is a great lower stratum to be "tapped," including emigrants and settlers needing social communication, to whom the existing charges are prohibitory. On the terms of the acquisition, if the inland telegraph question had been properly managed, the State would, by an annual expenditure of about £220,000, raised at 3½ per cent., have been put in possession of a business then producing some £350,000—the then estimated purchase money being about seven millions. But springing charges, occasioned by a want of sound economical knowledge on the need of a monopoly of from three millions more than was at first estimated, have swept away the anticipated immediate surplus. We shall be able to show, however, that in the instance of the great ocean telegraph companies, all of whose messages pass through the Post-office, so that every shilling of their income may be ascertained beyond dispute, no such question need arise. The terms of purchase for which we may contend in the interest of the shareholders, to whom we would make the offer individually, would be the grant of public security for the average of the existing dividends. This public security, which would cost the general public nothing, would give the shareholders an important augmentation of the saleable value of their property, covering the recognised fair terms of compulsory purchase. And this we have the assurance of large shareholders they would be willing to accept. By these means, with capital raised at 3½ per cent., the public, we are assured, may, for an annual expenditure of £850,000 per annum, acquire a business now producing between fourteen and fifteen hundred thousand pounds per annum. We may adduce the evidence of men of eminence in large commercial operations to show that the whole of the recited great advantages may be obtained without the State laying out or practically risking one shilling. Sir Rowland Hill was of opinion that a Government monopoly in the letter post was unnecessary, and we consider that a Government monopoly of the inland telegraphs was, as I have stated, a large economical mistake. We believe that in those cases, and also in the case of the ocean telegraphs, the administration would be better without any monopoly. In all cases of systematised public arrangements, minor collateral conveniences are apt to be overlooked, and are sometimes necessarily postponed or set aside; but we consider that private interests ought not to be allowed to be sacrificed to any system. The railway companies might have been left free to use telegraph lines for their own working. The colonies, we consider, should be allowed full freedom, and receive all such Government aids as they may require for the development of their own means of communication. The great mass of the ocean cables may be said to be British, created by British capital, and communicating mainly with the British dominions. In the so-called French cable there was very little, indeed, French capital, and there was probably less in the Anglo-American cable. Not above one-twentieth part of the ocean cables go over foreign shores. We really need only concern ourselves with our own colonies and dependencies in the first instance. But we may well enlist foreign commercial interests with us, by extending to them all the advantages of cheap ocean message-carrying which we obtain for themselves. If they thought they could get the work they require done cheaper by their own Governments, they should be offered every facility for so doing it. In the instance of the inland cables, however long they had continued in private hands, it was clear to all economists conversant with the subject that their ultimate purchase was inevitable, because it was impossible to suppose that the inter-communication of the country could have been allowed to continue depressed and restricted by the burthens of dear capital and duplicate establishments, and the privation of branch extensions. All delay in the requisite changes of the existing economic conditions is in aggravation of the eventual public charges. The first chairman of the chief inland telegraph company, Mr. Ricardo, urged at the outset of the enterprise that the work should be placed on a public footing. The chairman of the first working Atlantic Ocean telegraph company, the Rght Hon. J. Stuart Wortley, made similar representations as to the ocean telegraphs in time to have made a great saving. If we consider the geographical position of this country and its disadvantages in respect to distance from its colonies and chief markets, and how heavily its manufactures and commerce must be weighted by its additional cost of transit as compared with nearer competitors, it must be urged as of primary necessity for its progress, especially during the present depressed state of its arts, manufactures, and commerce, that all those disadvantages should be anxiously considered and strenuously reduced by all possible means.

After adverting to the fallacies of some professed free-traders, who regarded the repeal of import duties and fiscal charges as the end of all free trade, and citing instances to show that the saving of charges, by saving the time and cost of transit, would be generally greater, and give greater freedom to trade, the paper concluded by answering the political objection to strengthening the political relations of the colonies to the mother country, on account of their distance, that it was met by the wonderful power of the ocean telegraph, of bringing them all nearer, almost within a day of time, for intercommunication and discussion. If three of the Atlantic cables were cleared of the "business messages" for the occasion, some five columns of the *Times* newspaper of a colonial debate in Parliament might appear in the newspapers of the dominion the following morning, and as long a reply might appear in the London papers from the dominion on the next day. But full official intercommunication and expenditure were now obstructed by the excessive expense of the present system.

In the discussion which followed the reading of the paper, Mr. Botly urged the great practical importance of bringing it under the notice of the Chambers of Commerce, and on the motion of Sir George Campbell, the president of the section, a resolution was unanimously adopted to recommend the Council to take action upon it.

CORRESPONDENCE.

CANTOR LECTURES.

SIR,—The trial which I made of one of Messrs. Dietz's lamps, mentioned in a note to my last lecture, was not made with a photometer. I write this as I find that my words have been misunderstood. The trial of Mr. Silber's gas burner was made, as I stated, with a photometer.—I am, &c., FREDERICK BARFF.

November 3rd, 1874.

A Swiss correspondent of *Engineering* says that there are now in his country 15 kilometres of lines of one metre gauge opened, 93 building, and 130 projected, being a total of 238 kilometres, or about 148 miles of narrow gauge railways.

GENERAL NOTES.

American Mail Trains.—An arrangement, which has been nearly completed, has in view the carriage of the mails between the large cities of the United States in rapid trains to be used for no other purpose, and to which the freight and passenger traffic would alike give way. By this means it is expected that letters will be carried between New York and Chicago in 24 hours; communication with Cleveland, Cincinnati, &c., would also be greatly accelerated.

American Cotton Crop.—The cotton crop for the year ending 1st October, is 4,170,000 bales, which has been exceeded only three times in the history of cotton culture in America. This large crop follows the large crop of 1872-3, which was 3,930,000 bales. The natural result is that manufacturers are now provided with larger stocks than usual, and that prices are tending downward. The aggregate amount in dollars and cents realised by the planters from the crop of 1873-4 has been considerably less than the sum obtained for the crop of the preceding year, which was 240,000 bales smaller.

Manufacture of Sugar.—In 1873, the German Empire possessed 334 sugar boileries, distributed in the following manner:—Prussia 254, Anhalt 35, Brunswick 28, Wurtemberg 6, Thuringia 5, Bavaria 2, Luxembourg 2, Baden and Mecklenburg, each one. The Prussian sugar trade is especially flourishing in the Province of Saxony, in which 149 boileries were in operation; besides this, there are 49 in Siberia, 19 in Brandembourg, 15 in Hanover, and 8 in the Rhenish Provinces. More than 20,000,000 metric quintals (1,968,000 tons) of beet-root have been worked up; of which quantity the share of Prussia was 15,000,000 quintals (1,476,000 tons.) There are now in operation 11 more boileries than there were in 1872, and the quantity of beet-root worked up has increased by 512,500 quintals (50,430 tons).

Indian Native Newspaper.—Under the title of the *Bharat Sramajibi*, or "The Indian Workman," is now published at Barahanagar, in the neighbourhood of Calcutta, a monthly Bengali journal of 8 pages 8vo., with wood-cut illustrations. It is an educational paper, and its object is to supply a means of improving the moral and intellectual condition of the working classes by articles on subjects adapted to these ends, such as descriptions of natural phenomena or objects of general interest, accounts of native arts and manufactures, and the application of science to the improvement of such arts or other useful purposes as exemplified in more advanced countries, biographical sketches, and suggestions on subjects bearing on their own welfare or on their duties to their fellow men, whether of their own class or of their employers, or of the community in general, such as may tend to make or keep them worthy and respectable members of society.

Playing Cards.—These form one of the starting points in the history of the printer's art. Originally introduced as a source of amusement for kings and courtiers, they ultimately settled down into a series of decorative designs, having the emblem of kings, queens, and knaves. The character originally given to the designs has been perpetuated almost without alteration to our time, notwithstanding that the quality of the cards and the decorative character of the printing has been carried to a high state of perfection. By a recent invention Messrs. De la Rue have made an innovation upon past practices, and, while the general character of the court cards is still maintained, have attempted to give to them at least a passing interest by introducing in a modified form portraits of some of the leading kings and queens of Europe of our own day. They have at the same time avoided giving offence to any individual by attaching personality to the knave, and have therefore produced upon the knave card the emblem of a Scotch piper, a French commissionaire, a Swiss guide, and a Spanish matadore. In designing these cards, which form part of the series of the "Summerley" art manufactures, the object aimed at has been to fix the time when they were made, and to give them some historical and international interest, while the traditional quaintness of playing cards is preserved in order that the card players' attention should not be distracted by the designs.

New Paving.—A contractor has lately been authorised to put down at Liege, by way of trial, a new kind of pavement made of cast-iron. In the first place a bed of masonry is formed, on which a layer of asphalte is spread, and in this bituminous substance the iron blocks, 4 centimetres (1·5748 inch) thick are laid. A sufficient area has been put down to give a fair trial to the invention.

Lithographic Stones.—It is said in France that the quarries of lithographic stone in Bavaria are exhausted as regards the best kind, and that the only fine stones are now obtained by the Paris lithographers from Bruniquel, Tarn, and Garonne, in France. These stones are said to be well appreciated in the United States of America. There are quarries of the same stone also at Vigan, in France, but these are of an inferior description.

Commercial and Industrial Congress.—Some time since it was proposed to hold a Congress in Paris for the purpose of discussing the wants of industry and commerce, and, if possible, devising the means of supplying them; and, finally, reporting to the Government and the Assembly on the results. The subject has been taken up energetically by the Syndical Chambers of Commerce and Industry in the provinces, and the Prefect of Police has authorised the Congress to meet in the great amphitheatre of the Conservatoire des Arts et Metiers. The date is not yet announced, but the meeting will probably be in December.

Fuel for Indian Railways.—Writing on this subject, Mr. F. Mathew, Chief Resident Engineer of the Bombay and Baroda line, says that the expediency of utilising the productiveness of a tropical district for the growth of timber appears to be worthy of attention. The B.B. and C.I.R. having planted the spare lands along the railway some years ago, had many thousand tons of Babool timber fit for engine fuel after about six years; but Government having ruled that the railway company should not have such plantations, resumed the lands and made the plantations over to the Forest Department, with the condition that the railway company was to be supplied with 600 tons per annum, at six rupees per ton for engine lighting. Government at the same time directed the Forest Department to plant some considerable areas of waste land, with the view of obtaining a still larger supply; but so far the new plantations have not been successful.

NOTICES.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque, Post-office order, or Cheque Bank cheque, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Mon. ...Royal Geographical, 1, Savile-row, W., 8½ p.m. Lieut. Julius Payer. "On the discovery of new Arctic Lands by the Austro-Hungarian Expedition of 1872-74."

Tues....Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. Alexander R. Binnie, "The Nagpur Waterworks; with Observations on the Rainfall, the flow from the ground, and Evaporation at Nagpur, and on the fluctuations of Rainfall in India and other places."

Anthropological Institute, 4, St. Martin's-place, W.C. 1. Mr. F. W. Rudler, F.G.S., "Report on Anthropology at Belfast;" 2. Mr. Hyde Clarke, "Report on Anthropology at the Oriental Congress, London;" 3. Mr. H. H. Howorth, "Report on the Congress of Anthropology and Prehistoric Archæology at Stockholm;" 4. Col. Lane Fox, V.P.S.A., "On a Series of Flint and Chert Implements from Patagonia."

Wed. ...Royal Society of Literature, 4, St. Martin's-place, W.C., 4½ p.m.

Fri.......Archæological Institution, 16, New Burlington-street, W., 4 p.m.

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FRIDAY, NOVEMBER 13, 1874.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

NOTICE TO MEMBERS.

The 121st session of the Society will commence on Wednesday, November 18, when the opening address will be delivered by Major-General F. EARDLEY-WILMOT, R.A., F.R.S., Chairman of the Council.

Candidates proposed for election as members are privileged to attend on this occasion.

ORDINARY MEETINGS.

The following arrangements for the Wednesday evenings before Christmas have been made:—

NOVEMBER 18.—Opening Address, by Major-General F. EARDLEY-WILMOT, R.A., F.R.S., Chairman of the Council.

NOVEMBER 25.—"On School Buildings and School Fittings," by T. ROGER SMITH, Esq. On this evening Sir CHARLES REED, Chairman of the School Board for London, will preside.

DECEMBER 2.—"On the Expediency of Protection for Inventions," by F. J. BRAMWELL, Esq., F.R.S.

DECEMBER 9.—"On the Protection of Buildings from Lightning," by Dr. R. J. MANN.

DECEMBER 16.—"On the Sandblast and its Application to Industrial Purposes," by W. E. NEWTON, Esq.

CANTOR LECTURES.

Courses of Cantor Lectures will be given on Monday evenings at eight o'clock, as follows:—

1ST COURSE.—"Alcohol: Its Action and its Use." by Dr. B. W. RICHARDSON, F.R.S.

2ND COURSE.—"On the Material, Construction, Form, and Principles of Tools used in Handicraft," by the Rev. ARTHUR RIGG, M.A.

3RD COURSE.—"On some of the Forms of the Modern Steam Engine," by F. J. BRAMWELL, Esq., F.R.S., President of the Institution of Mechanical Engineers.

The following is the syllabus of the first course:—

LECTURE I.—MONDAY, DECEMBER 7TH.

The history of Alcohol in relation to its varied service to mankind—in the Arts and in Science.

LECTURE II.—MONDAY, DECEMBER 14TH.

The Alcohol group of organic bodies.—Respective action of different Alcohols.

LECTURE III.—MONDAY, DECEMBER 21ST.

The influence of Common or Ethylic Alcohol on animal life.—The primary physiological action of Alcohol.

LECTURE IV.—MONDAY, JANUARY 18TH.

The position of Alcohol as a food.—Its effects on the animal temperature.—Hygienic considerations.

LECTURE V.—MONDAY, JANUARY 25TH.

The secondary action of Alcohol on vital functions.—Physical deteriorations of structure—general and special—incident to its excessive use.

LECTURE VI.—MONDAY, FEBRUARY 1ST.

Influence of Alcohol on the nervous organisation, with special reference to the mental phenomena induced by its use.—Summary.

AFRICAN SECTION.

Meetings of this Section will be held on Tuesday evenings at eight o'clock. Papers to be read will be announced in the *Journal.*

CHEMICAL SECTION.

Meetings of this Section will be held on Friday evenings at eight o'clock. Papers to be read will be announced in the *Journal.*

INDIAN SECTION.

Meetings of this Section will be held on Friday evenings at eight o'clock. Papers to be read will be announced in the *Journal.*

JUVENILE LECTURES.

During the Christmas vacation, Lectures will be delivered, specially suited to a juvenile audience Particulars will be duly announced.

Members are privileged to introduce *two* friends to each of the Ordinary and Sectional Meetings of the Society, and *one* friend to each Cantor Lecture.

A book of tickets for the admission of friends to the Ordinary Meetings has been sent to each member. Tickets for the Sectional Meetings and Cantor Lectures will be delivered with the *Journal* in due course.

Members are admitted on signing their names.

PUBLIC MUSEUMS AND LIBRARY.

A meeting of this Committee was held on the 10th November. Present:—Mr. Henry Cole, C.B., Mr. Hyde Clarke, Lord Ronald Leveson Gower, Lieut.-Col. A. Strange, F.R.S., Mr. E. Thomas, F.R.S., Mr. Thomas Webster, Q.C., with Mr. Le Neve Foster, Secretary.

ECONOMICAL USE OF FUEL.

A meeting of this Committee was held on November 6th, at the Western Annexe, International Exhibition Buildings. Present:— Mr. F. J. Bramwell, F.R.S., Major-Gen. Eliot, Capt. Douglas Galton, C.B., F.R.S., Dr. Mann, Dr. David S. Price, with Mr. Le Neve Foster (secretary), and Mr. S. W. Davies (in charge of the testing).

A meeting was also held on November 11th, at

the Western Annexe. Present:—Major-Gen. F. Eardley-Wilmot, F.R.S. (in the chair), Mr. F. J. Bramwell, F.R.S., Capt. Douglas Galton, C.B., F.R.S., Dr. Mann, Dr. David S. Price, with Mr. Le Neve Foster and Mr. S. W. Davies.

EXHIBITIONS.

Philadelphia Exhibition.—A complete collection of ores, &c., illustrating the mineralogy of Chili, is in process of collection for the Exhibition of 1875, and with it much information of interest to Englishmen as to the mineral wealth of Chili will be presented. Some interesting statistics from the Mining Department of Copiapo have just been published. The mineral production of last year was as follows.—Chanarcillo, in ores, 2,721,571 kilogs; in fine silver, 12,312 kilogs. Lomas Bayas, in ores, 2,992,034; fine silver, 8,964; Chimbero, in ores, 11,355,284, fine silver, 35,649. Tres Puntas, in ores, 1,374,187; fine silver, 3,330. Total in ores, 18,443,076; fine silver, 60,255 kilogs. The province of Atacama has produced in the last thirty years 201,826,240 dols. worth of mineral, principally copper and silver, or about 6,700,000 dols. annually. In 1867 the exports rose to nearly 11,500,000 dols. in value, and since then have ranged between ten and eleven million dollars.

The Algerian Exhibition.—With reference to this exhibition, a brief notice of which was given in a recent *Journal*, it is announced that the objects admitted will be all Algerian productions likely to prove of interest to scientific and commercial men and manufacturers, as well as tools, agricultural and horticultural machines, and appliances of any nation, articles made in France and other countries out of the raw products of Algeria, and the products of industries peculiar to Northern Africa. The exhibition will be opened on the 15th November, 1875, and close on the 15th February following. The products will be classed by divisions and groups in the following manner:—1st Division—Algerian productions, fine arts, and manufactures (10 groups). 2nd Division—Agriculture and horticulture (18 groups). 3rd Division—French department (5 groups). 4th Division—Foreign department (5 groups). 5th Division—Industries peculiar to Northern Africa (6 groups). Prizes will be awarded to those exhibitors whose objects are reported by the jury as especially good. These prizes will consist of medals of gold, silver, and bronze, certificates of merit, honourable mentions, and sums of money. There will shortly be published a detailed programme, containing the general regulations of the exhibition, the names and classification of the products, particulars of the prizes in each division, and all necessary information for exhibitors and the public.

Exhibition at Uruguay.—The Montevidean Government, in conjunction with the Rural Association of Uruguay, propose to hold a National Exhibition of Arts, Manufactures, and Products, which will be opened at Montevideo on August 25th, 1875, and closed on April 20th, 1876. The exhibition will comprise four great sections, viz.—Agricultural products, farming stock, arts and manufactures, and mineral samples. Each exhibitor will send in before May 25th, 1875, his name and address, specifying what he is going to exhibit, and how much space he will require. No charge will be made for placing articles in the general stalls, but such persons as require special stalls will have to pay a moderate rent, besides the cost of fitting up their stall. No gunpowder, dynamite, or the like will be admitted. Animals, plants, and green fruits will only be received in the four days preceding the date of opening. All other articles must be sent in between July 15th and August 20th, 1875. A receipt will be given to each exhibitor, that he may claim his goods at the close; he cannot in the interim remove the articles exhibited, but may sell them, to be delivered after the distribution of prizes, and for this purpose may mark the price on each article when placing same in the stall. Cattle exhibited will be fed by the committee, but must be taken care of by a servant of the owner. Parties exhibiting machinery either made in the country or imported, must apply to the committee before May 25, 1875, stating how much space they require. A suitable site for testing these will be chosen near Montevideo, and prizes awarded both for the machines and the best workmen. Each exhibitor must bear the expense of conveying his goods to Montevideo and delivering same to the committee, who will do their best to protect them from injury, but not insure them to the owners; the latter running all risk in the matter. The committee will publish a complete catalogue of all the articles exhibited and their owners, specifying such as obtain the gold, silver, or bronze medals, and honorary mentions, awarded by the jury. The above prizes will be distributed by the President of the Republic in April, 1876. Any goods not removed in 30 days after the close will be used by the committee as they may judge best. The committee reserve the right of refusing to exhibit any goods they may think not worth accepting. A list of 12 questions is also furnished to each intending exhibitor, such as these:—"What is the best way to improve grazing farms?" "Do you think fenced land and artificial grass good for sheep?" "Which is the fairest way to tax horned cattle?" "How do you consider planting of trees may be promoted?" "Are you in favour of colonies by joint-stock companies?" "What is the best means for destroying ants?" Those whose answers are considered the best will receive prize medals, and the essays in question will be read in public at the close of the exhibition.

ANNUAL INTERNATIONAL EXHIBITIONS.

COLOUR PRINTING.

A novel method of printing in various colours or tints at the same time has been on view for the last few weeks at the International Exhibition.

The existing process of chromolithographic printing, as is pretty generally known, consists in printing the outlines and shading of a subject in black either from a wood block or a lithographic stone, faintly on the paper, and then printing each colour or tint, separately, upon the black outlines and shading. For this work, besides the black impression, or "key," a separate stone is required for each tint, and some of these only print a few spots, or lines, of colour. Now the preparation of so many stones is a matter of time and considerable expense, and what is called the "register," that is to say, the placing of each colour exactly in the right place on each stone, and then placing the paper each time that it goes through the press in precisely the correct position, is a matter of great skill, nicety, and, when it is stated that one chromolithographic print often requires ten, twelve, and even sixteen stones, such nicety would seem almost impossible of attainment. Yet wherever there is a preceptible fault in register the print is spoiled.

The new process, which was exhibited by Messrs. J. M. Johnson and Sons, has for its object to do away with all the stones but that on which the outline black "key" is drawn, and make masses of colour perform all the rest of the work.

Perhaps the simplest mode of giving an idea of this process, is to suppose a number of cakes of colour placed side by side in an iron frame, or "chase." The surface being all rubbed down all to the same level, and a piece

of damp paper being placed over the whole, a rude mosaic of the various colours would appear on the paper on pressure being applied as in ordinary printing.

In the new process the colours are not water colours, nor is the paper soaked in water; the colours are of a peculiar description, and the paper is slightly moistened with turpentine. If the object were merely to produce regular geometrical mosaics of colour, the process certainly effects that object completely, and, to complete the work, any outlines, ornamentation, or shading, may be printed in the ordinary way upon the coloured mosaic. But a further step has been accomplished, namely, the printing of coloured maps or any other similar work.

This is effected in the following manner:—The outlines of the countries or other divisions of the map are laid down on a thin sheet of brass, and the various colours cut apart with scissors. Each piece of brass is then laid upon a cake of the colour required, and made to adhere to it, and the colour is cut round to the exact form of the plate by means of a small wire-band saw. When all the pieces of brass are furnished with their proper pigments, the whole is put together exactly like a child's puzzle map in the "chase" already mentioned, and being subjected to a certain amount of warmth and pressure, it is completely welded, as it were, together. The coloured ground-work being then printed, the black "key," with the outlines, shading, names, &c., is then printed on the coloured impression.

The production of artistic subjects is not so complete, but to a certain point it is equally simple. All the colours and shades in a composition are cut out in brass exactly as above described in the case of map-printing, and the "key" applied in like manner afterwards to complete the work. The incompleteness consists in this, that the Mosaic printing process is not applicable to very small masses or lines of colour, so that for fine works these would have to be supplemented by one or more additional printings from stones in the ordinary way, either before or after the printing of the black "key."

The result is, supposing the experimental process to answer practically, that the means is here presented of printing any number of colours at once, either for the production of simple and cheap chromolithographs, with the help of the black "key" alone, or of producing coloured grounds, which may afterwards be worked up in the ordinary manner.

The machine in which the work is done is of special construction, and was designed for the purpose by Mr. Arthur Rigg.

AGRICULTURAL STATISTICS.—GREAT BRITAIN.

The abstract of the Agricultural Returns for each division of Great Britain, which has just been published, affords an interesting key to the changes that have taken place in farming operations in this country during the past year.

In the first place a considerable extent of land was brought under tillage as compared with the area cultivated in 1873. This increase amounted in England to 114,810 acres, in Wales to 31,650 acres, and in Scotland to 17,839 acres. The subjoined table shows the several variations in the culture of the respective crops and of pastures, but it may be useful to draw attention to a few particulars which it exhibits. As regards the acreage under corn crops it will be observed that there was an increase in England, while in Wales and Scotland there was a considerable decrease. The average under wheat in England shows a large increase, and this increase appears to have taken place to a great extent at the expense of the other corn crops. The average under barley was less in each division of the kingdom; as was also that of oats; indeed the average under this latter crop is the smallest that has been returned since agricultural statistics have been collected, viz., since 1867.

As respects green crops it will be noticed that there was a large increase in the acreage under turnips and swedes in England, and a decrease in Scotland; the other variations are unimportant. Flax was less cultivated in each division of the country, but the acreage under hops was extended by 2,500 acres. As compared with the previous year there was considerably less land under bare fallow, especially in England. In consequence of the season there was a great decrease in the acreage of both artificial and permanent grass land kept for hay, which in a great measure accounts for the increase of pasture land. The increase in permanent pasture, however, is partly due to the extension of pastures on the hill sides, &c.

Statement of the Increase (+) or Decrease (—) in the Acreage of Crops in 1874 over 1873, in England, Wales, and Scotland.

Crops.	England.	Wales.	Scotland.
	Acres.	Acres.	Acres.
Wheat	+ 138,638	+ 1,017	+ 265
Barley or bere	— 36,461	— 11,188	— 277
Oats	— 62,389	— 9,272	— 8,182
Rye	— 2,975	— 332	— 1,099
Beans	— 26,612	— 319	— 586
Peas	— 6,838	— 691	— 137
Total under corn crops	+ 3,363	— 20,785	— 10,016
Potatoes	+ 5,152	+ 443	+ 153
Turnips and swedes	+ 20,550	— 22	— 9,144
Mangold	— 2,126	— 740	— 222
Carrots	— 1,239	— 107	— 230
Cabbage, kohl, rabi, and rape	— 5,540	— 282	+ 345
Vetches, lucerne, &c.	— 1,933	— 612	+ 294
Total under green crops	+ 14,864	— 1,276	— 8,804
Flax	— 4,734	— 73	— 482
Hops	+ 2,523	+ 4	...
Bare fallow, or uncropped arable land	— 41,885	— 2,700	— 1,707
Clover, sanfoin, and grasses under rotation:—For hay	— 97,855	— 1,824	+ 6,834
" Not for hay	+ 38,199	+ 6,347	+ 22,223
Total	— 59,656	+ 4,523	+ 29,057
Permanent pasture, meadow, or grass, not broken up in rotation:—For hay	— 135,785	+ 183	— 122
" Not for hay	+ 336,120	+ 51,774	+ 9,913
Total	+ 200,335	+ 51,957	+ 9,791
Total acreage under all kinds of crops, &c.	+ 114,810	+ 31,650	+ 17,839

The following table is a corresponding return for each division of the country, showing the amount of live stock in 1874 as compared with that kept in the previous year.

It will be observed that there was a general increase in both cattle and sheep. This was doubtless owing to the high price of meat. The large increase in the number of unbroken horses and of mares used for breeding was caused by the scarcity of horses in the previous year. It must be borne in mind that the number of pigs given in the agricultural returns is exclusive of pigs kept by cottagers, and that it does not therefore represent the total of this class of live stock reared in the country.

Statement of the Increase (+) *or Decrease* (—) *of Live Stock in* 1874 *over* 1873, *in England, Wales, and Scotland.*

Live Stock.	England.	Wales.	Scotland.
Horses.	No.	No.	No.
Used solely for agricultural purposes, &c.	+ 2,691	— 554	+ 743
Unbroken horses, of any age, &c.	+ 25,695	+ 3,804	+ 2,916
Total	+ 28,386	+ 3,250	+ 3,659
Cattle.			
Cows and heifers in milk or in calf	+ 33,565	+ 4,004	— 1,286
Two years of age and above	+ 54,092	+ 18,195	+ 17,548
Under two years of age	+ 44,248	+ 49	— 9,473
Total	+ 131,905	+ 22,248	+ 6,789
Sheep.			
One year old and above	+ 533,403	+ 60,772	+ 76,799
Under one year old	+ 156,504	+ 37,062	+ 21,766
Total	+ 689,907	+ 97,834	+ 98,565
Pigs	— 82,636	+ 2,580	+ 2,629

The early publication of the abstract of the returns this year will, it is hoped, be appreciated by all interested in knowing the agricultural condition of the country.

JAPANESE VEGETABLE WAX.

The *Japan Mail* contains some further particulars respecting the preparation of the vegetable wax produced in Japan, and chiefly exported to England. This wax is obtained from the fruit, or, more correctly, berry of the wax tree. The tree, which is by no means unlike the juniper tree, flourishes more especially in the southern provinces of the empire. The fruit, which usually ripens about the month of October, is gathered when ready, and cleansed from its loose, outer husk, a process which is accomplished in large wooden vessels, with wooden malls, similar to those in use for cleaning rice. The residue product, available for the manufacture of wax, is a bean-shaped kernel of the size of a lentil, possessing an unusual degree of hardness, of a dark yellow wax colour, and offering a saponaceous exterior to the touch. The kernel is subsequently exposed in a sufficient degree to a steaming process, which deprives it of its extreme hardness, and allows of its oily properties being more easily extracted in the pressing stage. In this process, the oil is received into small earthen vessels, in which it subsequently hardens to a blueish-green mass, in the shape which it is commonly met with in home consumption.

Wax so produced is impure, and is only suitable for certain descriptions of candles and for wax-thread manufacture for home use. In order to render it merchantable for the exporter, the following refining process is resorted to:—The wax is boiled with a lye until it is brought to a perfectly fluid state, and is then drawn off into a reservoir filled with clear water, the pure wax, which floats upon the surface, being removed. The mass is then exposed to the sun's rays for a period of fifteen or sixteen days, during fine weather, for the purpose of bleaching it, at the expiration of which time the wax presents a dirty white crumbling appearance and a strong tallowy smell. The boiling and bleaching are repeated with the view of rendering the refining process still more complete, the only difference being that, instead of lye, pure water alone is employed in boiling it. The product is a clear, white powder, which, in place of its former crumbling appearance, has assumed an almost crystalline formation. The last stage of the preparation for export consists in rendering the powder a compact mass, which is effected by melting it over a fire with a little water (in order to avoid burning), and running it off into flat vessels. The product thus obtained, and known to commerce as vegetable wax, differs exceedingly little from white bees'-wax, with which it possesses the properties of colour, brittleness, and similarity in its fan-shaped fracture in common. The only characteristic difference may be said to be in the odour, the bees'-wax giving off a refreshing aromatic scent in burning, while the tallowy smell of the Japanese wax is far from being agreeable. Vegetable wax is chiefly used in England in the manufacture of wax candles.

PUBLIC MUSEUMS AND LIBRARIES AIDED BY PARLIAMENTARY VOTES.

Number of visitors for the month of September. When they are counted by sight the words "by sight" are used, when by turnstile the word "machine:"—

	Voted in 1874.	Number of Visitors.
1. British Museum	£102,442	return refused.
2. National Gallery	6,346*	65,184 (by sight).
3. Kew Gardens and Museum	17,862	50,092 (by sight).
4. South Kensington Museum	38,024†	80,917 (by machine).
5. Bethnal-green	5,810	50,092 (by machine).
6. National Portrait Gallery	1,748	.. (by machine).
7. Geological Museum, Jermyn-street	8,998	2,200 (by machine).
8. Patent Office Museum	1,490	25,808 (by machine).
9. Edinburgh National Gallery	2,100	12,074 (by machine).
10. Edinburgh Museum of Antiquities	..	12,079 (by machine).
11. Edinburgh Museum of Science and Art	9,824	30,932 (by machine).
12. Edinburgh Botanic Gardens	1,750	
13. Royal Dublin Society	1,823	
14. Dublin Museum of Natural History	1,672	5,390 (by machine).
15. Glasneven Botanic Gardens and Museum	2,148	18,813 (by machine).
16. Dublin National Gallery	2,380	No return.
17. Geological Society, Dublin	500	,,
18. Museum of Royal Irish Academy, Dublin	2,084	,,
19. Tower of London	2,236	18,287 (by sight).
20. Royal Naval College, including Greenwich Painted Hall	1,416	No return.

* Exclusive of special purchases.

† These expenses may be treated as local to the Museum; others for purchases, circulation, travelling, carriage, &c., for 120 Schools of Art, amount to £51,859, and a portion, say £15,000, should be added to the above.

THE INDUSTRIES OF ANGORA.

The town of Angora, the capital of the Turkish vilayet, or province of the same name, is situated about 250 miles inland from the nearest ports on the Black Sea and Gulf of Ismid: its latitude 40° north, 33° east of Greenwich. It is the market for the disposal of the special products of a large district, and where the proceeds of such merchandise are exchanged for the necessaries or luxuries of life. The town is built on the slopes of a precipitous rocky hill, in the middle of a wido, flat plateau, and is thus visible from a long distance. This position made it formerly a place of great military strength, as its half-ruinous citadel and fortifications still remain to prove. Exact returns of the number of inhabitants, public revenue, &c., are extremely difficult to procure, but Consul Gatherall has obtained certain facts which may be relied upon. The number of the Moslem and Christian population amounts, the former to 849,432 persons, and the latter to 155,046. The population of the town of Angora has been much disputed by travellers and even by residents, but a careful enumeration of the houses, and the average number of inhabitants to each, indicate somewhat less than 38,000 as the total. Of that number, less than half, or 18,000, are Moslems; a fourth is composed of Armenian Christians, and the remainder is made up of Greeks, Syrians, and a very few Italian, French, and English residents. The bazaars, or market-places, occupy considerable space, and in these are sold the exports of the district, which are—Mohair, or goat's hair; sheep's wool; yellow or Persian berries, the fruit of the *Rhamnus infectorius*, a species of buckthorn; gum tragacanth, the produce of the *Astragalus verus*, and *Astragalus gommifer;* and opium.

The import trade is also very considerable, and consists of grey cottons, prints, madapollams, coffee, sugar, grain, flour, and metals. There is also a smaller, but exclusively local, trade in goat skins, carpets, salt, honey, rice, cheese, and copper from the extensive Kurie mines, near Kastambol. In these various industries the inhabitants are engaged. There are no public works or factories of any kind. Formerly, yarn-spinning, cloth-weaving, and shawl-making flourished, but these have been entirely ruined by European competition or change of fashion. The purchases in the various articles are made principally by representatives of merchants established in Constantinople, or by agents of English spinners and consumers, and it is their operations that have made the Angora market second only in importance to that of the capital itself. The trade in all products was seriously affected by a severe drought during spring and summer. The rainfall was so deficient that the harvest was almost a total failure, and much misery and destitution prevailed in consequence. The cereals of the district are usually sufficient for its wants, sometimes even taking place amongst its exports, but last year grain and flour had to be brought from the capital and from the outlying districts at great expense. The clip of goats' hair and wool was quite up to, if not over, the average, but the European demand was sluggish, and goods changed hands very slowly. The yield of yellow berries and gum tragacanth from the same cause was very much reduced, whilst opium was almost *nil.*

We are given to understand by Consul Gatherall's statements, that the British commercial interests involved are in this district of considerable importance. English spinners and manufacturers are the principal customers for the native products, and British manufactures meet with a steady and increasing demand. The difficulties and drawbacks business labours under are as follows—the want of easy and rapid communication with the sea coast. The post-road to Ismid has been carefully made, but it is kept in such wretched repair as to be almost impassable with mud in winter, and dust during the heats of summer; the accommodation by the way is also of the most miserable description. The only means at present of forwarding produce is on mule or camel-back, taking twelve to twenty days, much time being thus occupied, and the goods often deteriorating on the way. A single line of rail from Ismid to Angora has been projected, and the embankments had made considerable progress, having been carried forty miles from Ismid, and twelve from Angora. This railway was a Government project, and for some time was pushed on with great spirit, but recent financial difficulties have caused it to be almost entirely abandoned. Should it be resumed and completed within a reasonable time, there can be no doubt that it would cause a large increase in the export as well as the import trade of the province, as it would not only facilitate communication with Europe, but lead to the establishment of branch banks and other indispensable requisites of modern business. Another very serious drawback to the development of the trade in goats' hair is the determined dishonesty of the native graziers and dealers, who persist in drenching the fleeces with water, and mixing in all sorts of rubbish in order to increase the weight, and so realise an extra profit, although by so doing they destroy the lustre of the hair, which is its principal recommendation to spinners, as it enables them to use it as a substitute for silk. The English agents in Angora have made repeated efforts to have the practice forbidden, and have even induced the Central Government to interfere to prohibit it, but the active opposition or passive resistance of the local authorities have hitherto prostrated their wishes.

Until the evils thus indicated are removed, this part of Turkey in Asia offers no inducement to British emigration, or even to the investment of British capital. Were it once connected by rail to Europe, as it is already by telegraph, with a wise and enlightened Government there is nothing to prevent this province becoming as rich, as populous, and as prosperous as it was in ancient times.

COAL MINING IN ITALY.—THE MINES OF MONTE RUFOLI.

The coal basin of Monte Rufoli, or rather Podernuovo, as that part of the estate is called, is situated in the valley of one of the numerous tributaries of the River Cecina, about five miles from the village of Serrazzano; there one of the establishments belonging to Count Lardarch, for the extraction of boracic acid, is in operation. The coal, which is formed in two seams in the clay, belonging to the lower miocene period, and locally termed "maltajone," which lies immediately above the *albaresc* limestone and schists of the Eocene formation, and which in many places have undergone a complete change, from the intrusion of the serpentine rocks, which evidently have been the disturbing elements in this district, and form the nucleus of the whole range of hills bordering upon these valleys. The section of the strata is as follows:—

Clay (locally termed "maltajone")	Variable.	
Limestone breccia......................	0·50	metres.
Sandstone (grès)	0·30	,,
Coal...................................	1·00	,,
Band, or parting of "grès,".. from 0·30 to	0·50	,,
Coal of slightly inferior quality..........	1·00	,,
Clay ("maltajone") forming the bed.		

The clay appears to be of marine origin, and contains a great quantity of shells, the principal varieties belonging to the genus *conus* and *area.* The grès, or sandstone, of the roof and parting between the two seams of coal, is evidently a fresh-water deposit. The upper seam, which is the best in quality, appears to extend very regularly over the entire basin, whilst the lower one only is found towards the centre. The upper workings are reached by

a day level, 380 metres in length, driven in the hill-side, and substantially walled for its entire length.

The engine-pit is sunk to the fifth level, at a depth of 50 metres below the surface; and to meet the seam at this point it is estimated that it would have to be sunk 100 metres more. A horizontal engine of about 20-horse power, and winding gear complete, are now being fixed, and everything being prepared in readiness for working these mines, which it is estimated will yield 100 tons daily; there are two other shafts for the upcast.

As this coal is subject to spontaneous combustion from the oxidation of pyritous matter that it contains, it is found advisable to drive all the levels in the clay about 6 inches above the coal, and then by means of horizontal cross-cuts, driven at intervals to intersect the seam, the coal is wrought on the long-wall system. An inclined plane is being driven from No. 3 to No. 5 level, for the purpose of lowering the coal and conveying it to the bottom of the engine-pit.

A railroad has been made from these mines following the course of the torrent Sterza to the valley of the Cecina, where it joins the Roman railway at the station of Casino di Terra, a distance of 16 kils. (about 10 English miles). Besides the carriage of coal, there is also a considerable traffic on this line of charcoal.

PRODUCTION OF SILKWORM GRAIN IN JAPAN.

The Minister of Agriculture and Commerce has communicated to the Chamber of Commerce cf the principal towns in Italy a report by Signor Bruni, the Italian Consul at Yokohama, on the sale of silkworm grain during the last season (1873-4). From this it appears that the total number of cards of grain introduced into the concession or territory of Yokohama, as results from the registers of the various government offices, amounts to 1,288,063, whilst the number exported from this province was 1,418,900, the difference, 130,837, representing no doubt the number of cards with the grey stamp, the exportation of which is prohibited by the Government, and which were introduced and sold clandestinely within the territory.

The above figures show an increase of 189,327 cards in the exports of grain during last season as compared with those of the previous year. when the total number amounted to 1,229,573 cards. The report gives a table showing in a detailed manner the quantity of grain produced in the different provinces during the last two seasons. From this it appears that 10 provinces which previously took no part in the production of grain have been added to the list during the past seasons. The price of cards has varied considerably, depending not only on the quality, but also on the province in which they have been sold, as will be seen as follows :—

Name of Province.	Yens.
Oscius	4
Yanagrua (best)	3.70
,, (choice qualities)	3·00 to 3·60
Siniscin	1·90 ,, 3·25
Gioscin and Buscin	1·80 ,, 3
Goscin	1·60 ,, 3·25
Coscin	0·75 ,, 1·50
Name of Locality.	
Yonesana	2·25 ,, 3·80
Scimannira	3·40 ,, 4·25
Wedawa	2·80 ,, 3·70

The total value of the exports is estimated by the returns of the Custom-house of Yokohama at 3,069,035 yens, which would give the average value of each card to be 2·16 yens.

As regards transport to Europe, it appears that 4,667 cases of grain, of which 2,662 for Italy, and 2,005 for France, were brought by the steamers of the Messageries Maritimes. The Peninsular and Oriental line carried 1,497 cases, of which 1,328 were for Italy and 169 for France. And lastly, the Pacific Mail and China Trans-Pacific Mail, whose steamers brought 527 cases, which were forwarded to Europe *viâ* America, making a total of 6,691 cases, containing each, on the average, 212 cards. Of these 6,691 cases, 3,522, or more than half, were exported by Italian firms.

With regard to the coming season, upwards of three millions of empty cards have been distributed by the Japanese Government. The home consumption is estimated from 800,000 to 1,000,000 of cards, so that there will probably remain about two millions for exportation. It is anticipated that with the prospect of such a quantity of grain being brought into the market, that the prices for the ensuing season will not exceed from a dollar to a dollar and a-half per card for the best qualities.

CALCUTTA BOTANIC GARDENS.

A great deal of interest is attached to the last report of Dr. King, the superintendent of the Calcutta Botanic Gardens, for, besides the usual details as to the exchange of plants and seeds with the Royal Gardens at Kew, and other similar colonial and foreign establishments—which exchange, by the way, has not been a light affair, inasmuch as from April 1873 to March 1874, 12,812 plants and 2,532 parcels of seed were sent to various parts of the world—we have satisfactory accounts of the cultivation of the mahogany tree, the ipecacuanha, and the Para rubber tree. The former, as is well known, is a native of Central America and the West Indies; but there are, as Dr. King tells us, a good many old mahogany trees about Calcutta, which, however, rarely if ever yield perfect seed, so that fresh plants have been obtained direct from their native country. He says, further, that "it has been abundantly proved that the tree will thrive in most part of Bengal, and that the Indian grown timber is valuable." There are fine mahogany trees in the garden at Saharunpore and Madras, and Dr. King doubts not that it will grow admirably in almost any part of India in situations free from frost, and where a little moisture can be secured in very dry weather. O the few trees that were left in the Calcutta Botanic Gardens after the last cyclone in 1867, the mahoganies are by far the finest; they were planted about eight years since, and are now from 8 to 11½ feet in circumference, 6 feet from the ground. The quality of the wood of some of the trees blown down in the cyclones of 1864 and 1867 was found to be excellent. Such, then, are the prospects of the successful acclimatisation of one of the most valuable furniture woods known; so valuable indeed is it in European commerce, that about 40,000 tons are annually imported into Great Britain from Honduras, Jamaica, and San Domingo. So far as the increase of the ipecacuanha plant is concerned, the propagation by root and leaf-cuttings has been so successful that there is at present a stock of 63,000 living plants; whereas only four years since there were but twelve cuttings at the Cinchona Gardens, and seven out of these twelve were afterwards accidentally destroyed. Then again, with regard to the most valuable of all the india-rubber producing plants, namely, that of Para—the *Hevea brasiliensis*—six plants of which Dr. King took with him from Kew on his return to India in November last, we are told that already a few plants have been raised from cuttings taken from these six plants, and before the lapse of another year Dr. King hopes "to be able to report a considerable increase." The advantages to be obtained by the successful introduction of these trees into India are many, for besides the great superiority of the rubber over that obtained from the East Indian figs, the principal of which is *Ficus elastica*, and consequently a higher market value, it will add to the Indian revenue by establishing a course of

regular industry by a systematic tapping of the trees, and it will perhaps, to some extent relieve the figs from a continued strain upon them, and probable future exhaustion.—*Nature.*

THE COAL MINES OF DRANISTA.

A party of English engineers having recently surveyed, on behalf of the Viceroy of Egypt, the coal-field of Dranista, and excavated from it some 350 tons of coal, which they have sent to Wales for the purpose of satisfactorily testing its steam generating or other properties, Consul Blunt has obtained from them the following account of their survey:—

The coal-field of Dranista is situated about 50 miles to the south-west of the town of Salonica, and is enclosed by a range of mountains, of crescent shape, commencing in the south at Mount Olympus, and termnating at the north at the Bay of Kitros, in the Gulf of Salonica. There is an aggregate thickness of about eight feet of coal, extending over a known area of about 2,000 acres; but it is highly probable that the coal-field is of much greater extent, and although not actually proved, the engineers are of opinion, judging from the surface formation, that there is a total area of 30 square miles in which the above thickness of coal would be found, and which, in round numbers, would contain 255,000,000 tons of coal.

The coal, which is of the tertiary formation, appears to be of good quality, and would be useful for steam purposes. It burns very well in the open air, giving good heat, with very little smoke; but the engineers were not prepared to give a definite opinion as to the chemical properties and fitness of the coal for generating steam, they not having been provided with means of making proper experiments with it on the spot.

They say that in outward appearance it most resembles Scotch coal, but differs from all English coal in its rapid deterioration upon exposure to the atmosphere. When so exposed it breaks up and crumbles into dust in a very short time, but when stored under cover it preserves its quality very well. Should the experiments with the coal prove satisfactory as regards its quality and marketable value, active operations on an extensive scale will probably be commenced early this year. The engineers propose sinking two pits, each of 300 yards depth, and to construct a rail or tram-road of about twenty miles in length from the mines to Kitros, the nearest and most eligible place for shipping on the coast. The sinking of the pits would not entail great expense as the ground to be sunk through consist principally of alluvial and tertiary deposits. And the railway also could be cheaply constructed, the country through which the line would traverse being very level. A jetty would have to be erected at Kitros, the harbour of Salonica being very shallow, and exposed to northerly winds.

Dranista, the chief village in the vicinity of this coal-field, is prettily situated at the foot of Mount Olympus, in the centre of a well-wooded and picturesque country; its climate is salubrious, and the peasantry of this and surrounding villages, principally Greeks, are industrious and quietly disposed. Catterina, the nerrest town of Dranista, is the centre of a very active and extensive trade in timber, which gives profitable employment to the population of the district. It is governed by a sub-governor under the Pasha of Salonica, with which, and with the chief towns in Thessaly and Macedonia, it is in telegraphic communication. In a country like Turkey, where the consumption of coal goes on continually increasing, owing to the advance it is making in agriculture, industry, and population, and to the success of railway extensions and other undertakings, the coal mines of Dranista, if they are found sufficiently fertile and worth making, will be of very great consequence.

ARTIFICIAL BUTTER.

According to reports from Paris, the question of producing cheap artificial butter has been practically solved, for the sale of a substitute for butter has been authorised by the authorities.

The new butter is called by the name of Margarine Mouriès, after the inventor, M. Mège Mouriès. The process by which it is produced is not published, but it is stated in a report of M. Boudet to the Conseil d'Hygiène that no difference can be discovered by analysis between this and ordinary butter.

M. Mège first made a careful study of ordinary butter, and, it is said, found the means of copying nature with the same elements that compose ordinary butter, but at the same time eliminating the germs of of corruption which chemistry has pointed out. The new butter is declared to be incorruptible, and going twice as far as ordinary butter. It has been adopted by the Council of Health, the sale of it authorised, the Minister of the Interior has ordered it to be used in the public institutions, and, by way of anti-climax, the Octroi officers charge the same tax on its coming into Paris as on ordinary butter.

This invention is put forward as a boon to the people of Paris, who are extremely fond of butter, and whose delicate cookery depends in a great degree upon it; but the price had become so high as to be prohibitory for poor people. The new preparation is of course much cheaper than real butter. Within a few years the price of butter has ranged from about three to eight shillings per kilogramme; the present average price is about four shillings; the price of the artificial butter is 1s. 10d. to 2s.

The butter is manufactured by a company, which has seven establishments, employing four hundred workmen. A warehouse has been opened in the Rue du Pont Neuf, near the great central market of Paris, and the sale of the new article is said to be already very large. It is of course to be understood that the above account is merely the announcement of the inventor, and that no opinion as to the merits of the preparation can be expressed here.

USE OF SEWAGE.

An important decision has just been arrived at by the authorities of Paris, namely, to expend the sum of £30,000 in the necessary canalisation, reservoirs, and lifting machines, for distributing the sewage water over the plains of Gennevilliers. The experiments made at Clichy and on the plain of Gennevilliers have been noticed at various times in the *Journal*, and the value of the sewage water has now been so clearly established, that the market gardeners of that great sandy plain are clamorous for a full supply. As to the excellence of the vegetables produced with the aid of the sewage, that requires no demonstration. At the last exhibition of the Agricultural Society of France, the vegetables from Gennevilliers called forth constant exclamations of surprise, especially the cauliflowers.

This vote is important also, from the fact that it announces the total failure, in the opinion of the authorities of Paris, of all attempts at purification of the waters, or of precipitating the substances in suspension economically. Opinion was not unanimous in the Municipal Council, but the opposition was very feeble. It was argued on one side that possible means of purification had not been tried; and on the other that analysis had superabundantly proved that the waters of the Seine were absolutely unfit for drinking and culinary purposes; that purification of sewage, by means of sulphate of alumina was impracticable; and that the only possible way to avoid turning it into the Seine was to use it to irrigate the plain of Gennevilliers, where it was

most valuable, and quite inoffensive as had been clearly proved.

This question, which has been before the authorities, in one form or other, for six or seven years, may now be considered settled. The whole of the sewage of Paris will, before long, be distributed over the plains of Gennevilliers, as a portion is already; and when the great reservoir at Montsouris is finished, which will be almost immediately, the water of the Seine will cease to be used for domestic purposes.

THE TRADE OF MOROCCO.

Morocco is a country which may be said to be comparatively little known, although under the government of the present Sultan its trade is becoming gradually developed. From its position at the entrance of the Mediterranean, and proximity to the Atlantic Ocean, Morocco is most favourably situated for commerce. The coasting trade with Barbary, which is carried on by feluccas, and its commerce with the interior of Africa by caravans, is of considerable importance, though, on the other hand, its intercourse with other nations is insignificant. The soil of Morocco is extremely fertile, and produces wheat, barley, maize, millet, almonds, dates, grapes, olives, sugar-cane, tobacco, and cotton. The quantity of grain produced is more than sufficient for the requirements of its population. Morocco leather also forms an important article of export.

There are several important branches of industry in this country, the principal manufactures being woollen, cotton, and silk stuffs, carpets, articles of leather, and earthenware. The mineral products are chiefly iron, copper, and tin. Antimony is found in the Atlas mountains, and rock salt is met with in abundance in many places.

The principal ports of Morocco are—Tangiers, Mazagan, Dar-el-Baida, Laroche, Rabat, and Saffi. The movement of shipping in these ports during 1873 will give some idea of the commerce of Morocco with other nations. The total number of arrivals of shipping at Tangiers was 525, amounting to 48,956 tons, in 1873, as compared with 498, of 52,215 tons, during the previous year. Of the former 273 ships were English, 174 Spanish, 44 French, and 34 Portuguese. The Spanish and Portuguese vessels are very small, and amounted to only 4,589 tons, whilst the tonnage of the English was 26,964, and of the French 17,403. The English shipping was composed of 247 steam and 26 sailing vessels, whilst all the French were steamers. The total value of the imports to Tangiers in 1873 was £231,625, or about £150 less than that of the previous year.

About two-thirds of the imports, viz., to the value of £152,750, come from England or Gibraltar. The imports from France amounted to £77,891, whilst Spain figures only for a value of £470, and Portugal for £314. The principal articles of import are cotton, silk, and linen stuffs, cloths, loaf-sugar, coffee, and tea.

The total value of the exports in 1873 was £195,786, or about £34,000 less than that of the previous year. The goods exported to England and Gibraltar were valued at £114,427, those for France and Algeria £64,301, to Spain £11,200, to Portugal £5,616, and to Tunis £242. Dressed skins occupy the first place amongst the exports, and were valued at £56,222; next come cattle, goat skins, eggs, meal, and carpets. No wheat or barley was exported last year from Tangiers on account of the bad harvest in that district. The harvest however was, generally speaking, abundant in the other provinces, and the deficiency was made up for by the increased exports of corn from the other ports.

A notable increase has been observed in the trade of Mazagan, the total value of the imports last year amounting to £196,901, divided as follows:—England for £100,445, France £66,456, and Spain £36,000. The exports amounted in value to £530,170, in which England figures for £196,854, France £65,069, Spain £53,237, Portugal £12,168, and Italy for £2,842. The total number of arrivals of shipping at this port was 280, amounting to 59,665 tons. The nations to which these vessels belonged were as follows:—

	No. of ships.	Tonnage.
England	145	32,316
France	42	17,630
Spain	61	4,925
Portugal	11	1,367
Italy	8	1,530
Germany	4	525
Norway	3	485
Denmark	4	623
Sweden	1	178
Holland	1	86
	280	59,665

This shows a considerable increase in the trade of this port as compared with that of previous years.

A great increase has been made also in her exports of grain from the port of Dar-el Baida in 1873, being 136,201 quarters, as compared with 77,397 quarters exported during the previous year, the great part of which was exported to England. The imports also show a considerable increase, and amounted in value in 1873 to £267,429, against £212,979 in 1872; this increase is mainly due to trade with England. The total number of ships of all nations that arrived at this port during last year was 176, of a tonnage of 47,030, against 153 ships with 39,891 tons during 1872, showing an increase in favour of last year of 23 ships with 7,139 tons; of this number 11 ships with 2,259 tons were English.

At Laroche the value of the imports last year was £41,400 against £15,030 in 1872. The exports amounted to £196,020 against £107,643 of the previous year. The principal articles of import at Laroche are Manchester goods, sugar, tea, coffee, composite candles, and iron, whilst the exports are chiefly leather, wool, beans, and peas. The number of English ships that arrived at this port during 1873 was 65, of an aggregate tonnage of 5,931, showing an increase of 30 ships, and 2,672 tons on the previous year. The number of ships of other nations (principally French) was 74, measuring 7,714 tons.

The trade by English ships at Rabat in 1873 may be said to be *nil*, one vessel only having arrived in ballast, and left with a cargo of 378 tons, of the value of £8,424.

The commerce of the port of Saffi was very prosperous during 1873, the principal trade being with England. The imports and exports from this port show a considerable increase last year, as compared with those of previous years. The imports amounted in value to £113,718, and the growth is chiefly due to an increase in cotton and other goods brought from England. The total value of the exports amounted to £277,628, showing an increase of £156,748 on that of the previous year, the principal articles of export being olive oil, wool, and grain. Olive oil is chiefly exported to England, as also is wool, with the exception of about 1,800 cwt., which was sent to France. The total quantity of grain exported was 182,500 quarters, of which 157,000 quarters was shipped for England, 9,500 quarters to Spain, 7,000 to Portugal, and 9,000 quarters to France. The shipments were made principally by English vessels, which have increased 68 in number and 10,892 tons last year. The total number of ships that arrived at this port during 1873 was 140, measuring 28,638 tons, and the value of the cargoes taken away amounted to £226,948.

No returns have yet been published respecting the commerce of the ports of Mogador and Casabianca, where the French trade is in the ascendancy, and is superior to that with England.

CORRESPONDENCE.

TECHNICAL EDUCATION IN FRANCE.

SIR,—Thinking some notice of an important technical institution in France, the Ecole Supérieure de Commerce et d'Industrie at Rouen, may prove interesting to your readers, I beg to give the following account of a recent visit. It is situate 20, Place St. Godard, with a neat exterior and a large outer gate, on entering which there was a small court surrounded by buildings. M. Bernardini, the principal, had started that morning for the seaside, the school being then *en vacance*. M. Cauvin, the surveillant-general, received me, and willingly undertook to show me the buildings, class-rooms, and appliances for the special instruction. M. Bernardini had been principal of a similar school at Mulhouse, on the German frontier, but since its cession to Germany he had removed to Rouen.

The school of "commerce" is placed in the old building, and is furnished with several class-rooms of medium size. One is arranged as an office, with office-desks for about eight pupils. It has a series of books of account, such as are usual in the offices of French merchants; these are kept by the pupils in a very neat and systematic mnner, and relate to imaginary purchases and sales of produce, such as cotton, coffee, sugar, flax, silk, tar, tallow, iron, &c., all the entries being duly kept, showing the duty, freight, and various expenses connected with each transaction, the mode of settlement, and full completion of payment. When somewhat advanced, the pupils carry on a correspondence as if they represented mercantile firms in various parts of the world; in these cases the knowledge of foreign languages is brought prominently into use.

In another class-room was a large collection of specimens of the various products bought and sold by merchants. These specimens varied in quality, and the various good and bad qualities are explained to the pupils, as also the means of detecting adulteration, &c. In a third room was a large collection of diagrams relating to natural history, showing the structure of animals, plants, &c.

The school of "industry" is in a new building, in the rear of the school of "commerce," and has been provided at the cost of the city of Rouen. It contains class-rooms, various laboratories for the teaching of chemistry, one so arranged that injurious gases are carried off at once; rooms for experiments in dyeing, another for those requiring great heat, and another with a very large and well-arranged collection of chemicals necessary for the work of the schools. There are at present between 40 and 50 pupils, only eight or nine being residents of Rouen—one is from America, and the others from various parts of France. The director, M. Bernardini, lives at the schools, and all the pupils are day pupils. The principal and the pupils being all absent, there was no opportunity of seeing the school at work.

The schools have been founded by the Société Civile pour le Développment en Normandie de l'Enseignement Commercial et Industrie. I cannot do better than extract the concluding paragraph from the printed "Programme des Cours":—

"Tel est le programme de l'enseignement de l'Ecole; à la fois élevé et pratique, il a été constitué en vue de préparer les jeunes gens à devenir des négociants capables, et à donner à notre commerce national une expansion d'autant plus désirable qu'elle doit aider la France à le relever de ses désastres."

As regards the care of English boys, the arrangements seem at present immature. In addition to board and lodging, most English parents would require some guarantees for the moral and religious training of their sons far away from home, and with all the temptations of a great city, and especially on the Sundays, when not employed at the school.

It is in this point that England possesses precious advantages for the care of her sons. By means of the boarding-houses maintained by the masters in connection with her great schools, a home is provided, where moral and religious training is part of the work of the master. And although it is sometimes said that English masters are hotel-keepers, as well as professors, these gentlemen perform a service of immense advantage to their country, which is comparatively unappreciated by those who have not had opportunities of seeing the foreign systems, supplemented by reading what others have seen, and hearing what the French have to say on the subject.—I am, &c., G. N. H.

GENERAL NOTES.

Channel Passage.—The trial of Captain Dicey's twin-ship *Castalia*, which was expected to have been made during the present autumn, to test her capabilities for preventing or diminishing sea sickness, has been indefinitely postponed. This is stated to have arisen solely from the priming of her present boilers, which fault has already delayed and proved a great expense to the company owning her. During a recent trial of the engines of the *Castalia*, the opinion of Messrs. Penn's firm was consulted, and in consequence of the discoveries then made it was finally determined to remove the vessel from Dover to London. She will be placed in the Victoria Docks, Blackwall, to undergo the necessary alterations, but as their exact extent and nature have not yet been determined, no idea can be arrived at as to when she will be again submitted for the final trial.

NOTICES.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque, Post-office order, or Cheque Bank cheque, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial officer.

THE LIBRARY.

The following works have been presented to the Library:—

Practical Instructions in Enamel Painting on Glass, &c., by H. J. Snell. Presented by the Author.

A Practical Treatise on the Manufacture of Colours for Painting, by MM. Riffault, Vergnand, and Toussaint, translated from the French by A. A. Fesquet. Presented by the Publishers, Messrs. Sampson, Low, and Co.

Transactions of the Institution of Naval Architects, Vol. 15, 1874. Presented by the Institution.

Half-hour Lectures on the History and Practice of the Fine and Ornamental Arts, by W. B. Scott. Presented by the Publishers, Messrs. Longmans.

Sun and Earth as Great Forces in Chemistry, by Thomas W. Hall, M.D. Presented by the Publishers, Messrs. Trübner and Co.

The Safe Use of Steam, containing Rules for the Guidance of Unprofessional Steam Users, by an Engineer.

Plants, their Natural Growth and Ornamental Treatment, by F. Edward Hunt. F.L.S. Presented by the Publishers, Messrs. Marcus Ward and Co.

INDEX TO VOL. XXII.

The Index and Title-page for the 22nd volume of the *Journal*, which concludes with the present issue, will be published shortly, and will be sent out with an early number of the *Journal*.

SCIENTIFIC MEETINGS FOR THE ENSUING WEEK.

Mon. ...Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Address, by Mr. Thomas Huskinson.

British Architects, 9, Conduit-street, W., 8 p.m.

Asiatic, 22, Albemarle-street, W., 3 p.m.

Social Science Association, 1, Adam-street, Adelphi, W.C., 8 p.m. Mr. Thomas Hare, "On the Construction of a Municipality for the Metropolis."

Tues....Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion on "The Nagpur Waterworks and on Rainfall Flow from the Ground, and Evaporation."

Statistical, Somerset-house, W., 7¾ p.m. Opening Address by Dr. Guy.

Zoological, 11, Hanover-square, W., 8½ p.m.

Wed. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Opening Address by Major-General F. Eardley-Wilmot, Chairman of Council.

Geological, Burlington House, W., 8 p.m. 1. Prof. Richard Owen, "On fossil Evidences of a Sirenian Mammal (*Eotherium ægyptiacum*, Owen) from the Nummulitic Eocene of the Mokattam Cliffs, near Cairo." 2. Rev. J. E. Cross, "On the Geology of North-west Lincolnshire." 3. Mr. Harry G. Seeley, "On the Femur of *Cryptosaurus enumerus*, Seeley, a Dinosaur from the Oxford Clay of Great Gransden."

Thur....Linnean, Burlington House, W., 8 p.m. 1. Professor Allman, "On the structure of *Stephanocyathus mirabilis*; the type of a new Hydrozoal Order." 2. Dr. M. T. Masters, "Monograph of *Durioneæ*."

Chemical, Burlington House, W., 8 p.m. 1. Mr. G. H. Beckett and Dr. Wright, "On the Action of Organic Acids and their Anrydrides on the Natural Alkaloids" (Part II.). 2. Mr. W. K. Clifford, "On the general Equations of Chemical Inactions." 3. Mr. W. H. Perkin, "On Propionic Coumarin and some of its Derivations." 4. Dr. Stenhouse, "Action of Bromine on Protocatechuic Acid, Gallic Acid, and Tannin." 5. Mr. A. H. Church, "On the Composition of Autunite."

Fri.......Philological, University College, W.C., 8 p.m. Mr. C. B. Cayley, "Italian Diminutives."

CONTRIBUTIONS TO THE READING-ROOM.

The Council beg to acknowledge, with thanks to the Proprietors, the regular receipt of the following Transactions of Societies and Periodicals during the year:—

DAILY.

Hour.

WEEKLY.

Agricultural Gazette.
Architect.
Athenæum.
British Journal of Photography.
Builder.
Building News.
Builders' Weekly Reporter.
Capital and Labour.
Chamber of Agriculture Journal.
Chemical News.
Colliery Guardian.
Cosmopolitan.
Draper.
Engineer.
Engineering.
English Mechanic.
Farmer.
Gardeners' Chronicle.
Herapath's Railway Journal
Irish Builder.
Iron.
Journal of Gas Lighting.
Journal of the Photographic Society.
Land and Water.
Les Mondes.
Metropolitan.
Mining Journal.
Moniteur des Arts.
Musical Standard.
Nature.
North British Agriculturist.
Papermakers' Circular.
Photographic News.
Public Opinion.
Queen.
Railway Service Gazette.
Revue Scientifique.
School Board Chronicle.
Spectator.
Sessional Proceedings of the Social Science Association.
Warehousemen & Drapers' Journal.

FORTNIGHTLY.

Jeweller & Metal Worker.
Publishers' Circular.

MONTHLY.

American Artizan.
Annales du Génie Civil.
Art.
Atlantic Monthly.
Bookseller.
Brewers' Guardian.
Bulletin de la Société d'Encouragement pour l'Industrie Nationale.
Bulletin de la Sociéte Imperiale Zoologique d'Acclimatation.
Bulletin du Musée de l'Industrie.
Educational Times.
Fortnightly Review.
Hatter and Umbrella Trade Circular.
Horological Journal.
Indian Economist.
Journal of Applied Science.
Journal of the Chemical Society.
Journal of Education.
Journal of the Franklin Inst.
Journal of the Horticultural Society.
Journal of the National Life Boat Institution.
Journal of the Pharmaceutical Society.
Journal of the Quekett Microscopical Club.
Leather Trades' Circular.
Lithographer.
London, Edinburgh, and Dublin Philosophical Magazine.
Nautical Magazine.
Practical Magazine.
Ocean Highways.
Presse Scientifique des Deux Mondes
Revue Maritime et Coloniale.
Sugar Cane.
Symons' Meteorological Magazine.
Telegraphic Journal and Electrical Review.
Workman's Magazine.

QUARTERLY.

Journal of the Asiatic Society.
Canadian Naturalist and Journal of Science.
Journal of the Geological Society.
Proceedings of the Geologists' Association.
Journal of the Linnæan Society.
Journal of Mental Science.
Journal of Science.
Naval Science.
Journal of the Royal Geographical Society
Proceedings of the Royal Society.
Journal of the Royal United Service Institution.
Journal of the Statistical Society.
Journal of the Victoria Inst.
Transactions of the Zoological Society.

ANNUAL.

Philosophical Transactions.
Archæologia (Transactions of the Society of Antiquaries).

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* *disc.*, discussion at a meeting.

T.

U.